

**ENERGY POLICY IN NOVA SCOTIA:  
ELIMINATING THE BARRIER TO WIND ENERGY  
DEVELOPMENT**

by

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B. Sc., McGill University, 1997

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## **Abstract**

Wind power has environmental and social benefits relative to conventional electricity sources, but electricity market distortions hamper development. Nova Scotia's Energy Strategy in 2002 sought to address these distortions without success.

To determine why some jurisdictions' energy policies are more successful than others, I map the relationship over time between the energy policies of the most successful jurisdictions to their impact on wind power development. These case studies reveal successful policy requires long-term focus, reform of regulations governing project development, public investment in practical research, and strong political commitment to market-pull measures.

Application of best practices in Nova Scotia requires political determination of priorities. Different policy tools have different impacts in terms of cost, equity, employment and wind power development. This study makes explicit the trade-offs of different policy tools for Nova Scotia to facilitate informed decision-making.

## Executive Summary

Concerns over climate change, local air pollution and volatile fossil fuel prices have focused policy makers' attention on the electricity sector. In Nova Scotia, rich coastal wind resources have the potential to provide a clean, renewable supply of electricity, while creating new business opportunities. The Minister of Energy introduced in 2002 a renewed Energy Strategy, "Seizing the Opportunity", to guide the electricity sector towards development of wind power. The Energy Strategy created new financial incentives and reduced regulatory barriers for wind power projects, but ultimately only 0.5% of the total wind power potential in Nova Scotia has thus far been developed. This report identifies the shortcomings of the Energy Strategy relative to international best practices and provides policy advice to facilitate the development of the province's rich wind resource.

To understand why some jurisdictions have successfully developed their wind power potential, I map the changes in energy policy over time to the development of new wind power facilities for the three countries most successful with wind power development. The analysis using a best-practices model revealed that certain policy frameworks are more effective than others in addressing specific barriers and sending appropriate signals to the private development and investment sectors.

### *Key Findings and Recommendations*

- The current Energy Strategy fails to **signal a long-term political commitment to the development of wind power**, which was common to all successful jurisdictions.
- Policy can create stable long-term demand for wind power through either a Renewable Energy Feed-In Tariff (REFIT) or Renewable Portfolio Standard (RPS). Each has differing impacts with respect to cost, equity, employment and rate of wind power development. This report provides a preliminary assessment of those impacts, but **selection from between the REFIT or RPS requires a political determination of relative weights of the impacts.**

- Regulations that impose higher project development costs on wind power plants relative to conventional power plants can be updated to accommodate new intermittent generation technologies. **Changes to regulations governing permitting, interconnection, transmission tariffs and ancillary service charges are low hanging fruit that reduce barriers to wind power development at low cost.**
- Public Research Development and Demonstration (RD&D) investment focused on the site evaluation, financing, construction and interconnection phases of wind project development bestow legitimacy to the industry and foster local business opportunities. **A partnership with academia and the private sector in a Wind Energy Research Facility contributes to keeping the employment benefits of wind power development in Nova Scotia.**

## **Dedication**

To Atsuko, with all my love.



## **Acknowledgements**

I could not have completed this work without the generosity of many kind supporters. Especially to Nancy Olewiler, Kennedy Stewart and John Richards, I extend my warmest gratitude for their patience and insights. Also many thanks to Trevor deBoer and Jeffrey J. O'Brien for their generosity of spirit.

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## Glossary

<b>Term</b>	<b>Definition</b>
Ancillary Services	Services required to support the safe, reliable and stable operation of the interconnected system, including the transmission of electricity from resource facilities to loads and to maintain reliability.
Capacity Factor	The ratio of the average annual power output to the maximum power output of generating facilities.
Combined Cycle Gas Turbine (CCGT)	The combination of combustion and steam turbines to generate electricity from two thermodynamic cycles. Exhaust heat from the combustion turbine is recovered to produce steam to power a steam turbine, resulting in higher thermal efficiency.
Distributor	Entity to deliver electricity to retail customers, generally at voltages lower than 69 kV.
Efficiency	The rate of conversion of a natural resource to useable energy or work.
Federal Energy Regulatory Commission (FERC)	US federal regulator of interstate and international energy transactions.
Gigawatt (GW)	A measure of capacity: 1,000,000,000 watts.
Gigawatt-hour (GWh)	A measure of energy/consumption: 1000 MW for duration of one hour.
Green Energy	The electricity generated from energy conversion systems utilizing low-impact resources. The resources that are typically included are wind, solar, tidal, wave, biomass and small hydro.
Integrated Electricity Plan (IEP)	A system of forward planning of electricity resources to meet forecasted changes in demand. The full range of potential electricity resources are assessed and compared across several criteria.
Megawatt (MW)	A measure of capacity: 1,000,000 watts.
Megawatt-hour (MWh)	A measure of energy/consumption: one MW for duration of one hour.
Nova Scotia Power Incorporated (NSPI)	The vertically integrated monopoly that owns and operates the majority of the generation, transmission and distribution assets in Nova

<b>Term</b>	<b>Definition</b>
	Scotia.
Open Access Transmission Tariff (OATT)	A system of posting and applying transmission charges predictably and without prejudice against private power producers.
Power Purchase Agreement	The contract that defines the terms and conditions by which a utility or load serving entity purchases electricity from a power producer.
REFIT	Renewable Energy Feed-In Tariff. A system of guaranteeing renewable energy suppliers a predictable price for all the power sold to the grid.
Renewable Energy Credits (REC)	Certification provided to renewable energy generators to recognize their generation of positive environmental attributes. One REC is typically allocated to renewable generators for every MWh of electricity produced.
RPS	Renewable Portfolio Standard. An obligation placed on either the suppliers or distributors of electricity to utilize renewable resources for a certain fraction of all energy sales.
Utilities and Review Board (UARB)	Provincial regulator of the electricity industry, specifically to oversee the regulated activities of Nova Scotia Power Incorporated.

# 1 Introduction

Electricity is fundamental to economic and social development. One of the central objectives of energy policy has been to create the economic and regulatory conditions to foster development of low cost and reliable electrical supply to meet a growing demand. In recent decades, the objectives of energy policy have expanded to include the targeted development of environmentally and socially acceptable sources of electricity supply. As the environmental and social characteristics of electrical supply have increased in priority, energy policy in many jurisdictions has been deployed to foster the development of clean, renewable electricity, especially wind power.

Nova Scotia's Ministry of Energy made the decision in 2002 to reform energy policy to develop its wind resources. The challenge to policy makers is how to design policy that will advance wind power development, while at the same time meeting the fundamental energy policy objectives of low-cost and reliable power. This report develops a set of viable policy alternatives for Nova Scotia based on lessons learned from in-depth analysis of case studies in a best-practices model. This report makes explicit the tradeoffs among policy alternatives in terms of the multiple objectives of energy policy in order to facilitate informed political decision-making that prudently advances wind power development in Nova Scotia.

The first section of this report provides a background into the current energy policy framework, wind power potential, and wind power development in Nova Scotia. The Energy Strategy released in 2002 introduces a variety of policy tools intended to facilitate the development of the rich coastal wind resources. Although there has been some limited wind power development in 2004 and 2005, there remains significant room for improvement, which points to a need for further energy policy reform.

The second section describes the range of obstacles found in various jurisdictions that work against wind power development in liberalized generation markets. Policy alternatives must directly or indirectly address these obstacles before wind power development can be



expected to occur. This section also reveals that the current energy policy framework has only partially addressed the obstacles that are manifest in Nova Scotia.

