# WIND TURBINE SUPPLY IN CANADA

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# 1 INTRODUCTION

The Canadian Wind Energy Association (CanWEA) has commissioned Garrad Hassan Canada Inc. (GH) to report on the dynamics of wind turbine supply to the Canadian market. Across Europe and North America, the market is currently supply-led, and this has in turn prompted concerns for the supply outlook in Canada.

The reason for this situation is largely the booming nature of the US market in 2005, 2006 and 2007. There has not been enough confidence in the long-term stability of the US market to allow either US domestic manufacturers to set up significant plants or to allow the predominant European manufacturers to invest in the US. Hence when the sudden growth in the US market was added to the consistent growth in the European market, a turbine shortage resulted.

The prospect of long lead-times on turbine orders is increasing the pressure to lock in turbine supply early in the development process. In Canada, like elsewhere, turbine supply difficulties are adding to existing uncertainties in the development process such as planning and grid connection.

Also in common with other markets, there is a natural desire to see maximum economic benefit from the development of wind energy in the form of manufacturing facilities. Recent growth in the Canadian market has raised expectations for local content.

Timely delivery of capacity and the realisation of local economic benefit will go a long way towards furthering provincial goals for wind energy, but neither can be taken for granted in today's market. However if wind energy fails to meet expectations, future growth will be compromised. CanWEA's principal objective therefore is to promote policies which are mindful of the global, and particularly North American, supply context and the implications for Canada.

The remainder of this report is structured as follows:

**Section 2: The North American Market**

An overview of growth in the market to-date, and the future outlook.

**Section 3: The Global Market**

The global market in which turbine suppliers operate.

**Section 4: Turbine Supplier's Survey**

A summary of telephone interviews with turbine suppliers.

**Section 5: Analysis**

Implications for the future of turbine supply to the Canadian market.

# 2 THE NORTH AMERICAN MARKET

The last 2 years have seen an upswing in wind energy activity in Canada, with installation levels reaching 200 MW in 2005 and some 767 MW by the end of 2006. Federal government support has been helpful, but initiatives at the provincial level to diversify energy supplies and secure affordable, timely capacity have also had a great impact.

Canada borders one of the largest wind energy markets in the world – the US – and naturally this has a bearing on the Canadian market. For the most part it has been a point of comparison, highlighting the scale of untapped potential in Canada. But latterly as the Canadian market grows, and industry interest in Canada heightens, the relative merits of the two neighbouring markets are brought to the fore. It is thus instructive to consider, briefly, the evolution of both markets.

## 2.1 Canada

Figure 2.1 at the end of Section 2 shows installed turbines by manufacturer to-date. Figure 2.2 shows the same data by Province. Historical growth trends – timing, magnitude and location – may be associated with the implementation of federal incentive programs and provincial-level tenders for wind capacity (Requests for Proposals (RFPs)).

Early growth in 1999 appears to coincides with the Federal Canadian Renewables and Conservation Expenses (CRCE) test turbine program between 1997 and 2001. Subsequent growth is in line with the creation and first payouts of the federal Wind Power Production Incentive (WPPI) program in 2001 and 2005. The WPPI program was then frozen in early 2006 while being re-evaluated by the new minority government. As of 19 January 2007, a federal incentive program was re-instated as the EcoEnergy for Renewable Power incentive (ERPI). However at time of this report, the terms of ERPI program have yet to be finalized and will only, therefore, be discussed briefly here.

The WPPI program was made available to projects commissioned between April 2002 and the end of March 2007. The incentive is payable for the first 10 years of operation, and was higher for projects commissioned earlier in the programme. Projects which were commissioned before 31 March 2003 were eligible for $12 per MWh. Thereafter, projects receive $10 per MWh. This level of support has been helpful, but is considerably less than provided in the United States.

The WPPI is calculated to provide approximately half of the additional premium required to develop a wind farm, with provincial and other measures required to bridge the remaining gap. Many provinces have taken some form of action to promote or initiate wind energy development. The most common mechanism is a tender for new capacity from the province-wide vertically integrated utility. Some projects have also been developed speculatively, and have secured individual PPAs.

The government originally allowed for some 1 GW of installed capacity, but a 2005 budget announcement allocates additional funds up to a total of 4 GW of capacity by 2010 (with payment extending to 2020). Detailed terms for participation in the extended WPPI were subject to discussion and ratification [2.1]. However the funds have recently been approved by Canada’s new government under the new ERPI program.

The ERPI program, initially announced on 19 January 2007, is a federal production incentive which appears to be quite similar to the WPPI program. With the terms yet to be finalized, this program is said to be in effect from April 2007 to the end of March 2011 [2.2]. The ERPI program has a target installation of 4000 MW of new capacity from all renewable energy sources and will pay $10 per MWh for the first 10 years of a project's life [2.2].

Table 2.1 shows province-specific RFPs to-date. Provincial targets are shown in Table 2.2. A number of provinces have aspiration rather than legislated targets. However RFPs have nonetheless been issued, at a utility's discretion or on government direction. Wind energy is also proving to be competitive in its own right, sometimes resulting in higher than expected contract awards where wind energy is competing with more established technologies.

Recent RFP contract awards in Ontario, Quebec and British Columbia are largely responsible for a pipeline of projects shown in Figure 2.4 and Figure 2.3.

Vestas has been the leading supplier to the Canadian market to-date, followed by GE. Both GE and Siemens are making solid progress in securing future orders and challenging Vestas' position. The Provincial spread of development reflects Provincial policies for the promotion of wind energy.

The factors driving turbine supply to the Canadian market are various but are principally:

- Technology offerings: while the main manufacturers all offer MW-scale turbines, there may be site-specific constraints which limit a purchaser to one or two turbine suppliers
- Turbine price: in the absence of any policies on local content, this is the key driver.
- Local content policies: if an RFP is contingent on securing local content, then clearly this limits turbine choice to compliant manufacturers.
- Availability: a manufacturer must be willing to supply the market.

Of these factors, price and availability have been paramount in Vestas' early dominance of the Canadian market. The Danish manufacturers have lead the way in pursuing sales outside of their home market, and in a world market has until recently been largely demand-lead..

Since then, the industry has undergone substantial change with the entry of GE and Siemens, and the increasing international outlook of the industry. These factors are discussed in Section 2.3.

Recent prospective orders for GE wind turbines are as a result of winning RFPs in Quebec and Ontario. In the case of Quebec, GE was aligned with two successful bids which had local content provisions. GE and Siemens are also relatively aggressive in their desire to secure a North American market share.

Somewhat separate to the market for commercial-scale projects is that for one or a few turbines. It has been and remains a steady, albeit small, market of several projects each year. Enercon and Vensys have won recent contracts in this market – Enercon supplying both its E48 800 kW machine and its E70 2 MW machine in 2006. Vensys supplied a single 1.2 MW machine in 2005 and Turbowinds supplied two 600 kW machines to two projects in the same year.

| Province | Size of RFP | RFP Issue Date | Response Due Date | Commission Date | Comments |
|---|---|---|---|---|---|
| British Columbia | 1559 MW | 08-Dec-05 | 07-Apr-06 | 01-Nov-10 | 300 MW awarded to wind only |
| Alberta | | | | | Free market |
| Saskatchewan | | Jan-04 | Cancelled | | Phase 1 SaskPower EPP 13.1 MW – cancelled |
| | 32 MW | May-05 | May-06 | | Phase 2 SaskPower EPP 24.75 MW awarded to wind |
| Manitoba | 300 MW | Said to be early 2007 | | | Intention 1000 MW |
| Ontario | 395 MW | 24-Jun-04 | 25-Aug-04 | 31-Dec-07 | RES I: 354 MW awarded to wind only |
| | 1000 MW | 17-Jun-05 | 15-Aug-05 | 31-Oct-08 | RES II: 854 MW awarded to wind. |
| | 200 MW | 12-Jul-05 | postponed | 31-Oct-09 | RES III: postponed |
| | 1000 MW | 22-Nov-06 | | | Limited 10 MW renewable energy projects |
| Quebec | 1000 MW | May-03 | 01-Mar-04 | 01-Dec-06 to 01-Dec-10 | Wind-only call 990 MW awarded |
| | 2000 MW | 31-Oct-05 | 15-Sept-07 | 01-Dec-09 to 01-Dec-13 | Wind-only call. |
| New Brunswick | 20 MW | Dec-03 | Apr-04 | Fall 2005 | Wind-only call 20 MW awarded |
| | 200 MW | | 28-Aug-06 | end of 2009 | Wind-only call 75 MW awarded |
| Nova Scotia | 130 MW | Said to be early 2007 | | | |
| | 60 MW | Sep-04 | | | Renewables in general - wind, solar, tidal and biomass |
| Prince Edward Island | | | | | No RFP yet - considering 100% renewables by 2015 (200 MW) |
| Newfoundland | 25 MW | Dec-05 | end of Aug-06 | | Island interconnected system only |

**Table 2.1 Request for Proposals in Canada**

| Province | Policy |
|---|---|
| British Columbia | A voluntary target for electricity distributors of 50% of new generation to come from clean energy.<br>BCHydro has published a White Paper on wind energy [2.3].<br>The BC Government is presently developing an Alternative Energy Strategy. |
| Alberta | 3.5% of electricity to be sourced from new renewables by 2008.<br>900 MW grid-related threshold in place pending technical solutions. |
| Saskatchewan | 5% of electricity – approx. 200 MW to be sourced from wind energy.<br>SaskPower has policy of sourcing new generation to 2010 from “Environmentally Preferred Power”. |
| Manitoba | 1000 MW target for 2009-2014. |
| Ontario | Government aspirational target of 2,700 MW renewable energy by 2010. Achievement is through RFPs. |
| Quebec | Quebec government is seeking 4,000 MW wind energy by 2015 in its Energy Strategy. Achievement is through RFPs |
| New Brunswick | NB Power soliciting up to 400 MW wind by 2016. |
| Nova Scotia | Government aspirational target of almost 20% of electricity from renewable energy by 2013. |
| Prince Edward Island | 15% of electricity from wind by 2010 – approximately 40 MW. |
| Newfoundland | A draft energy paper calls for 150 MW wind energy. |

**Table 2.2 Provincial wind policies**

## 2.2 United States

Figure 2.5 shows yearly installed turbine units by manufacturer for the US. Figure 2.6 shows the same data by State. The figures show the hallmark characteristic of the US market, namely its oscillating nature.

