



The Logistics of Transporting Wind Turbines

Reducing Inefficiencies, Costs and Community Impact by Streamlining the Supply Chain



With the focus on renewable energy worldwide, the rising cost of traditional energy, increased concerns about global warming and government support of alternative energy sources; wind power is becoming more popular and growing as a viable sustainable energy business segment.

However, several challenges face this developing industry. Because of the unusual length, shape and weight of wind energy components, logistics and transportation are complex and extremely expensive.

This white paper will look at the logistical challenges facing wind energy components, and the advantage of using an experienced transportation provider to help reduce inefficiencies, costs and community impact by streamlining the supply chain.

THE WINDS OF CHANGE - DEMAND AND THE INDUSTRY

According to the Canadian Wind Energy Association (CanWEA), *“Wind power keeps improving in big and small ways. Advances in technology and soaring global energy costs are making wind power a clean and viable option for big and small energy producers everywhere.”*¹

*“From major power producers looking for cleaner ways to produce energy for the grid to inventive companies searching for alternative ways to power their plants – even down to the individual who wants to live off-grid – it’s the people who believe in wind who power it.”*²

In early 2008, world wind capacity reached 121,188 MW, that’s the equivalent of producing enough electricity to power 37 million households. According to the World Energy Council, if the current growth rate continues, global capacity will reach 190,000 MW by 2010.³

As the need for cleaner and cheaper energy grows, the industry continues to grow. Worldwide it was worth over 40 billion € in 2008. The true potential for growth really is astounding, with the industry now doubling in size every three years.⁴

¹ Canadian Wind Energy Association (CanWEA) – Wind Technology

² Canadian Wind Energy Association (CanWEA) – Wind Technology

³ World Wind Energy Association (WWEA) – World Wind Energy Report 2008



HOW BIG IS BIG?

To understand and appreciate the logistics of transporting such massive parts it helps to understand the makeup of a wind turbine. The specs for a 1.8 MW turbine provided by the Canadian Wind Energy Association (CanWEA):

- **The nacelle (generator components)** is the size of a small motor home and weighs 63,000 kg (138,891 lb).
- **Each blade** is 39 m (128 ') long – the same length as a Boeing 737, and the 3-blade rotor weighs 35,000 kg (77,162 lb).
- **The 65 m (213 ') tower** is made up of rolled steel and comes in three pieces. The entire tower weighs 132,000 kg and contains enough steel to manufacture 206 average cars.
- **The foundation concrete** is 9 – 10 m (33 ') deep and 4 m (13 ') across. 102 tension type bolts run the full depth of the foundation.
- **Swept area** of the blades is 5,024 sq. m, (16,483 ') the size of 3 NHL hockey rinks combined or about 1.25 acres.
- **Total weight** of the entire turbine is 230,000 kg (507,063 lb) – about the same as two fully fueled 3,200 HP diesel electric locomotives.

This is just one example, however even the wind turbine components above are often even bigger than this.

⁴ World Wind Energy Association (WWEA) – World Wind Energy Report



THE LOGISTICS, NOT EXACTLY A BREEZE

Understanding the size of wind turbines provides an appreciation for the complexity of their transportation. A single turbine can require up to 8 loads (one nacelle, one hub, three blades and three tower sections). For an entire project of 150 MW, transportation requirements have been as much as 689 truckloads, 140 railcars and 8 vessels to the United States. And, many projects today are much larger than 150 MW (the largest operating project in the US is currently 736 MW, and projects of more than 4,000 MWs are in the early stages of development).⁵

It is no wonder that one of the biggest challenges facing the industry are the logistics of transporting such oversized parts sometimes over extremely long distances. Among the issues; traffic backups, road damage, coordination and cost.

TRAFFIC CONGESTION

As suggested in a recent article in the New York Times, *“As demand for clean energy grows, towns around the country are finding their traffic patterns roiled as convoys carrying disassembled towers that will reach more than 250 feet (76.2 m) in height, as well as motors, blades and other parts roll through. Escorted by patrol cars and gawked at by pedestrians, the equipment must often travel hundreds of miles from ports or factories to the remote, windy destinations where the turbines are erected.”*⁶

ROAD DAMAGE

Normal wear and tear of any road is expected over time, but whenever there is extensive pressure and constant flow of traffic, road damage becomes inevitable. In Texas for example, the state with the most wind turbines, the constant truck traffic is tearing up small roads in the western part of the state, where the turbines are being rapidly erected.

⁵ AWEA – Wind Industry Transportation Opportunities and Challenges

⁶ NY Times (July 2009) Slow, Costly and Often Dangerous Road to Wind Power



COMPLEX COORDINATION

Moving wind turbine components to a project site is not easy. It involves handling sensitive and expensive components that are very heavy and very big. This requires extensive coordination, communication and scheduling between logistics providers, railroads, trucking companies, port operators, barge and ocean vessel owners, among others.