The next section introduces the analytical model that I use to identify the lessons learned from other jurisdictions that have overcome the obstacles in their electricity markets and have successfully developed their wind power potential. The case studies focus on the UK, Germany and Denmark because they have demonstrated success by different measures and through different means. In each case study, I will map the relevant energy policy changes since 1990 to the development of wind power. Examination of the detailed interaction between the policies and wind power development will highlight the relationship between policy and the obstacles in the electricity market.

The fourth section describes the three case studies in-depth and highlights the critical constituents of energy policy that successfully fosters wind power development. The lessons learned from these case studies are assessed for their applicability to the Nova Scotia context.

Based on the lessons learned and their applicability to Nova Scotia, the fifth section outlines the four viable policy alternatives for Nova Scotia. Each alternative is composed of a portfolio of individual policies that complement one another to overcome the obstacles described in section two.

These alternatives are evaluated in section 6 based on their likely contribution to the multiple objectives of Nova Scotia energy policy. In the absence of an unambiguous best alternative, the final recommendation to policy makers is to deliberate upon the relative importance of each of the energy policy objectives to determine which alternative is best.

## **1.1 Evolving Energy Policy in Nova Scotia**

Provincial energy policy is changing the complexion of electricity generation in Nova Scotia. Coal-fired single cycle turbine generation has been the historically dominant form of electricity production by virtue of the low cost of power and the synergies with the domestic coal extraction industries. However, the rapid decline of the local coal extraction industry coupled with a growing national recognition of its pollution and climate impacts has reduced the attractiveness of coal-fired generation as an incremental source of electricity supply. Further, increasing liberalization and privatization in North American electricity sectors create pressures

for changes in utility regulations. In response to these forces, the government of Nova Scotia initiated energy policy reforms in 2002 to drive private sector investments towards environmentally benign and socially beneficial sources of electricity, specifically wind power.

The 2002 Nova Scotia Energy Strategy introduced wide-ranging changes to the way electricity is bought and sold. Since 2002, the balancing of Nova Scotia's supply and demand is managed by the regulated utility, Nova Scotia Power Incorporated (NSPI) through an integrated electricity planning (IEP) process. NSPI is formerly the publicly owned vertically integrated monopoly, but is now privately owned and under regulation by the Utility and Review Board (UARB). NSPI is required to submit annually a 10-year supply and demand forecast to the UARB as part of the IEP process. The schedule of the supply shortfall dictates how much new generation needs to be developed in order to maintain a standard of system reliability. NSPI issues a request for proposals to the private sector, outlining the requirements for new supply. Private power producers submit competing offers in a bidding process. The successful bids are selected by NSPI based on the lowest cost of power<sup>1</sup>. Successful bidders are awarded a long-term power purchase agreement from NSPI, guaranteeing a fixed rate for a stipulated amount of power production.

The Energy Strategy provides regulatory space for NSPI to pursue a voluntary 50 MW wind power capacity target by 2010. The voluntary target enables NSPI to issue a request for proposals exclusively for electricity from wind and other renewable sources of power. The winner of the bidding process is entitled to a premium contract whose price is capped at \$20 per MWh beyond the cost of conventional power. Premium contracts are available only to the first 50 MW of wind or other renewable sources of power.

Wind power producers as of 2002 are also entitled to enter into financial contracts for the purchase of their power with any of the five municipalities that operate their own distribution system. The municipal distributors are small, with a total demand equivalent to 50 MW of wind power, but they represent a viable alternative to NSPI's request for proposal process.

Wind and other green power producers will also be able to enter into direct financial contracts with any retail consumer in Nova Scotia as of 2005. Retail competition will be restricted to green power producers. NSPI will also be able to offer a competing green power

---

<sup>1</sup> Lowest cost of power is the first of several evaluation criteria. The others include financial viability of project proponent team, status of project equity and debt financing, developer's experience, and ownership structure.

product through a green pricing program to retail customers. Retail contracts and green pricing programs broadens the potential customer base for wind power producers beyond the IEP tendering process.

NSPI also streamlined the interconnection process for wind power producers. Through an Open Access Transmission Tariff (OATT), all generators pay predictable interconnection fees, transmission fees<sup>2</sup>, and ancillary fees<sup>3</sup> based on the capacity of the project. The OATT allows wind power producers to predict the costs of interconnection and transmission with greater certainty.

Despite these many changes in energy policy that are designed specifically to stimulate private sector development of wind power, only a few small-scale developments have materialized. Shortly after the introduction of the energy strategy, NSPI erected the first wind energy facilities in Nova Scotia – single wind turbines in two coastal locations with a total installed capacity of 1.2 MW. Development was at a standstill until the installation of two more wind turbines in 2004 at Pubnico Point in southern Nova Scotia, which is the first stage of a proposed 30 MW wind energy facility. The total development in Nova Scotia in 2005 is 4.8 MW, with a total of 32 MW expected to be completed by 2006. This growth in wind power development is very small relative to the Provincial aspirations of meeting a significant portion of the 2000 MW of consumer demand from wind resources.

The absence of wind power development is all the more startling in light of the rich wind resource at the northern tip of the Province and along the entire coastal area. Wind energy facilities in these areas are technically capable of producing electricity at a private financial cost comparable to conventional fossil fuel power sources. Further, wind power from these sites creates more employment and less pollution than power from conventional sources. However, these sites are not targeted for development. Considering the commitment from the Province to facilitate wind power development that is economical, and socially and environmental beneficial, the energy policy framework must be reworked to provide the proper incentives to prospective

---

<sup>2</sup> NSPI, as the transmission system owner, charges annual fees to all generators in order to recover the costs of maintaining the transmission system assets.

<sup>3</sup> NSPI, as the transmission system operator, requires generators to provide or pay for services that are essential for the reliable and efficient operation of the power system. There are five categories of ancillary services, all of which NSPI will provide to generators for a fee. The categories are I) Scheduling, Dispatch and Control, II) Reactive Power and Voltage Control, III) Load Following, IV) Reserve Services, and V) Energy Imbalance.

wind power producers. In this paper I seek to identify policies to remedy the failures of the existing energy policy framework.

## **1.2 Utility Scale Wind Power Production Technology**

Wind generates electricity through wind turbines that face into the prevailing wind direction. A wind energy system transforms the kinetic energy of wind into electrical energy that can be harnessed for practical use.

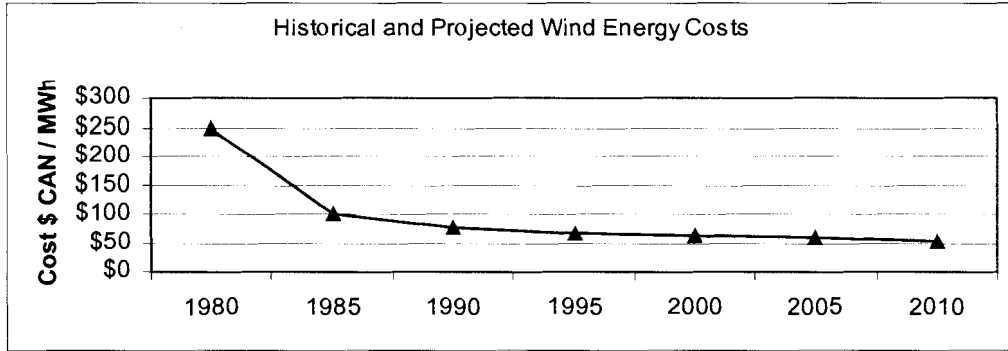
When the wind blows, it causes the rotor blades on the wind turbine to rotate the hub to which they are attached. The rotation of the hub turns a generator that produces electricity. The electricity is transmitted to a transformer at the base of the turbine tower and from there the electricity is transferred to a substation for delivery to the electricity utility's electricity transmission grid. The turbine, tower and transmission facilities to interconnect to the grid can be considered the entire wind energy facility.