Wind energy activity in the 80s and first half of the 90s was dominated by the Californian wind rush, promoted by state policies. There was a “boom” of activity with unprecedented numbers of machines installed. It was followed by an almost as dramatic “bust” and the consequent demise of a US-based manufacturer, Kenetech. Danish manufacturers supplying the Californian market at that time were saved by other more steady European markets, but it was a hard lesson in the risks of over-reliance on one market.

The second phase of development in the US has been driven at the federal level by the Production Tax Credit (PTC), which is a short-term political device used by the US government not only for wind energy applications but in various other different walks of life. There has never been a long-term commitment to the development of wind energy in the US. The duration of the PTC has been a maximum of three years. The mechanism essentially gives tax relief which is valued at 1.8 US¢ per kWh for ten years to any owner of a wind farm. The present PTC runs until December 31 2008.

In order to use this tax credit the owner must (i) be prepared to take the risk of entering the wind energy industry and (ii) be confident that it has a long-term tax liability in order for it to benefit from the relief accrued from the energy generated by the wind farm. Although there is no formal requirement for such companies to be substantial in size, in practice only large companies have been able to participate. This trend led to the strange position that half the US installed capacity belongs to one company: FPL Energy – the unregulated sister company of Florida Power and Light.

At the State level, governments can provide additional financial and other incentives for renewable energy. National policy encourages the use of a Renewables Portfolio Standard (RPS) which is a generic name for a volume-based obligation. An RPS can be state-mandated, or a utility commitment to itself. At least 20 states now have an RPS.

Other support measures include state tax credits, loans and grants. Individual utilities may also run their own green energy schemes.

Vestas / NEG Micon, Mitsubishi and GE / Enron have all been reasonably successful in supplying this PTC-RPS-driven US market. Latterly GE has dominated, buoyed by a competitive dollar.

The US experience has demonstrated (i) the power of the PTC to produce a very active market and (ii) the destabilising influence that such an oscillatory market can have, not only on the US industry but also on the industry as a whole. Reference is made elsewhere in this report to the present “sellers’ market” in which demand for wind turbines considerably outstretches the supply of turbines. The reason for this situation is largely the booming nature of the US market in 2005, 2006 and 2007. There has not been enough confidence in the long-term stability of the US market to allow either US domestic manufacturers to set up significant plants or to allow the predominant European manufacturers to invest in the US. Hence when the sudden growth in the US market was added to the consistent growth in the European market, a shortage resulted.

It is also important to recognise that the United States has not signed to the Kyoto Protocol, and it seems certain that, during Mr Bush’s Presidency, it will not do so. This does not appear to have resulted in a down-turn in wind energy in the US, but similarly there are no long-term commitments at the federal level, with the market presently uncertain beyond the end of 2008. However, there are two trends which may ultimately provide an alternative to reliance on the PTC. First is the improving comparative economics of wind energy: conventional fuel prices are rising, and wind energy is already looking attractive in certain applications such as offshore wind close to centres of population where the alternative is long-distance overland transmission of power. Second is the pressing and ongoing need for new capacity in the US as electricity growth remains unabated.