HIGH COST

On a per-turbine basis, the cost of transportation and logistics generally varies from around \$100,000 to \$150,000, said John Dunlop, an engineer with the American Wind Energy Association. And since recent wind farm projects are getting larger, costs will also grow.

TRANSBORDER COMPLICATIONS

When moving wind turbines from one continent to another and across state and provincial lines, you are bound to run into unpredictable situations. Most countries, states and provinces require shippers to have different permits in order to move over-sized cargo. This can be a difficult situation if the proper paper work is not obtained for each provincial or state regulations.



THE SOLUTION - AN EXPERIENCED, COST EFFECTIVE TRANSPORTATION PROVIDER

CN is playing a key role in the transportation of huge wind turbine components throughout North America.

REDUCING TRAFFIC AND ROAD DAMAGE IN YOUR COMMUNITY

Using rail to transport wind turbines relieves traffic congestion, improves mobility in urban areas, and can ease pressure to renew road infrastructure by taking these massive components off highways. Additionally, as road congestion continues to grow throughout North America, moving wind turbines by rail provides an alternative to spending countless hours sitting in traffic.

LOWER COSTS MEAN GREATER SAVINGS

The savings that are provided by using rail are two fold. For one, using rail can drive down costs through increased speed and reliability by getting your product to the destination faster and damage free. Two, because rail offers a higher payload than truck, it makes it a very economical choice; in fact, according to General Electric, a wind turbine supplier, rail transport can be significantly cheaper over long distances. In other words, rail is the most cost-efficient mode of transportation,

COORDINATED LOGISTICS – INCREASED EFFICIENCY

CN has extensive experience transporting a wide range of structures, heavy equipment and specialized materials and is one of the largest carriers of over-sized loads in North America, moving more than 2,100 carloads of wind turbine components since 2005.

To make it seamless, we have logistics specialists who handle your valuable wind turbine components from port facilities to rail and from rail to the wind farm. Through CN Specialized Services, we have access to logistics professionals with expertise in rail transportation, trucking, transloading, and warehousing. When necessary, we can also use third-party logistics companies.



A value-added logistics solution for your turbine components can include:

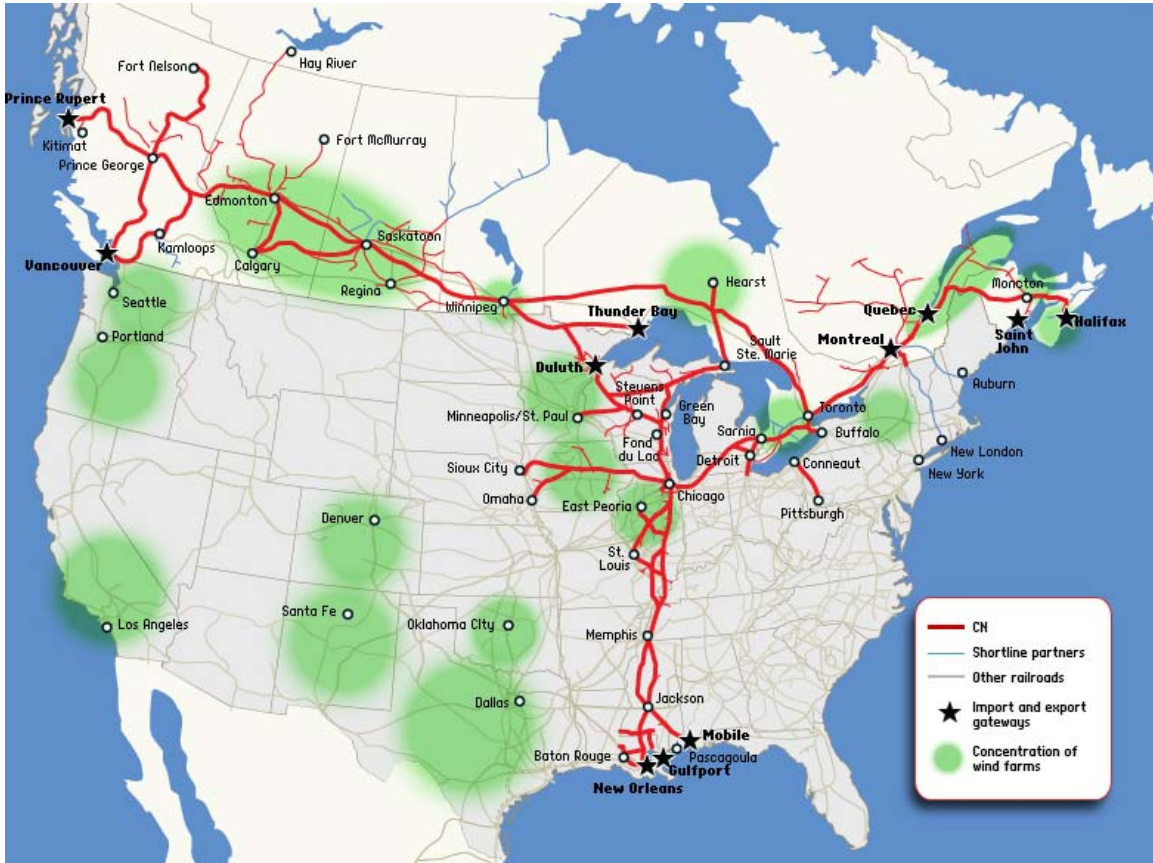
- Height and width clearance analysis
- Heavy duty railcars for your dimensional load and/or containers for smaller components
- Recommendations of special equipment for efficient loading
- Special train service (some turbine components may require special train service)
- Safe loading requirements and securement procedures
- Reliable transit times
- Door-to-door delivery, including ocean transport
- Transload facilities for truck to rail transfer
- Coordination at port terminals for vessel to rail transfer
- Recommendations for the best and most economical transport solution