The quality of the wind resource is a critical factor in the productivity of the wind energy facility. Most wind turbines begin operating at a wind speed of 4 – 5 metres per second (m/s) and maximum power is reached with wind speeds ranging from approximately 11 – 15 m/s. Wind power production is not feasible in locations where wind speeds never exceed 4 metres per second. Areas with average wind speeds between 6 – 8 m/s will produce approximately 25 – 35 percent of their theoretical maximum power output, which is sufficient to produce power at costs competitive with conventional fossil fuel technologies (Gipe, 2004).

## **1.3 Private Financial Costs of Wind Power Production**

The cost of electricity from utility-scale wind energy facilities has dropped by more than 80 percent since the early 1980s, such that a high-quality wind resource can yield power at a cost competitive with traditional sources. When the first utility-scale turbines were installed in the US, wind-generated electricity cost as much as \$400 US per MWh in nominal terms. Wind energy systems have advanced in terms of materials, aerodynamics and scale, with modern state-of-the-art systems capable of producing power at \$60 CAN per MWh at sites with favourable wind resources (Tampier, 2004). Figure 1 illustrates the trend in technically achievable wind power production costs, which are expected to reach \$30 - \$50 per MWh by 2013 (Kerr, 2005).

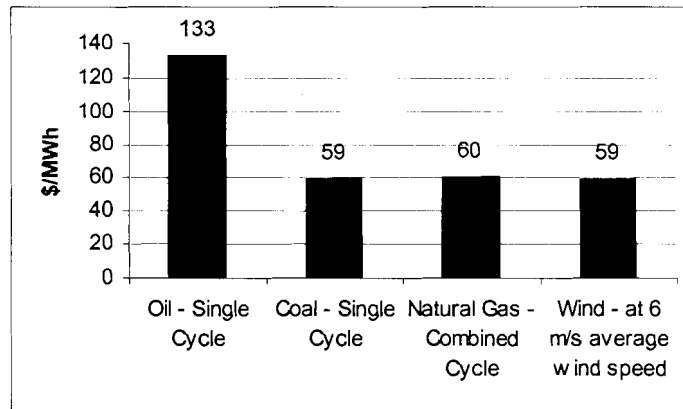
Figure 1 Cost of wind power production at sites with 6 m/s average wind speeds



Data Source: CanWEA, 2004

Wind power produced with state-of-the-art wind turbines in areas with stable winds of 6 m/s or more is economically competitive from a levelized cost of electricity perspective with electricity generated from state-of-the-art fossil-fuel technologies in Canada (BC Hydro, 2004)<sup>4</sup>. Figure 2 illustrates the costs of producing electricity from a range of fossil fuel technologies averaged over the lifetime of the facility. These cost estimates incorporate the capital, land, equipment, fuel, operation and maintenance costs. With the inclusion of project specific costs such as financing, permitting, project development, interconnection, transmission and ancillary service costs, wind power projects tend to demand a premium above conventional power projects. The premium may be as high as \$30 per MWh (Pollution Probe, 2004).

Figure 2 Technically Achievable Levelized Cost of Electricity



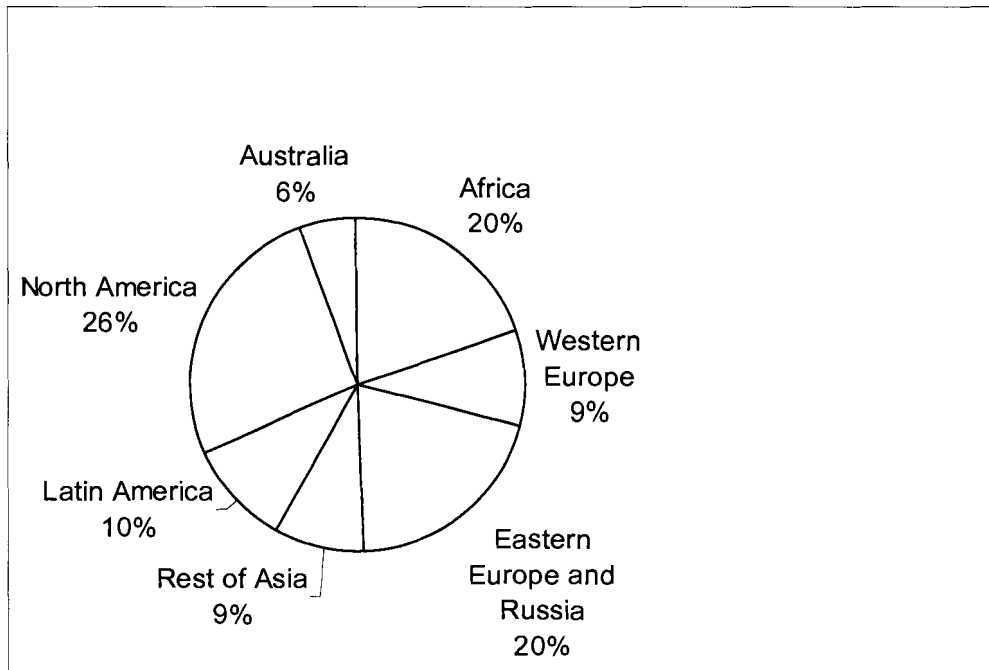
Data Source: BC Hydro, 2004

<sup>4</sup> The levelized cost of electricity, or unit energy cost, reflects the total of the fixed and variable costs of the plant divided by the total energy generated over the lifetime of the facility. The three types of costs – fixed investment, fixed operations, and variable operations – occur in different timeframes and are discounted at 8%, which represents the weighted average cost of capital for BC Hydro, to calculate a net present value of all costs. The energy is also generated in different time periods and this same discount rate is applied to calculate an equivalent net present value of the energy. This calculation does not differentiate between facilities that offer different values of dependable capacity.

## 1.4 Technical Potential of Wind Power in Nova Scotia

Several studies have assessed the potential for wind power potential in various regions of the world. The global wind power production potential was estimated in 1994 at 53,000 TWh/year, or nearly three times the global electricity consumption at the time. This was based on an estimate of the total land area with wind speeds greater than 5 metres per second, multiplied by 90% to account for land-use restrictions, multiplied by a technology factor that represented the optimal arrangement of state-of-the-art wind turbines in those areas. Figure 3 provides a regional breakdown of the wind power potential. It is clear that there is no global shortage of viable wind resources.

Figure 3 Distribution of Global Wind Resource – Total global resource of 53,000 TWh/yr



Data Source: Grubb & Meyer, 1994

In another study in 2004, Hoogwijk et al built upon this land-based approach to identify the regions with economically competitive wind power potential. This study supports the view that there are many populous regions where low cost wind power can theoretically be produced. It is worth noting that Atlantic Canada is among the highly populated regions with access to low-cost wind power.

A third study by Wijk in 1993 included both economic and technical limitations to estimate the wind power potential in Europe. The authors again used a land-based approach, identifying regions in Europe with average wind speeds in excess of 6 metres per second and applying a technology factor based on state-of-the-art turbines optimized for the area. This calculation is identical to the one employed by Hoogwijk. However, a technical restriction based on the maximum penetration of intermittent sources of power into the transmission system is also applied to the calculation. Studies have shown that the stability of the transmission system is likely to be jeopardized if greater than 20% of the electricity in the grid is supplied from wind power<sup>5</sup>, imposing an upper limit on the amount of wind power that can be developed in a jurisdiction. The results of the study are summarized in Table 1.