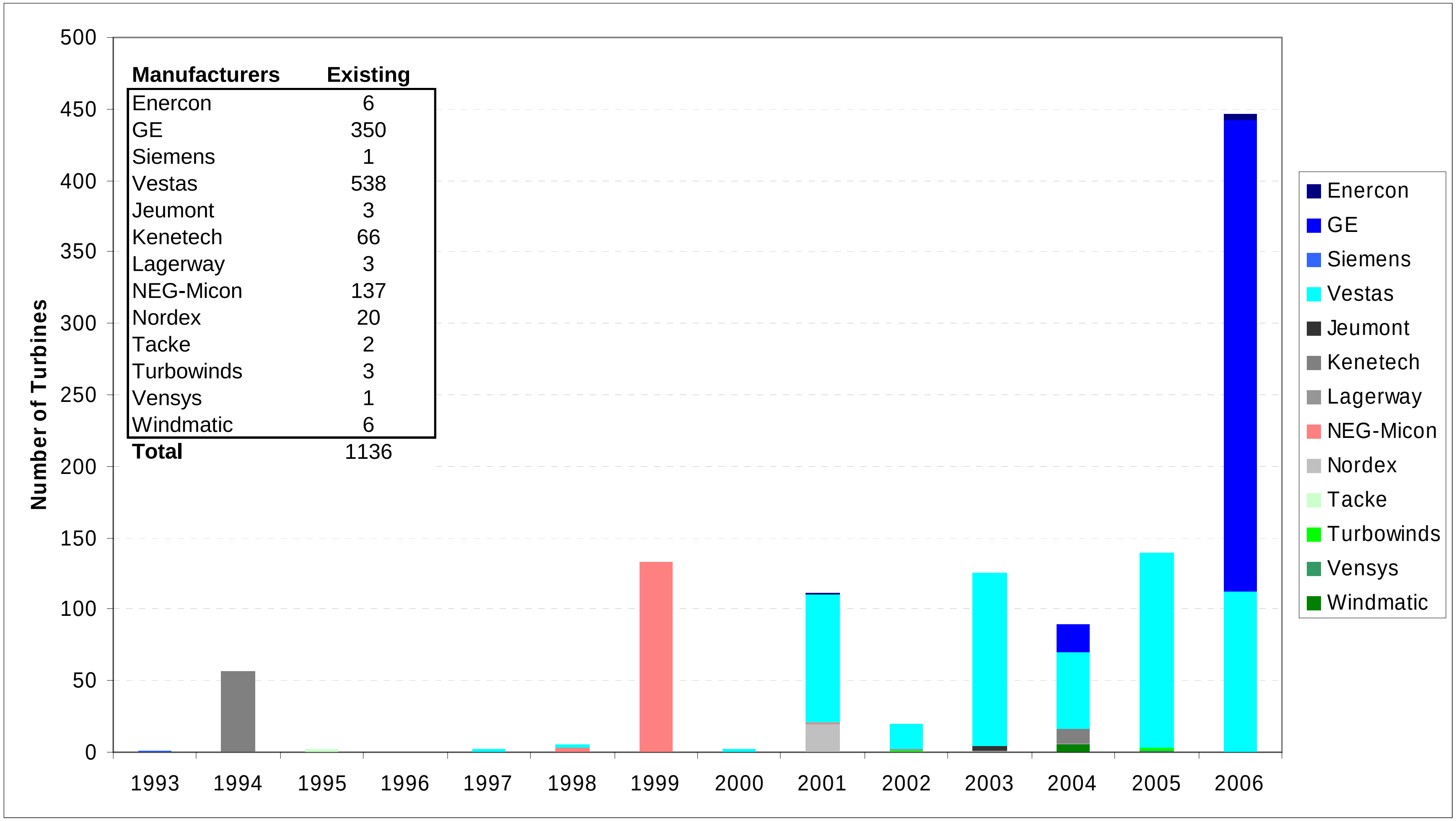



**Figure 2.1 Historical yearly installed turbines by manufacturer in Canada**

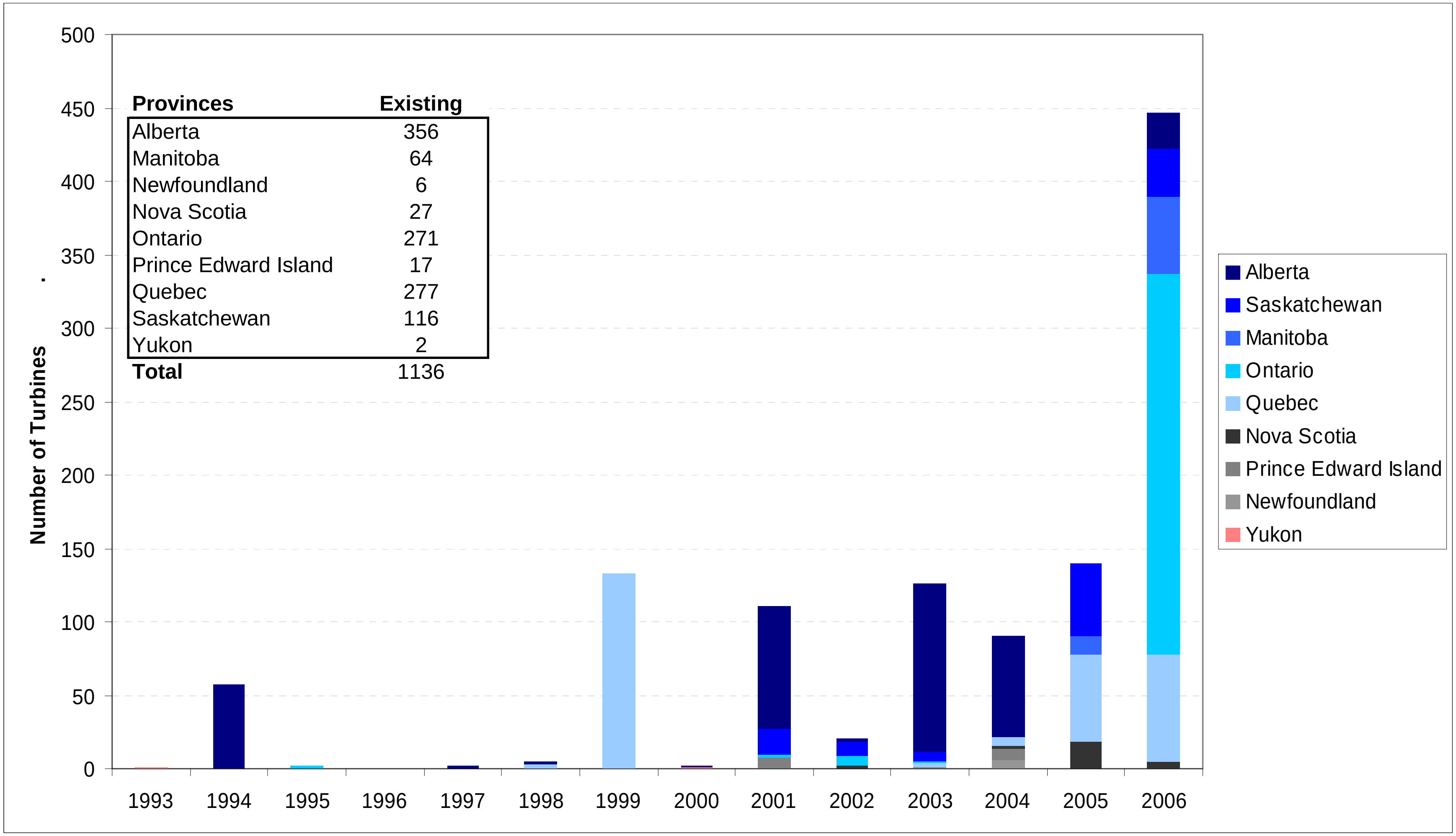



**Figure 2.2 Historical yearly installed turbines by province in Canada**

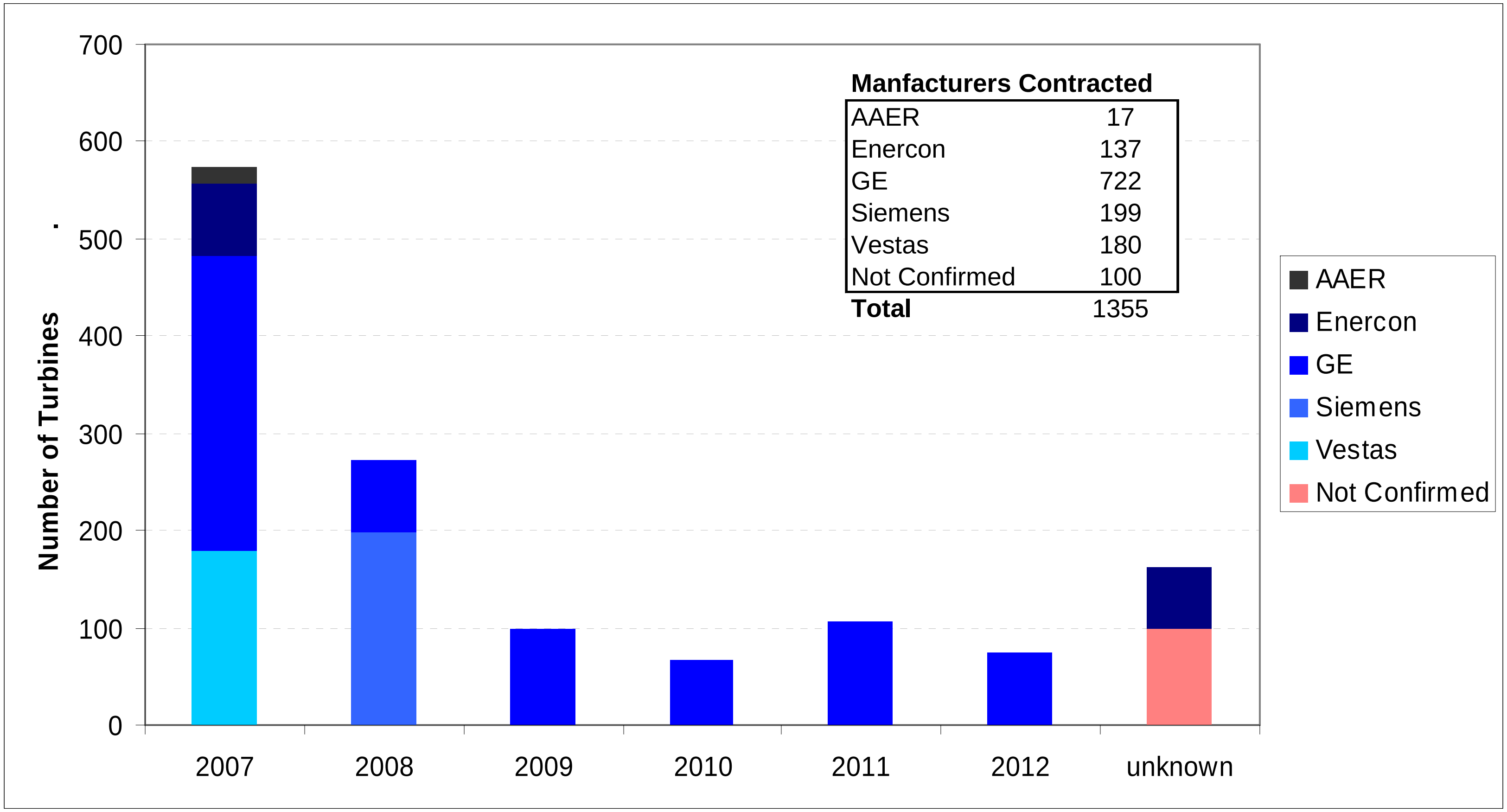



**Figure 2.3 Future yearly installed turbines by manufacturer in Canada**

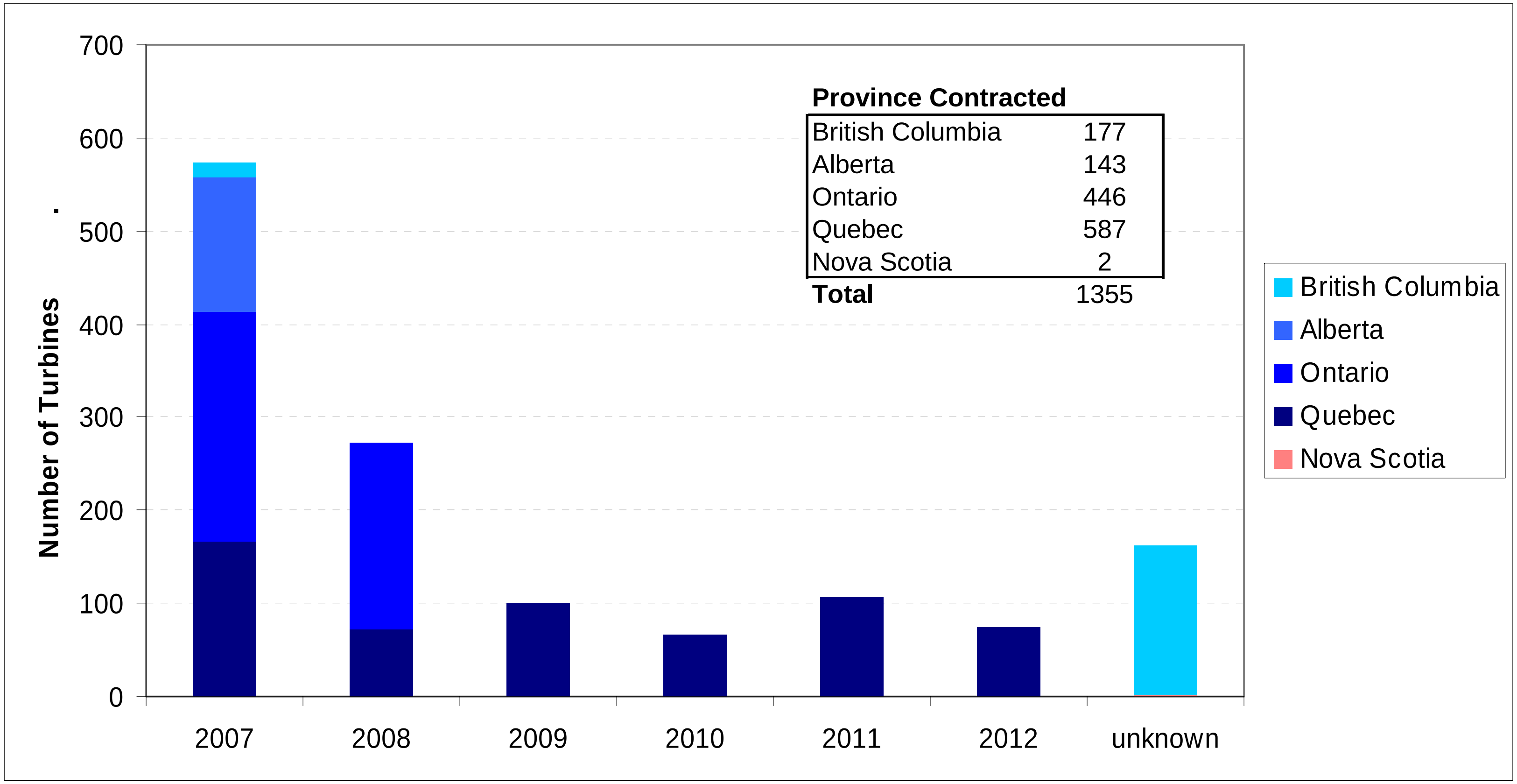
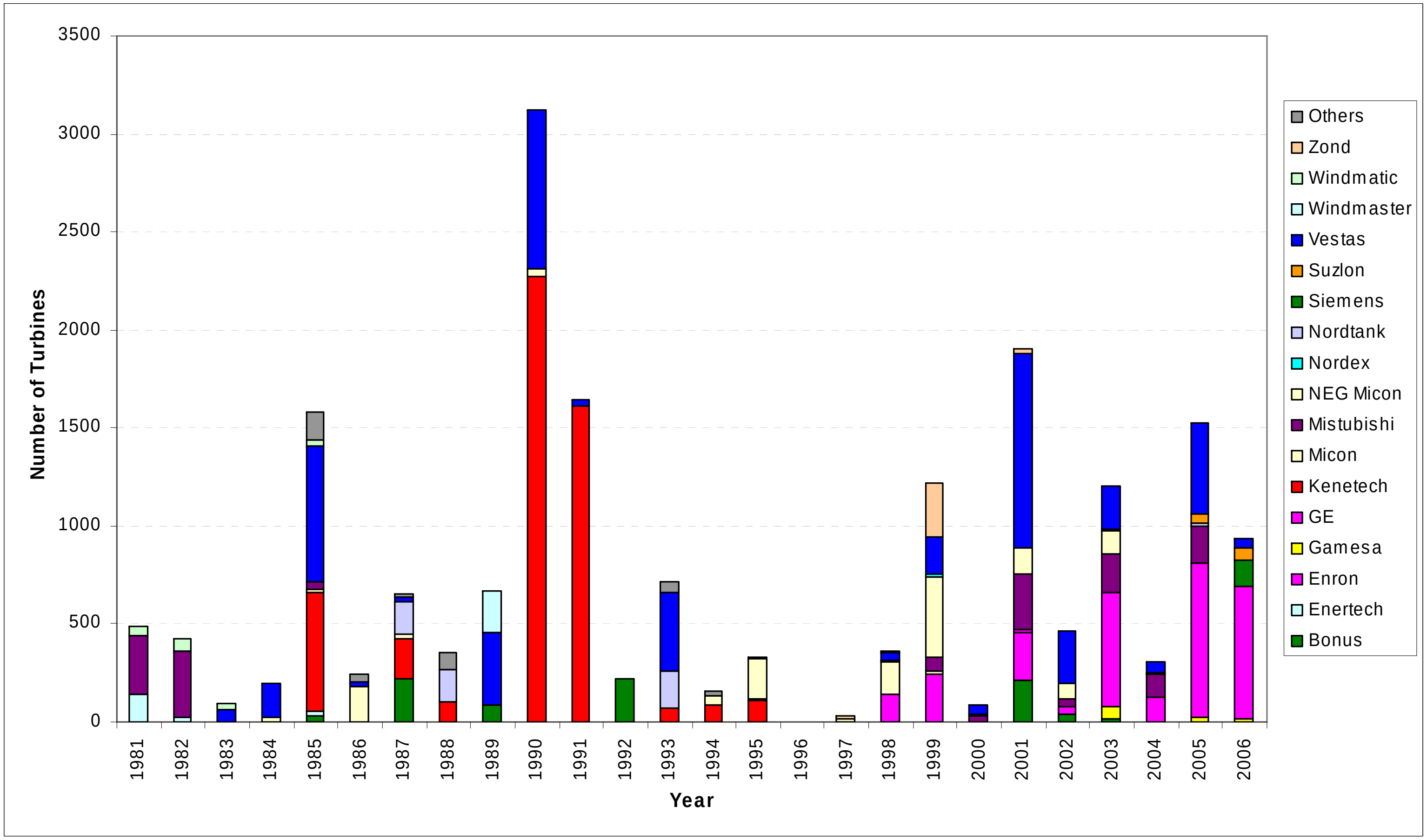
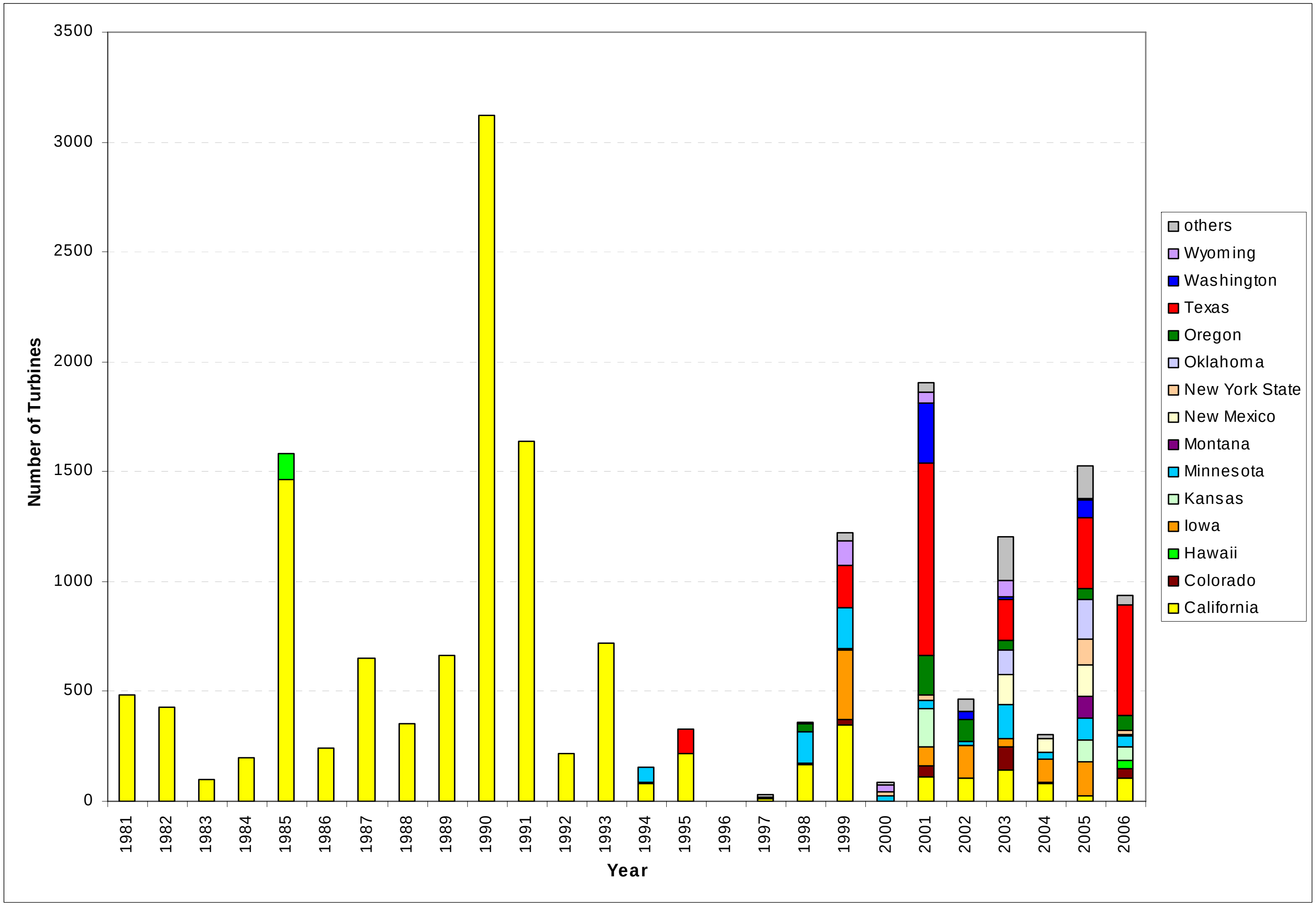



**Figure 2.4 Future yearly installed turbines by Province in Canada**




| Manufacturers | Installed |
|---|---|
| Bonus | 817 |
| Carter | 29 |
| Clipper | 1 |
| DWT | 35 |
| Enertech | 198 |
| Enron | 635 |
| Fuhrlander | 2 |
| Gamesa | 104 |
| GE | 2227 |
| Howden | 86 |
| Jacobs | 81 |
| Kenetech | 5056 |
| Micon | 472 |
| Mitsubishi | 1620 |
| NedWind | 20 |
| NEG Micon | 1010 |
| Nordex | 24 |
| Nordtank | 537 |
| Siemens | 137 |
| Storm Master | 28 |
| Suzlon | 114 |
| Tacke | 2 |
| Vestas | 4916 |
| WEG | 20 |
| Wincon | 57 |
| Windmaster | 211 |
| Windmatic | 180 |
| WTC | 1 |
| Zond | 309 |
| Total | 18929 |

**Figure 2.5 Historical yearly installed units by manufacturer in the US**




| State | Installed |
|---|---|
| Alaska | 2 |
| Arkansas | 1 |
| California | 11681 |
| Colorado | 230 |
| Hawaii | 154 |
| Idaho | 50 |
| Illinois | 98 |
| Iowa | 861 |
| Kansas | 339 |
| Massachusetts | 4 |
| Michigan | 6 |
| Minnesota | 827 |
| Montana | 108 |
| Nebraska | 48 |
| New Jersey | 5 |
| New Mexico | 340 |
| New York State | 178 |
| North Dakota | 97 |
| Oklahoma | 295 |
| Oregon | 477 |
| Pennsylvania | 99 |
| Rhode Island | 1 |
| South Dakota | 36 |
| Tennessee | 18 |
| Texas | 2181 |
| Utah | 2 |
| Vermont | 11 |
| Washington | 405 |
| West Virginia | 44 |
| Wisconsin | 55 |
| Wyoming | 276 |