CN AND WIND TURBINE TRANSPORTATION

CN's network serves the main wind farm regions of Canada, from Nova Scotia to British Columbia, and the U.S. Midwest as well as multiple ports suitable for importing wind turbine components – Halifax, N.S., Saint John, N.B., Quebec City, Q.C., Thunder Bay, O.N., Duluth, M.N., Vancouver, B.C., Prince Rupert, B.C., Mobile, A.L., and New Orleans, L.A. Furthermore with the rise in domestic wind turbine component manufacturing, CN is well placed to transport these parts throughout North America. Comparing the location of wind turbine manufacturing plants with CN's current network, we see clear synergies.



CN'S NETWORK – THE RIGHT FIT FOR TRANSPORTING WIND TURBINES



Leave it to us to plot the best, most efficient route for clearances to get your shipment anywhere in North America. We know every overpass, bridge, rock cut, tunnel and other structure, both natural and man-made, that might restrict the size of shipments over our rail network. We also work with our connecting railroads throughout North America to ensure seamless shipping.

But our network is not the only component that makes us the right partner for transporting wind turbines. We have the right equipment, dimensional load experts, and long-standing relationships



with regulatory and advisory agencies governing transportation. We are committed to safety and damage-free handling because we know how valuable your product is to you. .

CN Specialized Services (CNSS) provides expertise in handling over-dimensional rail-moves on CN. Its resources include comprehensive project management, including transload facilities throughout Canada, and a one-price, one-invoice service for door-to-door transportation. CNSS provides transload truck-to-rail, rail-to-truck and assistance with vessel-to-rail or rail-to-vessel loading.

THE BONUS - PARTNERS IN ADDRESSING THE CHALLENGES OF CLIMATE CHANGE

Rail is an energy-efficient choice. Rail emits six times less greenhouse gas (GHG) than heavy trucks and consumes a fraction of the fuel to transport one tonne of freight one kilometre. In fact, CN can move one tonne of freight 197 kilometres (197000 m) on just one litre of fuel. Using less fuel means fewer GHG emissions. In addition, CN's new main-line locomotives produce approximately 40 per cent less nitrous oxide than older locomotives and consume up to 20 per cent less fuel.



THE SOLUTION IN PRACTICE - PROVIDING OVER-LAND LOGISTICS PACKAGE OF WIND TURBINE COMPONENTS TO NORTHERN BRITISH COLUMBIA

CN and CNSS recently completed the first-ever rail move of twin-pack wind turbine blades from German manufacturer Enercon GmbH and Salco Energy Services Inc. of Calgary. Enercon is a leading global manufacturer of wind turbine systems, and Salco Energy is an experienced wind turbine transport and wind park logistics management company in Canada.

The 51 sets of twin-pack blades are being installed in the 102 MW Bear Mountain Wind Park in Dawson Creek, B.C. When completed the Bear Mountain installation will have 34 Enercon E-82 3.0 MW wind turbines that will generate enough clean, renewable electricity to power most of B.C.'s South Peace Region. The project is on schedule to become B.C.'s first fully operational wind park by the end of 2009.

The wind turbine blades, which are 135 feet (41 metres) in length, were transported by sea aboard three vessels from the Port of Emden, Germany, with the first ship arriving at the Port of Thunder Bay, Ont., in early May 2009. CNSS, which arranged for rail car modifications for the move, also coordinated the unloading of the blades from the vessel and the loading of the blades and support equipment onto rail cars.

A total of six trains were required to transport the equipment from Thunder Bay to Dawson Creek over CN's network. At destination, CNSS provided services for unloading the equipment for transportation to the wind farm.



CONTACT US

CN can help harness the energy of wind for electricity generation, wherever someone fits in the supply chain. CN understands the logistics of moving such large components and whether you are a manufacturer of wind turbines, developer of a wind farm, utility/energy company, or logistics supplier, CN can design a shipping solution that is right for you.

FOR MORE INFORMATION PLEASE CONTACT OUR WIND TURBINES EXPERTS:

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