Table 1 Technical Wind Energy Potential in Europe

	Economic Wind Energy Potential		Technical Potential limited to 20% of 2020 consumption	
	MW	TWh/y	MW	TWh/y
Austria	1500	3	1500	3
Belgium	2500	5	2500	5
Denmark	4500	10	4500	10
Finland	3500	7	3500	7
France	42500	85	42500	85
Germany	64000	124	54000	106
Greece	22000	44	7400	15
Ireland	22000	44	3000	6
Italy	34500	69	34500	69
Luxembourg	0	0	0	0
Netherlands	3500	7	3500	7
Norway	38000	76	20800	42
Portugal	7500	15	5700	11
Spain	43000	86	32000	64
Sweden	20500	41	20500	41
United Kingdom	57000	114	57000	114
Total	366500	730	292900	585

Data Source: Wijk, 1993

<sup>5</sup> System operators have a responsibility to balance the instantaneous demand for power with the supply of power. Through manipulation of the dispatch from individual generators or the controlled curtailment of demand, the system operator is able to achieve this balance despite some sources of supply having a variable output from moment to moment. The capacity of the system operator to manage the system in response to intermittent resources is considered fully taxed when intermittent resources comprise 20% of the total system consumption. The 20% threshold is an approximation based on generic system models, and may only approximate the genuine threshold in Nova Scotia.

Wijk's approach to combining wind speed data with technical limitations can be applied to Nova Scotia to estimate the Province's technical wind power potential. Figure 6 illustrates the distribution of the wind resource and transmission infrastructure throughout the province. A large area at the northern tip of the province has wind speeds in excess of 10 metres per second, which is an exceptional resource. In addition, the coastal areas of the province have a thin beltway of land with wind speeds greater than 6 metres per second. A coarse estimate of the total land area with wind speeds greater than 6 metres per second is approximately 100 km<sup>2</sup>. State-of-the-art wind turbines can be configured to extract approximately 14 MW of power per square kilometre (Institute for Energy and Sustainable Development, 1998). The raw technical wind power potential is therefore approximately 1400 MW. Assuming a capacity factor of 30% (Pollution Probe, 2004), the total electrical output from cost-effective wind power projects is approximately 3,700 GWh annually.

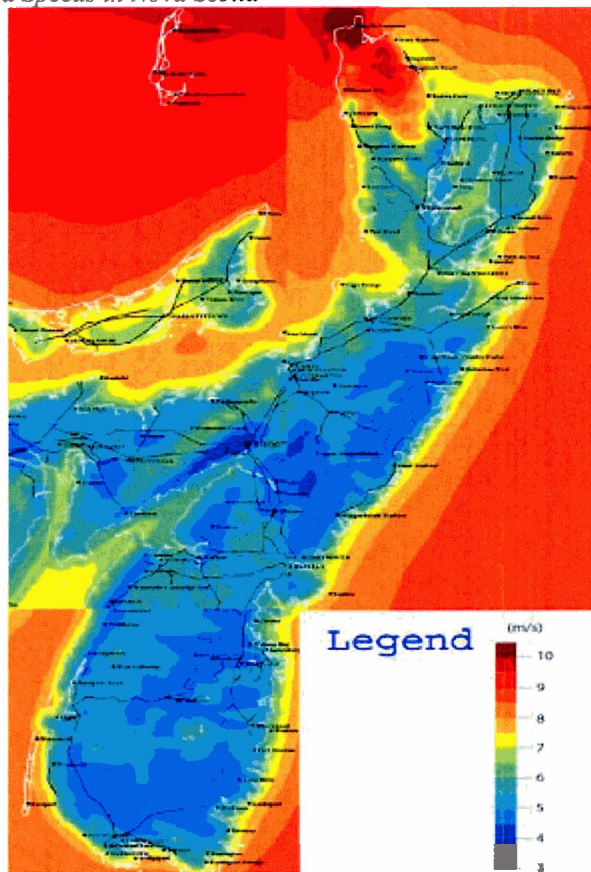
Given the world-class quality of the resource in Nova Scotia, the total potential for wind power is limited by the technical capacity of the grid. The total consumption in Nova Scotia in 2000 was approximately 11,000 GWh (Ministry of Energy, 2001). With a projected annual growth rate of 0.8% (Navigant Consulting, 2004), the total consumption by 2020 will be approximately 13,000 GWh annually. Considering the 20% technical constraint on all intermittent sources, the maximum output from wind power by 2020 that can be accommodated in Nova Scotia is 2600 GWh, or 980 MW of capacity<sup>6</sup>.

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<sup>6</sup> The 20% technical limitation can be expanded if the power exports are increased. In Nova Scotia, all exports must flow through a single high-voltage intertie with New Brunswick, which then interconnects with various Northeastern US jurisdictions. The export capacity of this intertie is 350 MW, however, utilization of the export capacity requires instantaneous load-shedding from the NSPI's Lingan coal plant. Exporters who wish to reserve transmission capacity across the New Brunswick intertie must provide compensation to NSPI. Without the load-shedding scheme, the export capacity is reduced to 75 MW. Considering the limited scale of export transmission capacity in the immediate term, 20% of domestic consumption will be considered a hard cap on the total wind power development potential.



Figure 4 Average Wind Speeds in Nova Scotia



Adapted from: Environment Canada ©, by permission

This section has illustrated that Nova Scotia has the potential to develop 980 MW of wind power that is cost-competitive with conventional sources of energy, that also yields significant environmental and social benefits relative to conventional sources of energy. Provincial energy policy should therefore strive to create the appropriate environment that would bring about the development of the entire 980 MW of wind power potential. However, the energy strategy has thus far only succeeded in fostering the development of 4.8 MW of wind power, or less than 0.5% of the potential. Clearly, there is a gap between the stated objective of energy policy to facilitate development of wind power, and the capacity of energy policy to deliver upon that objective. The following section will examine the obstacles that remain in Nova Scotia's electricity market that are holding back the development of wind resources.

## **2 Obstacles to Wind Power Production**

The survey of wind resources in Nova Scotia has revealed up to 980 MW of cost-competitive wind power, but more than 99% of that potential remains untapped. Why has Nova Scotia been so unsuccessful in developing the indigenous wind power potential? Owing to distortions in the electricity market, wind power producers often face higher project development costs relative to established and well-understood conventional generation technologies, thus the competitive generation market is not a level playing field (EWEA, 2004). This is true not just for Nova Scotia, but also in jurisdictions throughout North America and Europe (EWEA, 2004). It is important for policy makers to understand the type and magnitude of the barriers in order to craft appropriate policies to overcome them. This section explores these distortions and seeks to quantify the financial burden they impose on private wind power producers.

Three classifications of distortions are described below. The first distortion – environmental and social externalities – fails to provide appropriate cost signals to private wind power developers to meet the objectives of energy policy. The remaining distortions – imperfect regulations and imperfect information – impose costs on wind power projects and put them at a disadvantage relative to mature and conventional power projects. Wind power development is unlikely to occur in the presence of these distortions, given the tendency of market investment to focus on the private financial dimension (Jaccard, 2001).

### **2.1 Environmental and Social Externalities**

In the absence of policy supports, the revenues for private developers of wind power are limited to those generated from the sale of the electricity commodity. The production of wind power also generates environmental and social benefits, such as emission reductions, power portfolio diversity, and local employment opportunities relative to conventional power. The value of these positive attributes is not passed on to the developer through the electricity markets because they have the character of public goods. In Nova Scotia there is no policy mechanism that internalises the social and environmental impacts from the various power production

technologies<sup>7</sup>. The following subsections describe the three forms of externality – environmental, power diversity, and economic development in terms of employment – and estimate their total value between \$10-\$230 per MWh of wind power.