| **Total** | **18929** |

**Figure 2.6 Historical yearly installed units by State in the US**

## 2.3 Outlook

2006 saw a marked gear-change for the Canadian market, more than doubling installed capacity from 684 MW at the end of 2005 to 1,451 MW by the end of 2006. As of the end of 2006 there is a contracted pipeline of projects of nearly 2,400 MW (although a proportion will be subject to environmental permissions). Additional capacity is expected, and CanWEA estimates that Provincial targets total some 9,000 MW by 2015 [2.4]. Thus it would seem the outlook for the Canadian market is very positive.

However, provincial targets are for the most part not mandatory. Furthermore, the Canadian government is yet to set out its firm plans for market support. Utility RFPs are the principal basis for future capacity expectations, and beyond confirmed contracts this is reliant on the attitudes of provincial governments and the utilities themselves. This is a departure from traditional politicised wind energy markets, where stability is provided by sound targets and legislated support measures.

Recent RFP successes suggest that Canada is, like the US, showing signs that wind energy can be a logical choice for meeting the demands for increased generating capacity. That is, that the environmental benefits of wind energy are not its only driver. Rising conventional fuel prices, coupled with uncertainties for energy security, suggest that this trend could become more important in the future.

Figure 2.7 shows historical growth in electricity demand for the US and Canada [2.5], and demonstrates that demands for electricity continue to grow. It also amply demonstrates the nature of the US market compared to Canada – that is, that the US market is much larger and the gap is growing largely unabated.

Figure 2.8 shows industry market projections for the US and Canada. BTM [2.6] provides 5 year forecasts based on policy announcements and industry plans. The US forecast reflects the fact that there has yet been no extension to the PTC beyond 2008, and that therefore the historical trend of PTC-driven boom and bust years continues. Emerging Energy Research (EE) [2.7] provides two forecasts: the “low” scenario is based on announced plans in a similar fashion to BTM; an alternative forecast is more optimistic and considers what might be possible given current policy indications – for the US this could be an extension to the PTC and hence continued growth in 2008.

These market forecasts also highlight key characteristics of the two markets. The difference between a boom and bust year in the US is over 2.5 GW. In Canada, an optimistic forecast delivers approximately 0.5GW more than a baseline forecast. In 2008, the whole Canadian market at around a GW cannot compensate for potential lost business of 2.5GW should the PTC not be renewed. Canada is however presented as a more dependable market.

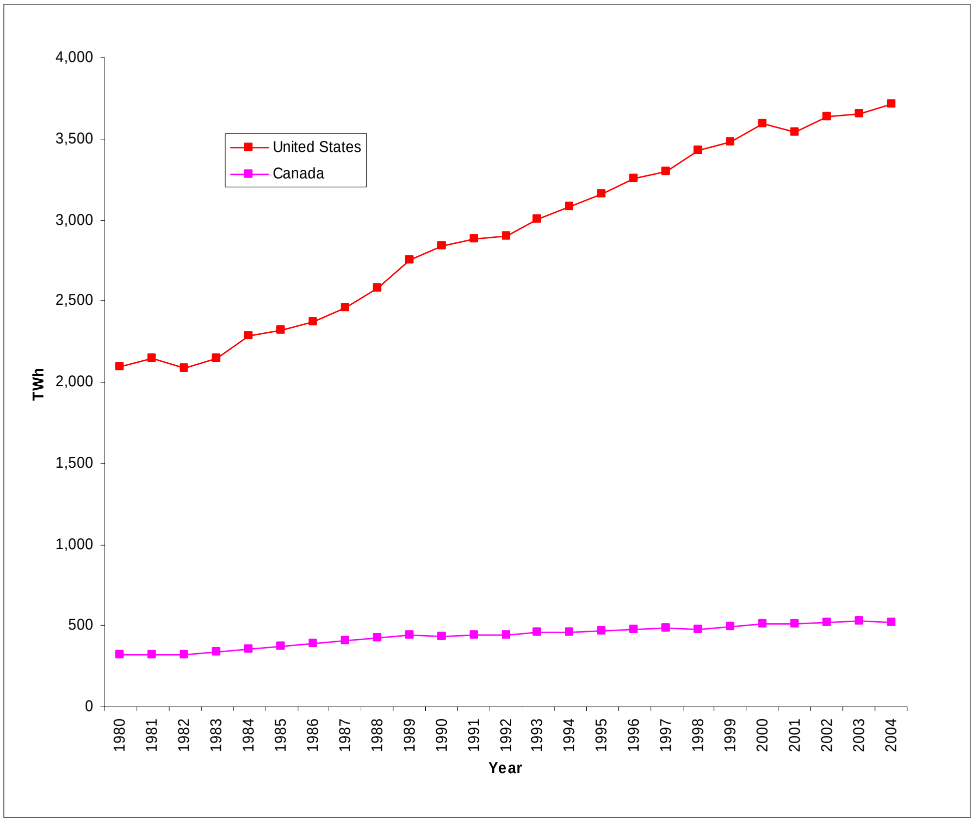



**Figure 2.7 Electricity consumption growth**

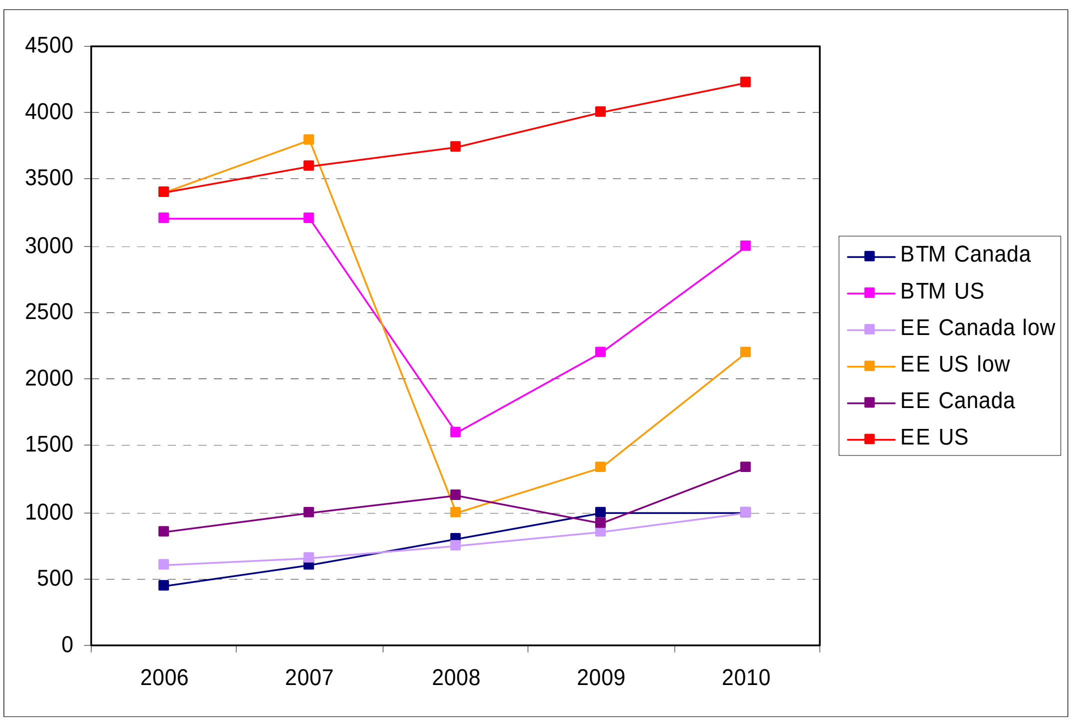



**Figure 2.8 Market Scenarios for the US and Canada**

Any uncertainty in US policy is in the context of the indisputably large and growing market. Even pessimistic forecasts pitch the bust years at around the same size as a good year for Canada and with subsequent years climbing to much higher levels. That is, market growth seems to be a question of timing rather than whether it will happen at all. Policy uncertainty in Canada is not similarly compensated for by a sense of inevitability.

But when viewed in a global context where the US is not the immediate comparison, the outlook for Canada is relatively optimistic. The Federal government is sympathetic to environmental concerns and Canada has ratified the Kyoto protocol. Wind energy is also proving attractive on grounds other than environmental. And while it may not be as large as the US market, its electricity network is interconnected with that of the US and Canada is a net exporter of electricity to the US.

# 3 THE GLOBAL MARKET

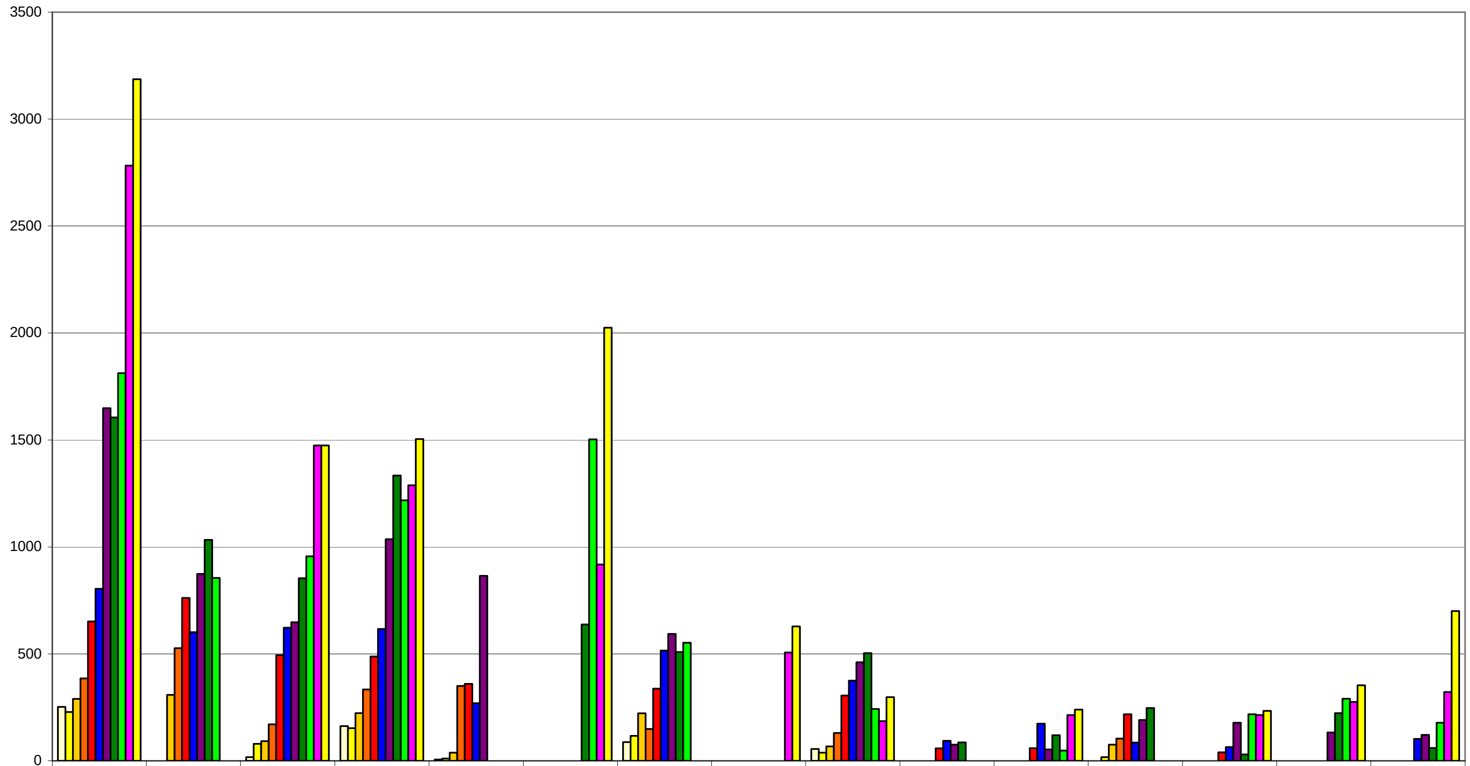
## 3.1 Turbine Sales

Global sales are recorded and published in the annual publication "World Market Update" by BTM. Figure 3.1 overleaf shows manufacturer sales as reported by successive BTM annual market reports [2.6], for the main manufacturers. Early-year companies subsequently purchased / merged are not included for brevity, but more recent, formerly separate companies are shown as follows:

- Enron which in 2002 was purchased by GE
- MADE, the Spanish manufacturer, which in 2003 was purchased by Gamesa.
- NEG Micon which in 2003 merged with Vestas and became Vestas
- Bonus which in 2004 was purchased by Siemens

BTM only records sales for the top ten manufacturers in each given year. This means that only those consistently in the top ten have sales shown in Figure 3.1 for every year. There is a number of other smaller manufacturers who, by virtue of sales volume, or possibly supply of lower-rated turbines (sales are recorded by MW rather than machine), do not feature in the top 10. These suppliers can be significant in any one domestic market, and may show potential for growth.