### **2.1.1 Environmental Externality**

Wind energy facilities do not produce greenhouse gas emissions or local pollutants associated with respiratory illness, smog and acid rain in the course of operation. The manufacturing and installation of wind turbines is mildly emission intensive, but the lifecycle impacts of wind power are a fraction of the lifecycle impacts of fossil fuel based generation. The total footprint of a wind energy facility tends to be very large per unit of power production capacity, but turbines and access roads require only a small percentage of the total land area. The rest of the facility site is available for other uses, such as agriculture, pasture, industry and recreation. Wind energy facilities have been known to have other negative impacts on the environment, such as noise, bird kills and loss of aesthetic value, though this can be largely eliminated through proper siting of the facilities<sup>8</sup>. In all, wind energy facilities can be environmentally benign provided they are located in regions where the facility footprint can be utilized for other purposes and away from areas with high concentrations of migratory birds and aesthetic value. In the context of Kyoto Protocol and the Federal targets for reductions in nitrous oxides (NOx) and sulphur oxides (SOx), wind power delivers significant environmental benefits relative to conventional fossil fuel based power.

The value of the benefit to be obtained from carbon dioxide reductions is dependent on which other generation method wind power is substituting for. Table 2 shows a range of carbon dioxide emission levels for different fossil fuels. On the assumption that coal and gas will still account for the majority of electricity generation in 20 years' time – with a continued trend for

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<sup>7</sup> At the federal level, there are three programs that provide incentives to wind power producers outside of the provincial framework. The Wind Power Production Incentive provides \$10 / MWh directly to wind power producers; the Canadian Renewable Conservation Expense allows for the write-off of project development fees; the Tax Act allows for accelerated depreciation of wind turbine equipment. All three of these programs are designed to enable the infant wind energy market in the short term, rather than to explicitly recognize the social and environmental externalities.

<sup>8</sup> Several experimenters have attempted to reduce the environmental impacts through innovative turbine and facility designs. For example, turbines have been painted with large black circles in efforts to have them 'fit into' existing cattle pastures. Controlled experiments have shown that these inventive measures do not significantly mitigate aesthetic and environmental impacts. However, the impacts for facilities sited away from bird migration paths or areas of significant scenic value can have very little impact in absolute terms. The number of bird kills attributed to a wind turbine sited away from major migratory bird paths is equivalent to the number of bird kills attributed to a typical barn located at the same site.

gas to take over from coal – it makes sense to use a figure of 600 tonnes per GWh as an average value for the carbon dioxide reduction to be obtained from wind generation (EWEA, 2004).

*Table 2 GHG Emission Intensities for various types of generation*

<b>Fuel Type and Technology</b>	<b>GHG Emission Intensity</b>
Coal, Various Technologies	751 – 962 tonnes CO2 per GWh
Oil (Single Cycle)	726 tonnes CO2 per GWh
Gas (Combined Cycle)	428 tonnes CO2 per GWh
Wind	0 tonnes CO2 per GWh

*Data Source: BC Hydro, 2004*

Many studies have been carried out to determine the social value of GHG abatement. The literature suggests a range of damage costs and abatement costs between \$3 per tonne and \$150 per tonne of GHG, with most calculations between \$10 - \$20 per tonne of GHG (Tol, 2004). A conservative estimate of \$10 per tonne of GHG abated reveals that the GHG externality alone is worth \$6 / MWh from a social perspective.

Several studies have sought to calculate the value of the entire environmental externality for various electricity sources based on damage costs. The Extern-E project – an ambitious 15-year project to calculate the environmental externality in all EU countries – released results in 2002 for the major electricity sources in the UK.

*Table 3 Total Environmental Externality for various fuel types*

<b>Fuel Type</b>	<b>Total Environmental Externality (\$Can)</b>
Nuclear	\$3.4 – 11.9 per MWh
Coal	\$34 – 255 per MWh
Gas	\$17 – 51 per MWh
Wind	\$2.6 – 4.3 per MWh

*Data Source: Extern-E, 2002*

The results of the Extern-E study of UK externalities from the electricity generation sector are summarized in Table 3. These results reveal that the environmental externality of coal-fuelled power may be as high as \$255 per MWh, while the environmental externality of wind power may be as low as \$2.6 per MWh. If wind power is used to offset incremental or existing coal power, the environmental value attributable to wind power is as high as \$252 per MWh. Damage costs from particulate emissions, which are a significant contributor to the externality of

coal, are higher when the source is located close to highly populated regions. The population density in Nova Scotia is far less than it is in the UK, therefore these estimates are likely higher than the true value in Nova Scotia. However, it is worth noting that incremental wind power in Nova Scotia offers an avoided damage cost savings between \$10 - \$200 per MWh depending on whether coal or gas is the business-as-usual source of incremental supply.

### **2.1.2 Power Portfolio Diversity Externality**

Market and technical shocks threaten the cost and viability of electrical systems that are dominated by a single electrical resource. Shocks can be split into several categories, notably price, quantity and technology. Price shocks are the most common: for example, the rapid increase in the price of natural gas in 2000 – 2002 that threatened to strand low-efficiency natural gas generators. Quantity shocks relate to physical constraints, such as transmission system bottlenecks that limit the quantity of electricity that can be sold. Technology shocks relate to new concepts and ideas, to failures (for example, the discovery of nuclear design faults), or to new constraints (for example, the unanticipated technical advantage of nuclear power over coal with the discovery of the climate change problem).

Diversity in the forms of electrical supply naturally reduces the impact of any one shock through a portfolio effect. Risks are spread in financial markets by diversification, and by extension, so too in electricity generation. The amount of insurance worth purchasing through diversification depends upon the scale and probability of the threats. It is therefore context-dependent. In the UK 20 years ago, the threat from unionized coal miners drove the national policy shift towards natural gas facilities.

The social value of the power diversity attribute of wind power in the Nova Scotia context has not been calculated. Coal generation dominates the Nova Scotia electrical supply, providing 80 percent of the total power production. Hydro power provides 9 percent; natural gas and heavy oil fuelled generators produce 11 percent. The relative dependence on coal, with an increasing proportion of natural gas, may expose Nova Scotia to market and technical shocks.

Examination of the potential shocks to the Nova Scotia system – quantity risk associated with coal, price risk associated with natural gas, and technology risks associated with climate change penalties – reveals that none are of substantial value. The availability of coal in Nova Scotia may be falling as mining operations have closed over recent years, but the technical and

labour capacity exists domestically to respond quickly to an increase in demand through a reopening of existing mines. Nova Scotia has relatively few natural gas power plants and thus has relatively little exposure to the volatile natural gas market. Climate change penalties are an imminent reality in Canada in the wake of the Kyoto protocol, but this risk has been considered explicitly in the preceding section on environmental externalities. The value of the power portfolio benefit in Nova Scotia is likely negligible.

### **2.1.3 Socio-economic Development Externality**

The contributions of wind power development towards social economic development are difficult to quantify. The literature asserts a variety of social economic benefits from wind power that are external to the private cash flows of the wind power producer. First, wind resources tend to be located outside of urban areas and may provide opportunities for industrial growth in rural areas. Exports from a vibrant wind power industry in terms of manufactured equipment and expertise have been a significant social benefit in Denmark and Germany (EWEA, 2004). Wind power has also been characterized as a gateway technology, whose deployment will reduce the costs of power conditioning and interconnection for other intermittent renewable sources of electricity (EWEA, 2004). Finally, wind power is labour intensive relative to conventional fossil-fuel power, and the employment in areas of chronic underemployment can be seen as a significant social benefit. All of these socio-economic benefits are valuable from the social perspective, but externalized from the private financial accounting.