Vestas is the world's leading manufacturer. In 2003 GE Wind was a serious second-place challenge to Vestas (buoyed by US market sales and the high exchange rate for the US dollar). In 2004, Gamesa came second-place and would have been a more serious contender for first place had it not been for the Vestas / NEG Micon merger, and the same can be said for GE's second-placing in 2005. Enercon placed third in the years 2003, 2004, and 2005, on the strength of sales almost exclusively to the German market. Over the coming years, challenges to Vestas' current market position can be expected to continue. While overall sales volume of wind turbines are expected to increase, individual markets will vary to the detriment of manufacturers which continue to rely on one or few shrinking markets




| | Vestas (DK) | NEG Micon (DK) | Gamesa (ES) | Enercon (GE) | Enron (US) | GE Wind (US) | Bonus (DK) | Siemens (GE) | Nordex (GE) | DeWind (GE) | Ecotecnia (ES) | Made (ES) | Mitsubishi (JP) | REPower (GE) | Suzlon (IND) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sold Capacity (MW) 1995 | 252 | | 17 | 163 | 6 | | 88 | | 55 | | | | | | |
| 1996 | 228 | | 79 | 153 | 11.5 | | 117 | | 38 | | | 17 | | | |
| 1997 | 290 | 309 | 93 | 223 | 38 | | 222 | | 67 | | | 75 | | | |
| 1998 | 385 | 527 | 171 | 334 | 350 | | 149 | | 131 | | | 105 | | | |
| 1999 | 652 | 761 | 494 | 488 | 360 | | 338 | | 306 | 58 | 59 | 218 | 40 | | |
| 2000 | 805 | 601 | 623 | 617 | 270 | | 516 | | 375 | 94 | 174 | 85 | 64 | | 103 |
| 2001 | 1648 | 874 | 648 | 1036 | 865 | | 593 | | 461 | 75 | 53 | 191 | 178 | 133 | 122 |
| Installed Capacity (MW) 2002 | 1605 | 1033 | 854 | 1334 | | 638 | 509 | | 504 | 86 | 120 | 247 | 30 | 223 | 60 |
| 2003 | 1812 | 855 | 956 | 1218 | | 1503 | 552 | | 242 | | 48 | | 218 | 291 | 178 |
| 2004 | 2783 | | 1474 | 1288 | | 918 | | 507 | 186 | | 214 | | 214 | 276 | 322 |
| 2005 | 3186 | | 1474 | 1505 | | 2025 | | 629 | 298 | | 239 | | 233 | 353 | 700 |

**Figure 3.1 Turbine Manufacturer Sales**

Some key industry trends to note are:

- Entry of Siemens and GE into the market confirms that wind energy is now a mainstream business. Their financial strength opens new opportunities which allow the companies to operate in ways not possible for their competitors. Their business margins are also perhaps more ambitious than previously seen in the wind industry, which means a move away from smaller, lower margin projects. Both companies appear to be taking a cautious approach to development of the business, which might be the beginning of a slowing of the rather rapid technology development and deployment seen to-date throughout the industry;
- Vestas remains the market leader both in terms of market share and technical innovation. It is not comparable in financial strength to Siemens and GE and presently is undergoing major restructuring which has not been as successful as anticipated by the management. A large proportion of the R&D effort is now being focussed on the remediation of known problems in the existing product range;
- Enercon and Gamesa have traditionally focused on their home markets of Germany and Spain respectively, but are now looking further afield including Canada;
- Asian manufacturers Suzlon and Mitsubishi could be serious future contenders on the world-wide market;
- The emerging Chinese market is now a focus for a number of manufacturers. Strong local content requirements for participation in China, coupled with cheap manufacturing costs, represent strong incentives to set up manufacturing facilities in China. At least two major manufacturers have stated aspirations to supply the North American market from China. It is however questionable whether supply from China to European markets is a viable strategy. The present large Chinese projects do not offer adequate rates of return to attract major western investment.

The main battle in the near-term will be between GE, Siemens and Vestas. GE has both financial might and technical depth. GE does not presently have the full product range which it needs but it is coming. It is investing substantially in R&D activities all over the world and is able to bring to bear its expertise in power systems and other related technology. GH expects to see GE's market share increasing in all areas as soon as it has the 2.x (now called 3.0) turbine commercially available. Siemens is comparable to GE in financial strength and also has an excellent product range. Technology development by both entities will be substantially slower than in the recent past. With respect to offshore applications, Seimens appears to have fared better than either Vestas or GE, but the next few years will be crucial for maintaining this record.

Most industry commentators think it likely that Vestas will be purchased by a major conventional power industry player within the next few of years. GH considers it likely that new large industrial entities from the Asia will make an entry in a similar time frame.

The global wind market is, for the first time, limited by turbine and specifically component supply. Multi-MW turbines are now in demand and the supply of these turbines is limited to relatively few players. Some big industrial entities have recently joined the relatively young wind turbine industry. The arrival of these players and the move of the market towards "utility scale" in both the size of the projects and the size of the customers has caused some of the suppliers to retract from smaller projects – say less than 20 MW. These various characteristics have created a niche for new turbine suppliers. It is anticipated that this position will continue for at least two to three years.

## 3.2 World Markets

Figure 3.2 shows installed wind energy capacity by Region each year up to 2005 [2.6].

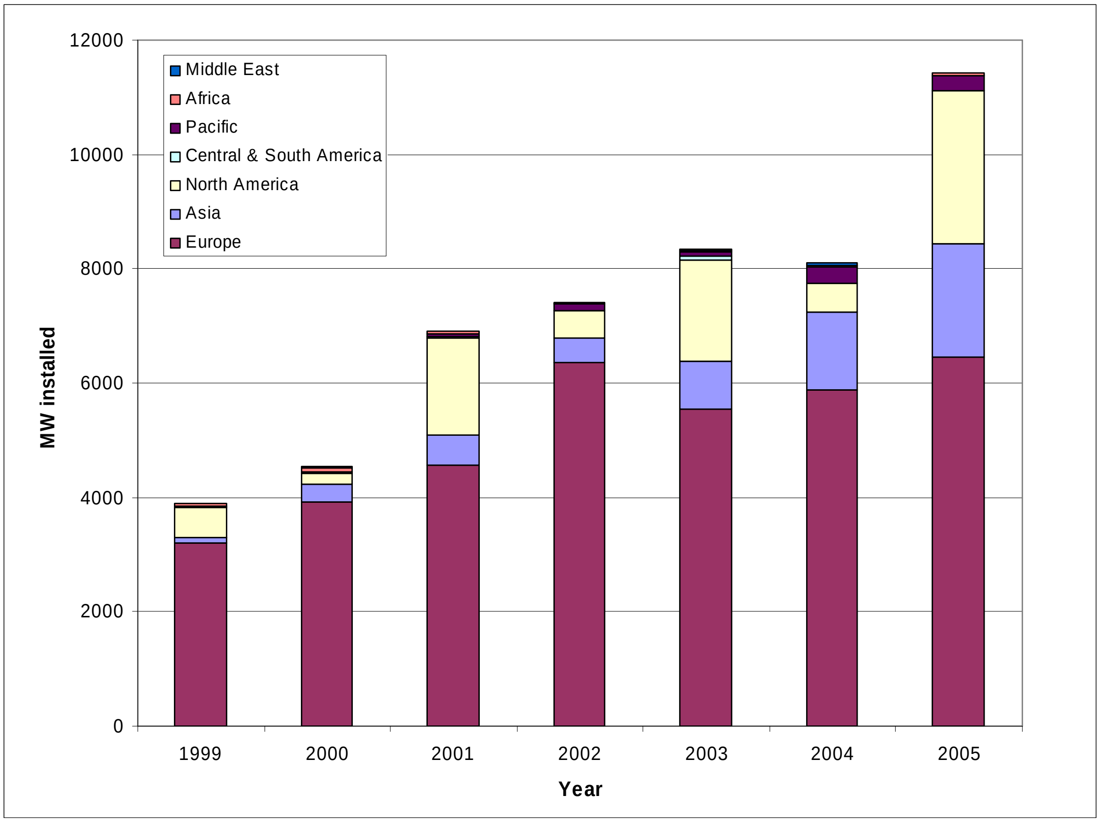



**Figure 3.2 World-wide installed capacity by Region**

***Europe***

Europe has to-date been the dominant market. While the European market grew in 2005, its share of the total market dropped, reflecting the increasing share taken up by American and Asian markets. The main driver in Europe has been environmental imperatives. Germany and Spain remain the world's first and second largest wind energy markets. Development has been such that onshore markets in Denmark and latterly Germany have experienced a down-turn as available economic sites have been exhausted. The focus for both these countries is now re-powering onshore and development of offshore sites.

***North America***

Installations in the US represent the vast majority of the North American market. The US market is notoriously "boom and bust" – a characteristic driven by the Federal support mechanism, a tax credit called the Production Tax Credit (PTC). The PTC is implemented or extended, on average, for 1 year at a time, thus requiring periodic legislative renewal. This has resulted in cycles of frenetic construction to meet a PTC deadline, followed by a fallow period until a new PTC is confirmed. Despite its significant share of the total world market, the variability and unpredictability of the US market has been almost singularly responsible for the very low level of domestic production. It is only since GE entered the wind energy business that this situation has improved somewhat. Even then, the US market has a strong influence on global markets. There has not been enough confidence in the long-term stability of the US market to allow either US domestic manufacturers to set up significant plants, or to allow European manufacturers to invest substantially in the US. Hence when sudden growth in the US market has been added to the consistent growth in the European market, a shortage has resulted.

Canada's contribution to the North American total has been steadily increasing.

***Asia***

India has experienced rapid growth in the past, under government promotion and a growing economy. After a quiet period, it is now showing renewed growth. China has recently passed a renewable energy law and is expected to show considerable growth over the next few years. In fact even before the new law came into effect, China had its best year yet in 2005 with just under 500 MW installed. Chinese law requires local manufacture of turbines, which is an important development as it has the potential to alter both the dynamics and economics of the global market.

Japan's wind energy market has seen some growth over the last few years, but at present potential is capped by the electricity utilities. There has also been some activity in South Korea and Taiwan.

Asia is playing an increasingly prominent role in the world-wide wind energy industry. Of the top ten turbine suppliers in 2005, two are Asian – Suzlon (Indian) in fifth place (up from sixth in 2004) and Mitsubishi (Japanese) in tenth place (down from eighth in 2004), with 6.1 and 2% respectively of the total 11,207 MW installed [2.6]. By installed capacity, India was the world's fourth largest market in 2005, with China in sixth place.

***Pacific***

Development in Australia and New Zealand has been promoted through government support. In New Zealand, a lack of government support has muted the market. An upturn in 2004, on the strength of electricity prices and international carbon credits, was not sustained in 2005. Erosion of government support in Australia looks to have brought development there to a halt for now.

***Middle East, Africa and Central and South America***

In these markets, growth has been modest and sporadic, often promoted on a project-by-project basis through international aid programmes. Brazil has seen positive steps towards development from the government, but has been disappointing in its failure as yet to take off.

# 4 TURBINE SUPPLIERS SURVEY

Turbine suppliers' perspectives on the Canadian market are of course key to any strategy aimed at securing reliable supplies and maximising local content. Views were ascertained via a questionnaire (reproduced in Appendix A) which sought to understand supplier's motivations for market participation. The majority of interviews were by telephone. Because some questions touched on areas of commercial confidentiality, only aggregate outputs and unattributed viewpoints are presented here.

Eight suppliers were interviewed or supplied general comments: AAER, Clipper, Enercon, GE, Nordex, Siemens, Suzlon and Vestas.

Questions were grouped under four topics as follows:

## 4.1 Current Supply Status and Aspirations

*This section of the questionnaire was concerned with past experiences of the Canadian market and future objectives, if any, for market participation. Experiences could encompass anything from comments on the procurement of turbines through to installation and on-the-ground practicalities. Questions on future aspirations were accompanied by consideration of what has encouraged or discouraged suppliers in participating in the market.*

**Experiences**

For those with a Canadian supply record (4), or future orders for 2007-08 (2) there were no major obstacles or negative experiences reported.

One supplier noted that it was shielded from direct exposure to market conditions in Canada because its participation was through a local partner.

There is naturally a period of familiarisation for any new entrant, with one supplier noting the requirement for certification to Canadian Standards [4.1] on electrical equipment, and the consequent additional costs. Another supplier of machines, who is new to the Canadian market, is committing higher than expected resources to grid integration of their machine.

Transaction costs were cited by one supplier as higher (for them) in Canada than America, while another considered it easier to supply the Canadian market by virtue of there being no duty to pay. Another noted that contractors were more expensive in Canada than America, probably reflecting the relative inexperience of Canadian contractors. The USD and the CAD currencies can either be a benefit for North American manufacturers or a source of volatility for European manufacturers.

The GE-held variable speed patent was cited by another manufacturer as a barrier from entry, resolution of which was a pre-requisite for market re-entry.

On a practical level, one supplier noted the short window for installation – 8 months – in Canada, limited by frozen seaway access for delivery and frozen ground which prohibits construction.

Provincial RFPs are not always straightforward, in so far as they are characteristic of each issuing utility and can present difficult compliance criteria. The "lumpy" nature of RFPs, which forces activity into the RFP timescales, was considered by one supplier to be a factor in some developers underperforming on their project portfolios. One respondent thought that aggressive pricing by competitors in the RFPs was effectively buying into the market.

However the RFPs do present an adequate route to market for the suppliers (albeit some are more reluctant than others to bid where there are strong local content conditions). Compared to the US, Canada is clearly seen as the more stable market, either implicitly (through a hope that it can act as a hedge to the US) or explicitly (stating its stability as an advantage). There was one very positive outlook on the RFP process in general, where it was considered a benefit that utilities rather than politicians drove the process. The implication is a potentially more predictable, less fickle market-place. A contradictory viewpoint expressed was that utilities may well switch technology allegiances due to the vagaries of the market or an underlying affinity to conventional power, as opposed to a more stable political framework.

**New market entry**

Three suppliers interviewed had no Canadian track record and one was planning market re-entry having previously pulled out of the market. Of these four, three were active in investigating the market and local conditions, with two in receipt of orders for 2007-08.

The remaining supplier did have aspirations for Canadian market entry, but a booming US market had been and continues to be an immediate pull on company resources. Cracking a new market requires effort and cost which is a diversion from the essentially easier option of meeting expanded demands of existing US business. For this company, there is no interest in piecemeal supply to the Canadian market. The preference is to be in a position to enter the market meaningfully as and when it has the resources to do so – this will be no earlier than 2009.

**Supply objectives**

No-one disclosed any specific supply targets for Canada. There is of course a natural desire to secure business and Canada is no exception to this rule. However where supply is constrained, Canada market can and does lose out to the US. Only one supplier, a Canadian manufacturer of European technology, prioritised the Canadian market. In this case the target market is small to medium-sized projects. Another supplier mentioned that their priority is not simply to gain a large market share in Canada, even under perfect market conditions but to focus on a providing a critical mass of quality services and performance in stable markets to maintain a positive reputation.

Canada can compare unfavourably to the US market where US customers are in a position to financially secure significant orders at an early juncture. This situation has lead to a departure from the perceived model of reserving production units for different markets. Today's reality, at least for some suppliers, is more opportunistic supply to maximise shareholder value.

However valued customers can and do command loyalty from turbine suppliers, with an eye on long-term business relationships which are not necessarily limited to the wind turbine business. This has been a driver for at least one supplier.

## 4.2 Influences

*Questions in this section examined the factors which have the most significant bearing on suppliers' views of the Canadian market.*

**The US**

Canada's proximity to the US market features strongly in all suppliers views of the Canadian market, although the degree of influence is varied. Different perspectives appear to stem from the suppliers existing level of activity in the US compared to Europe. That is, if the US market is important, then interaction with the US market is important. If Europe dominates a supplier's customer base, then both Canada and the US offer potential expansion opportunities in their own right, and the comparison is with European market conditions and prices.

Thus suppliers differ in whether the Canadian market is viewed in terms of its interaction with the US market or as a market in isolation. To an extent, this is semantics as attractive supply opportunities will elicit a response in any event. But because the larger US market is inevitably more attractive to some players, they consider that Canadian activities could usefully be timed in advance to present a "hedge" to the US market – this in turn would potentially lead to more timely supply and increased participation for the Canadian market. This viewpoint is very much correlated with a high level of activity in the US market and an opportunity cost of forgoing US opportunities.

Proximity to the US market can be important where contracts with any one developer cover both the US and Canada. Some developers securing turbines in advance of confirmed projects may ask for the option of supply to Canada should there be no future extension of the PTC. Company resources can also be shared across the two markets, including component supply and the ability to supply the same turbines to both markets. In these respects the market is very much North American rather than one or the other.

The potential for electricity export to the US was mentioned by two respondents as a positive future market indicator. Infrastructure to facilitate this would be a constructive step.

**Tendering opportunities**

Suppliers tend to discriminate across the different utility RFPs – they are not seen as uniformly attractive to all potential participants. A few respondees did not think local content requirements were helpful, or at least that some were more onerous than others. This was a factor in lowering potential RFP participation, although it is difficult to say whether suppliers might be more willing to participate were the market not so supply-led.

**Federal government policy**

This is naturally a factor in so far as market support measures benefit customers. The current hiatus in respect of government policy is a concern for the Canadian market.

**Variable speed patent**

This was an issue for one interviewee.

**Supply bottlenecks**

Current turbine and component supply bottlenecks are affecting the market world-wide, and Canada is no exception to this. One interviewee thought that it was not entirely correct to attribute high prices to supply bottlenecks. They thought that a strong factor has been the need to improve profit margins in the business where prices have previously been unsustainably low.

Bottlenecks appear to have affected companies differently. It has clearly created opportunities for smaller turbine suppliers in a growth phase. For everyone, business is good and resources are stretched. Expansion beyond current plans – for the turbine suppliers and their existing component manufacturers – is for the most part not on the agenda for 2007-08.

There is a potential opportunity for new component suppliers, but the turbine manufacturers need to commit resources to the process of finding and accommodating new sub-suppliers.

**Other influences**

One supplier was influenced by its Canadian provenance, and a consequent allegiance to its home market.

**Trigger events for the Canadian market**

*The questionnaire asked if there were any future scenarios under which supply prospects to the Canadian market might be significantly altered (upwards or downwards).*

A downturn in the US market is universally seen as a trigger for increased activity in Canada.