The difficulty in monetizing these benefits stems from the difficulty in calculating the impacts from wind power development relative to business-as-usual development patterns that exclude wind power. One exception may be the employment benefit, which has been the subject of study in Denmark. Employment in the wind industry and supplying sectors has been estimated at 22 man-year/million dollars in capital in 1998 (Oleson, 2000). In addition, operation and maintenance (O&M) of the turbines is estimated to create 17 man-year/million dollars of O&M. In order to determine the employment benefit of wind power, the decrease in employment in the conventional power sector must also be accounted for. The employment in fossil fuel power plant construction is estimated at 21 man-year/million dollars, the operation & maintenance is estimated to be 8.1 man-year/million dollars of O&M, and employment in fuel supply is estimated to be 1.9 job-year/million dollars of fuel costs. It is difficult to directly compare the employment created from investment in a wind power plant relative to a natural gas plant because

the operating regimes are categorically different for the two types of plants. However, it can be said that wind power is slightly more labour intensive in the construction phase and significantly more labour intensive in the operations and maintenance phase per unit cost relative to conventional power.

Although it is clear that investment in wind power indeed creates more employment than an equivalent investment in conventional power, it is not clear what is the social value of that extra employment. Incremental employment is a social benefit only to the extent that the wages offered are greater than the opportunity cost of the prospective labourers. An analysis of the opportunity costs of Nova Scotia labourers is beyond the scope of this study. Further, an estimate of the percentage of new wind power jobs captured by Nova Scotia residents is also outside the scope of this study.

In summary, incremental wind power development is capable of generating additional employment in Nova Scotia, although an estimation of the social value is beyond the scope of this study. In the short-term, Nova Scotia is likely to capture a zero or negligible social benefit from wind power because most of the turbine manufacturing jobs will be sourced internationally. If Nova Scotia were to develop turbine manufacturing facilities, the social benefit is likely to be more substantial over the long term. Considering the importance of employment in the Nova Scotia context, the potential of additional employment should be deemed significant.

## **2.2 Imperfect Regulation**

The electricity market typically consists of three parts: generation, transmission and distribution. Historically, a single vertically integrated monopoly utility spanned all three markets, regulated to serve the public interest. Contemporary liberalized energy markets are characterized by a competitive generation market, but the transmission system remains under the control of a regulated natural monopoly utility. The end customers of the production from the generation market reside within the distribution market, but the transaction must be mediated through the regulated utility. Regulations are critical for ensuring the utility manages the acquisition of new supply in a manner that serves social interests.

There is evidence that electricity regulations in liberalized generation markets are discriminatory against wind power producers. The nature of wind power is such that the size of the projects tends to be of smaller capacity relative to conventional power plants; good wind

resources tend to be located away from urban areas and transmission system corridors; the power output is intermittent; and utilities have very little experience with it. Regulations have been slow to adapt to the peculiarities of wind power, and impose requirements and costs on wind power producers beyond what is technically required (Kerr, 2005). Discriminatory regulations can be categorized as follows:

- **Onerous Technical Requirements.** NSPI requires assurance that all new generation facilities are compatible with the transmission grid. Wind energy facilities must meet requirements for protective equipment, safety measures, and custom engineering analyses. Proponents of wind energy facilities claim these technical requirements of interconnection are unnecessarily costly and duplicative (Alderfer, 2003).
- **Arbitrary Interconnection and Grid Service Fees.** Regulations require new generation facilities pay fees to compensate the utility for interconnection services and for provision of standby dependable capacity. The size of these fees has been characterized as arbitrary and disproportionate to the impact from wind power projects. Interconnection fees in Nova Scotia are based on the capacity of a project, which can be seen as discriminatory against intermittent power producers like wind (Tampier, 2003). Although a grid service fee may be appropriate for intermittent power producers, evidence has shown that the fees typically charged are higher than the cost of providing the grid balancing services (Tampier, 2003).
- **Uncertainty in the Planning Process.** Unlike fossil fuel deposits, wind energy sources are unregulated in Nova Scotia. They are subject only to general business and consumer laws (Ministry of Energy, 2001). As such, there is little structure to guide proponents of wind power projects through the land use application and permitting procedure. In the absence of structure, it is impossible for the wind power developer to determine the costs associated with permitting before the process is initiated. There is no data from within Nova Scotia, but total costs of negotiating the permitting process for wind power projects has varied widely in other jurisdictions. This uncertainty adds unnecessary risks, and therefore costs, to the projects.

The argument put forward here is that the costs imposed on wind power generators for permitting, interconnection and transmission are higher than they would be if wind power were to have the mature regulations that benefit conventional power sources. It must be acknowledged



however that the costs to the utility for interconnection and transmission services may indeed be higher than for conventional services because of the intermittent nature of the wind resource. Nonetheless, the regulations in place that successfully facilitate conventional power impose large penalties on wind power producers beyond what is technically necessary. The cost impact of the discriminatory regulations is more severe for smaller wind projects. Quantification of the impact in absolute terms is beyond the scope of this study.

## **2.3 Imperfect Consumer Information**

The rate of change in electricity markets tends to leave consumers in the dark in terms of their options and their interests. Despite broad social surveys indicating unequivocal support for clean renewable power, that support has not been well expressed in the electricity markets owing to a lack of clear information about available opportunities to support wind power. Also, public opposition in the planning and permitting stage has been a significant barrier to wind power in numerous jurisdictions, often associated with a lack of public understanding of the environmental impacts from wind power facilities (Kerr, 2005). The lack of information among consumers and communities is a significant failure of the competitive electricity market.

The Nova Scotia energy policy has created opportunities for end-consumers to express their demand for wind power through two programs. Through a NSPI Green Pricing Program, end consumers can voluntarily pay premium prices for their power. Also, end-consumers can choose to purchase their power from green energy retailers. Both of these programs were introduced in 2004 but have not yet been implemented. Consumer understanding of how these programs contribute towards development of new wind power supplies in other jurisdictions is low (European Renewable Energy Council, 2004), which results in low consumer demand.

Public opposition to the permitting of new wind power facilities is to some extent fuelled by a lack of information. Opposition tends to voice concerns over environmental impacts from new development, especially related to bird kills. Wind power development does indeed have impacts; however, the impacts of individual developments vary widely depending on the care with which new facilities are sited. New wind power developments that are sited in major bird migrations routes have killed thousands of birds per year<sup>9</sup>, although recent studies of new wind

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<sup>9</sup> The first large-scale wind turbines in North America were sited within a major migratory bird route and raptor hunting ground in coastal California. The obvious impacts of bird populations from these first developments fuelled public opposition to wind power development internationally.

power developments on the eastern coast of the US indicate that wind turbines can have negligible avian impacts if sited outside of migratory of bird routes. The environmental assessment regime for all new wind power developments<sup>10</sup> ensures that they are sited with care, and thus minimize avian impacts, by requiring proponents to map avian migration routes near the facility site. Provision of accurate information about bird impacts from new facilities would reduce the opposition to new developments, and reduce the costs associated with the permitting process.

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<sup>10</sup> All wind power projects that seek participation in the federal Wind Power Production Incentive program must undergo a federal environmental assessment. For all intensive purposes, all the near-term wind power projects can be expected to undertake the assessment.

### 3 Analytical Model

In section 2, it has been shown that there are barriers to wind power development in Nova Scotia in the form of external environmental and social benefits, discriminatory regulations, and deficiencies in public information. In the presence of these obstacles, private developers are reluctant to invest in wind power. In various international jurisdictions, public policy has been used to eliminate or compensate for these obstacles by providing incentives to the private wind power development community. In effect, energy policy tools are independent variables that influence the rate of wind power development by reducing or compensating for the obstacles. This section will first introduce the types of energy policy tools that have been used internationally, and the types of obstacles against which they are effective.

The literature on international wind power development makes frequent reference to the profound relationship between changes in energy policy and changes in the rate of wind power development. The analytical model I use to explore this relationship is a best-practices model, in which the changes in the use of energy policy tools are mapped to changes in wind power development rates over time for the three jurisdictions with the greatest success in wind power development. This section will conclude with a survey of global wind power development to identify the jurisdictions most relevant to this study.

#### 3.1 Independent Variables – Energy Policy Tools

Various jurisdictions have employed a wide range of policy tools to address these market distortions in order to advance the development of wind power. The various types of tools can be segregated into three categories, each aimed to compensate for one of the three market distortions. To compensate for externalities, **Fiscal Policy Tools** reduce the capital costs of new projects or increase the prices paid for power. To correct the regulatory discrimination against wind power, **Regulatory Policy Tools** level the competitive playing field between wind power and competing sources of power. To bridge the public awareness gap, **Public Information Tools**

increase public awareness of the benefits, costs and opportunities associated with wind power. The types of tools within these categories are listed in table 4.

*Table 4 Policy Types to Support Wind Power*

Fiscal Policy Tools	Feed-In Tariffs / Guaranteed Prices Obligations Tradable Renewable Energy Certificates Capital Grants & Investment/Property Tax Credits Production Tax Credits/Incentives Third-Party Finance/Soft Loans
Regulatory Policy Tools	Green Pricing Wholesale/Retail Competition Permitting, Land Use and Interconnection Codes and Standards Rationalization of transmission & ancillary service charges
Public Information Tools	Public Awareness Campaigns Research, Development & Demonstration.

### 3.1.1 Fiscal Policy Tools

Fiscal policy tools use government sponsored grants, loans or incentives to increase the price paid for wind power or decrease the costs of generating wind power. For example, **capital grants** from government in support of wind energy facilities were a hallmark of German and Danish energy policy throughout the 1990s. The grants were technology and project-size specific, and limited to a percentage of the total capital cost of the project. **Research, Development & Demonstration** programs have also often provided funding to reduce the capital cost of wind energy facilities in innovative applications.

The government may reduce the cost of financing or assume some of the project risk through provision of **third-party financing** arrangements. National banks may provide loans to wind power developers at rates below the market average, or alternatively banks may guarantee the cash flow of a project, which reduces the risk to investors and reduces the costs of project finance. Government-sponsored lending schemes have been one of the most effective measures in Germany in driving wind power development (Johnson & Jacobsen, 2000).

Tax measures can also be used to reduce costs of the production facilities or to reduce risk to the investors. **Property tax exemptions** and **investment tax credits** reduce the tax burden for project owners. In the Canadian Renewable Conservation Expense tax credit, the project development expenses are tax deductible. The tax credit can be flowed through to

individual investors, guaranteeing them a tax benefit even if the project fails to generate taxable revenues.

**Feed-in tariffs**, or guaranteed prices, have been adopted in several European countries. The tariff is usually administratively determined, and may be fixed for long periods or decline over time. A guaranteed price system, supported by complementary utility regulation, is seen as the main impetus behind the development of wind energy facilities in Denmark (OECD, 2004).

Premiums above the wholesale price of conventional power can also be provided through **production tax credits**, which utilize the federal tax system to deliver a subsidy to the wind power producer. In the US, the production tax credit supported by complementary utility regulations has spurred substantial new wind power development

The success of these premium pricing mechanisms to influence private investment decisions depends on whether the level of the premium is sufficient to compensate for the additional costs of the wind energy facility relative to other market investment alternatives. These mechanisms rely on administrators to set the premiums, which may be less than the wind energy facility requires. None of these mechanisms guarantees any new wind power development.

In comparison, administrators may choose to set the quantity of wind power production rather than the price of wind power production through **obligation** mechanisms. A common form of obligations is the **renewable portfolio standard (RPS)**, where distributors are required to provide a set quantity of their generation or capacity from renewable sources. **Tradable renewable energy certificates** may be used to track the compliance with the RPS, while reducing the overall cost of compliance. In effect, wind power producers generate both electricity and tradable renewable energy certificates, which can be separated to produce two revenue streams. The value of the certificate will rise and fall with the supply and demand for them. An effective obligation system will set the quantity of renewable power production in line with the jurisdiction's total resource potential.

### **3.1.2 Regulatory Policy Tools**

Regulatory policy tools seek to create a level competitive playing field for wind power in relation to conventional forms of power. **Permitting and Land Use Procedures** can be streamlined such that project proponents and municipal zoning authorities have a common

understanding of what constitutes an appropriate project. For example, German federal agencies assisted municipal planning councils to integrate wind power targets into their planning process, facilitating the permitting of acceptable wind power projects. Similarly, **Interconnection Standards** can be streamlined and made transparent to new developers, reducing uncertainty and costs. **Transmission and Ancillary Service Tariffs** can be rationalized to recognize and accommodate the unique character of intermittent wind power at a minimum system-wide cost.

Regulations may also facilitate the voluntary purchase of wind power at premium prices. Within the consumption market there may be a latent demand for wind power, but the nature of the segregated market makes the transaction between individual consumers and suppliers difficult. **Green Pricing** programs are mechanisms by which utilities offer consumers the opportunity to pay premium rates for their electricity to support wind power. The premium may represent all of the incremental cost to the utility to procure wind power beyond the lowest cost marginal source of supply, or the utility may top-up the premium from general revenues to procure a sufficient quantity of new wind power supply. The utility essentially becomes the agent for consumers who wish to support incremental wind power production.

In some liberalized energy markets with competitive generation, the monopsony position of the utility may create principal-agent problems. These can be overcome through market restructuring. **Wholesale market competition** introduces the possibility for new financial relationships between generators and distributors directly. Distributors are free to compete with the central utility and each other for the most attractive sources of power. Similarly, wind power producers have a broader community of potential buyers for their power. **Retail market competition** allows generators to enter into financial relationships with end-consumers directly, bypassing the utilities and distributors entirely.

### 3.1.3 Public Information Tools

**Public awareness campaigns** to educate community groups of the impacts of wind power projects have been shown to reduce public resistance to new wind power generation (Fouquet, 1998). Examples of these programs include media campaigns, event-sponsorship, and formal training programs. Misconceptions of the noise and wildlife impacts from wind energy facilities have fuelled opposition and have imposed costly permitting delays on projects that have undertaken appropriate steps towards impact mitigation. Public education about the genuine

impacts and the regulatory protections already in place to reduce the impacts will minimize the time and expenses incurred in the permitting process.

Rather than a strictly voluntary participation in green pricing program, the government can commit its agents to participate through **government purchasing** programs. Leadership by example may spur other consumers to participate, and provides legitimacy to the wind power industry. **Research, Development and Demonstration** is another instrument through which the government can signal support and provide legitimacy to the wind power industry, while disseminating knowledge among private and public entities.