One supplier thought the passing of Canada's Clean Air Act would alter the whole market upwards in Canada.

Caps on future development, (for instance in Alberta on grid integration grounds) were obviously triggers for a down-turn in the market.

## 4.3 Local Manufacturing

*This section enquired about experiences in scouring local components, and prospects for doing so in the future.*

**Existing experiences**

Several suppliers had first hand experience of sourcing components locally, or of investigating the possibility. One had second-hand experience through a local partner.

The most common locally sourced component was towers, apparently on the grounds of convenience and cost as opposed to any requirement to do so. One supplier reported sourcing towers from Canada for US projects.

Mandating local content through RFPs was not popular – reported component prices were higher and attributed to the captive demand. That said, there was a view that the impetus it provides for component suppliers, especially where supported by government, could establish a longer-term, experienced supply base.

One supplier noted that it simply did not have time to do the groundwork required to establish a price for local components. Similarly established sub-suppliers were extremely stretched and would not have the resources to consider new facilities.

**Future Prospects**

The general view is that local content can be / is feasible in Canada, and will be / is a cost-effective option in the right circumstances. Specialist components such as generators are, not surprisingly, more difficult to source locally, in so far as there are few, if any, known suppliers of these components.

Where there was a local content condition, measures which would assist meeting this were supported – of those suggested, the most helpful were considered to be: support for local component suppliers in meeting supply criteria; a minimum order book (500 MW / year was a generally-agreed guideline minimum although this is very much dependent on circumstances); and financial assistance for component suppliers.

Two interviewees had current plans for setting up facilities in Canada. Others had investigated the possibility but had no firm plans. One noted it had decided to set up facilities in the US, believing there to be a stronger, more certain market for the foreseeable future. Free trade between the US and Canada assists in setting up a facility to supply the entire North American market.

As a general rule, towers and blades are the natural choice for local manufacture. Nacelles are high value for their density and thus exhibit good economics for shipping. Exceptions to these rules include the positive economics of importing cheap towers from Asia.

In terms of helpful conditions for sourcing locally, there was agreement that the presence of established industry suppliers is definitely a plus. Only one supplier thought that local turbine / nacelle assembly was a must for sourcing components in Canada.

## 4.4 Future Policy Developments

*Questions here seek to prompt suggestions for policy change which might succeed in securing reliable and, ideally, local, turbine supplies.*

Of course a stable market and a minimum order book are very encouraging for turbine suppliers. As the previous responses demonstrate, suppliers have different views on the definition of a stable market. Several suppliers specifically noted that they thought the US market *was* stable, despite perceptions to the contrary. Another supplier mentioned that a PTC driven market was not considered stable, and that they are more interested in a market environment with a long-term perspective (i.e. 20 years). Essentially, in a supply-led world market, market prospects in any one country are viewed in relative terms.

The majority support market mechanisms, via mandatory targets, advance commitment to RFPs, standard offer prices and / or tradable credits – essentially mechanisms with which players are familiar. One supplier commented that the new Ontario standard offer price was too low. A couple suppliers thought targets could be counter-productive where they were seen as a limitation, and that a level playing field in the energy market is, in the long-term, preferable to isolated incentives. One went further to say that tender driven markets often reflect political will which may change rapidly and is therefore not considered stable.

Two suppliers were specifically supportive of a standard form of turbine procurement contract, but one of these thought it an unrealistic aspiration.

Canada-wide standardisation of grid code conditions was mentioned by one supplier.

The potential for export of electricity to the US was cited as a benefit by several respondees, as was the consequent need for infrastructure.

# 5 ANALYSIS

Information in this report is on a variety of levels – country- and regional-wide drivers for wind energy, the global market for wind turbines and the differing perspectives of individual turbine suppliers. With interactions within and between these levels, distillation of a clear picture and formulation of recommendations is challenging. This section looks at some basic perceptions of the market and local manufacture, and tests these against material collated.

Any chosen course of action very much depends on the desired outcome and the feasibility of implementing actions.

## 5.1 Supply Bottlenecks

There are bottlenecks in the supply of components and complete turbines, which have been exacerbated by a strong demand for turbines in the US. A number of turbine suppliers report committed production until 2009 and this is understood to be the case for all but, perhaps, those offering relatively unproven technology. It is not impossible to secure turbines now for 2007-08, but this will likely require substantial financial commitment and / or very strong purchasing power.

Production capacity is being expanded, but there appears to be little appetite at present for any additional expansion beyond that planned.

The implications for Canada are:

- Any uncontracted requirements for turbines in 2007-08 are more likely to be met by smaller turbine suppliers. There will be higher risks, and hence costs, of using newer technology. Developers and suppliers may benefit from assistance with “new-entrant” issues such as grid compatibility, securing local contractors etc. The opportunity in this situation is the prospect of advance familiarity with new technology and the prospect for local companies to align themselves with suppliers in a growth phase.

- Any strategy to attract additional local manufacture by some of the more established suppliers to Canada should focus on 2009 onwards.

- While certain components are in short supply, there is no sense that suppliers might be hastened into use of new, unproven suppliers. In fact there is a suggestion that current resource constraints are limiting the extent to which suppliers can work with potential sub-suppliers in accrediting their products. This presents obvious difficulties for any would-be new sub-suppliers in Canada. Efforts to establish as sub-suppliers will need to be carefully targeted to manufacturers with the resources to support their work, with recognition that there is unlikely to be immediate rewards.

## 5.2 The US Magnet

While the US may seem like a magnet for turbines in a supply-constrained market, the corollary for Canada is the opportunity to export both turbines and wind-generated electricity to the US. In placing turbine orders ahead of secured projects, some market participants appear to regard the US as a "safe bet". Similarly, a supplier betting on the Canadian market could regard the US as a safe fallback position. The majority of suppliers interviewed indicated a marketplace for the most part betting on the US, but not to the complete exclusion of the opposite approach.

If the US inevitably attracts turbines when the market is booming, there is an implication that Canada could schedule tendering opportunities to coincide with down-turns in the US market. The risk, of course, is predicting these bust periods or, that they do not occur. Furthermore, is it politically acceptable for Canada to deliberately place itself as a market hedge to its neighbour?

Some observations on the US influence include:

- The influence of the US market cannot be ignored – its effects are felt much further away than Canada. A realistic strategy would be to recognise the US / Canada market interactions and maximise the positive aspects.

- The willingness of participants to commit to the Canadian market is for many dominated by the opportunity cost of forgoing US business. This situation can be expected to last for a further 2 years at least, after which the US market may wane somewhat and when expanded production capacity is on-line.

- For 2007-08, the options would appear to be one or more of
  - (i) Accept the status quo.
  - (ii) Focus attention on participants not overly distracted by the US.
  - (iii) Strengthen the ability of Canadian developers to make early financial commitments to turbine contracts. This could be through some form of public-private sharing of the financial risk. However this will encourage an escalation of the financial commitments required.
  - (iv) Strengthen the purchasing power of Canadian players – measures which might achieve this include pooling purchasing requirements across developers and providing policy commitments to future development pipelines.

## 5.3 Canadian Policy

Uncertainties over the future of the Canadian market are not helpful. Firm policy commitments by governments and the utilities would go a long way towards encouraging investment in the Canadian market. In the survey, turbine suppliers were supportive of policy developments, although there were some differences in the form these might take. Encouraging measures included advance scheduling of RFPs, standard offer contracts with attractive prices, tradeable green credits and mandatory targets.

To a greater or lesser degree, for the turbine suppliers there is probably an element of maintaining appearances. That is, while the US is clearly attractive at present, it would be foolish to appear disinterested in other markets, especially in view of the potential long-term consequences. For Canada, this implies recognition that suppliers' views on Canadian policy may be more the result of being asked, than of serious in-depth analysis.

On the question of the US, if Canada were to explicitly position itself as a hedge against the US oscillations, it would by implication be vulnerable to those same oscillations. Certainly it makes sense to be mindful of the US market, but market stability comes from clear and consistent policy-making and some cause for making long-term financial commitments. In this respect helpful policy measures might include:

- Legislated market support at the Federal level.
- Mandatory federal and provincial policies which indicate intent on the future development of wind energy. The exact mechanism is almost unimportant – the clear intent implicit in an effective mechanism, against which financial commitments can be made, is the most important aspect. Measures could include: translating provincial targets into firm commitments for the utilities; standard offer contracts for a wide range of developments; or a market for tradable green credits.
- Advance planning on the timing of RFPs would give developers confidence in progressing project portfolios and in conducting negotiations with turbine suppliers. Similarly early award of RFP contracts would allow developers to lock in turbine supply contracts.

## 5.4 Local Manufacturing

Canada already hosts some local manufacturing facilities for complete small wind turbines, towers, blades, electrical and control infrastructure. The business case for establishing facilities has been influenced by either the general market or, in the case of the blade facility, local content conditions of the Hydro-Quebec RFP.

A ballpark 500 MW/year is indicative of the sales which would merit consideration of manufacturing facilities for the turbine suppliers – that is, principally blades and nacelle assembly. Tower and blade manufacture are the first natural choice for local manufacture by virtue of the savings in transport costs. Any accepted supplier of high technology components such as generators and gearboxes should be in a very good position to secure orders.

Although Canada could be well placed to secure additional economic benefit in the form of local manufacturing, the current market conditions are not particularly favourable, especially for attracting some of the more established suppliers. Given existing levels of activity in the US, it seems unlikely that any policy changes in Canada will attract a major supplier over the next 2 years. With this in mind, some recommendations for policy makers are:

- Capitalise on existing manufacturing facilities to ensure that order levels are maintained and ideally expanded. Facilitatory actions might include ongoing practical assistance in securing orders, and market measures which can be expected to lead to orders.
- A near-term focus on assisting manufacturers of small to medium-sized turbines.
- A near-term focus on assisting manufacturers of newer technology commercial-scale turbines
- A longer-term focus on developing domestic manufacture of high technology components. Efforts should begin now for results in 2-3 years time.
- A longer-term focus on attracting facilities from the established turbine suppliers, from 2009 onwards.

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