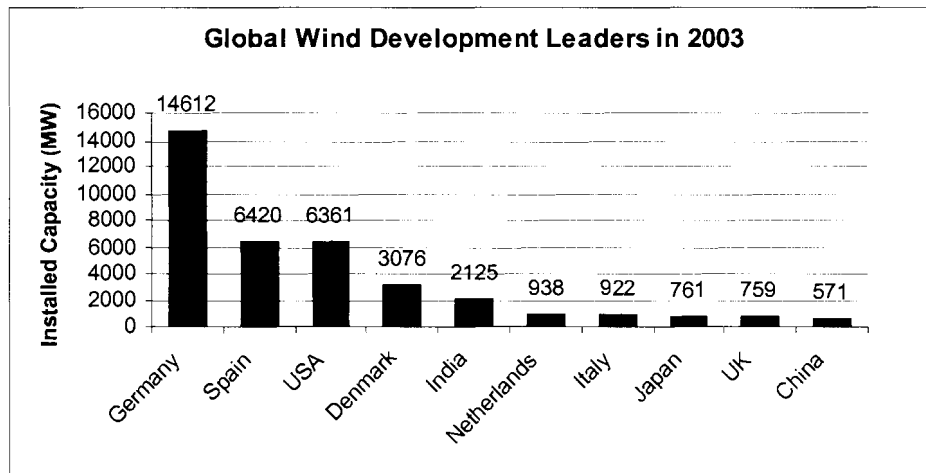
### **3.2 The Model – Case Studies of International Best Practices**

The approach of this paper to gauge the effectiveness of the various policy tools in addressing the market distortions will be through an examination of best international policy practices. For each case study, I will map the relevant energy policy developments since 1990 to the development of wind power. Examination of the detailed interaction between the policies and wind power development will highlight the relationship between policy and the pre-existing distortions in the electricity market.

It is difficult to develop a universally applicable policy prescription because the multiple objectives of energy policy may vary among jurisdictions. Also, the severity of the market distortions may vary across jurisdictions (EWEA, 2004). The result is that some policy tools will be more appropriate for some jurisdictions than others. In order to determine what policy tools are appropriate for Nova Scotia, first the generic relationship between policy tools and barriers must be established. This analysis first identifies that relationship through detailed historical observations of energy policies and their results. Once the policy-development relationship has been established, I identify the specific policy tools that are relevant to Nova Scotia based on the objectives of energy policy and the characteristics of the province.

To identify jurisdictions that are likely to provide important insights as to the efficacy of the various policies, it is useful to start with the jurisdictions that have had the greatest success at developing wind power. Figure 6 presents the wind power development in the ten leading wind power jurisdictions as of 2003. Germany has the largest installed wind power capacity, representing nearly 40% of the global total. The singular success of the German policy environment to foster wind power development will form one of the case studies for this paper.

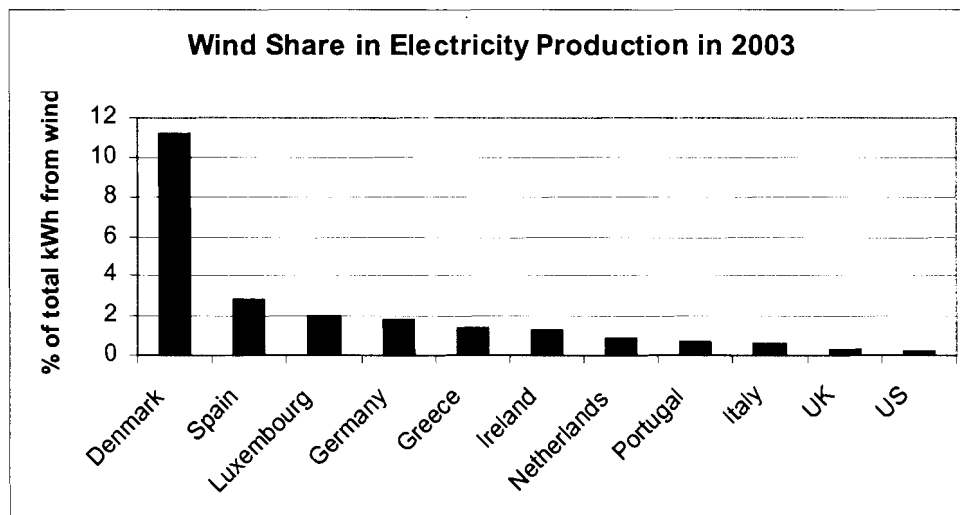
Figure 5 Global Wind Development Leaders



Data Source: IEA, 2004

Another measure of successful wind power development is the percentage of the total electricity production in kWh from wind power. Figure 7 depicts fraction of total electricity production from wind power for the global leaders in this metric. Denmark is the clear leader in this respect, with a total penetration of nearly 12%. From this perspective, Denmark can be seen as having achieved a successful wind power development environment worthy of study.

Figure 6 Wind Share in Total Electricity Production

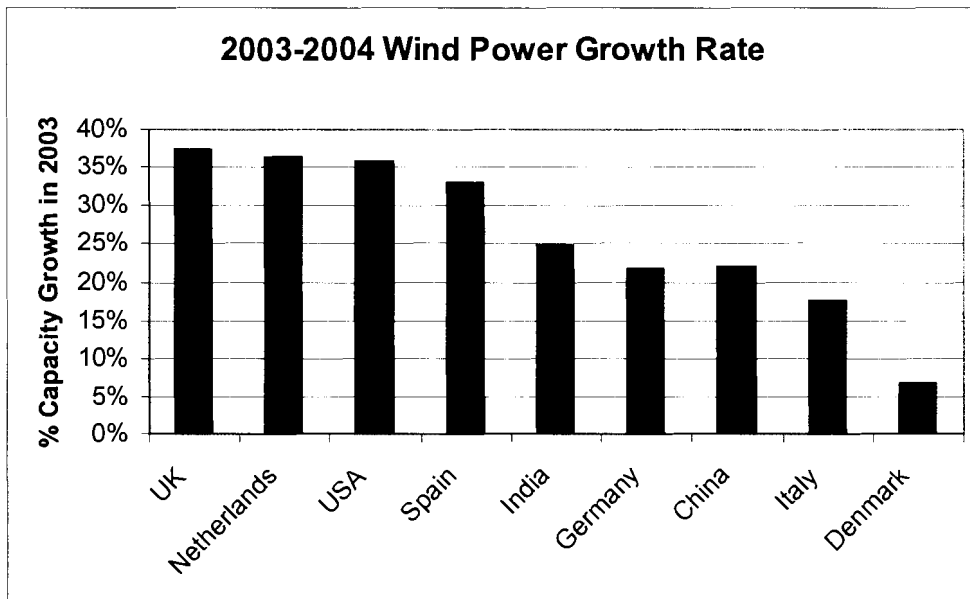


Data Source: IEA, 2004 & Platts, 2002



A third perspective from which success can be viewed is the rate of wind energy development growth. Figure 8 illustrates the rate of growth of wind power capacity during 2003 for the global wind development leaders. The UK exhibits the highest rate of growth, expanding from an installed capacity of 552 MW at the start of 2003 to 759 MW at the end of the year. The contemporary UK policy environment, which fosters high rates of growth, is also worth observing.

Figure 7 Wind Power Growth Rates during 2003



Data Source: IEA, 2004 & Tampier, 2004

Spain, the USA and the Netherlands all exhibited comparable rates of growth to the UK, but several factors make the UK an especially interesting case study within the context of developing policy recommendations for Nova Scotia. First, the UK has a wind resource profile similar to Nova Scotia's. The coastal areas around the circumference of the UK have some of the premier wind resources in Europe, which is similar to the situation of Nova Scotia in the Canadian context. Further, the development of wind power in the UK was disappointing throughout the 1990s considering the wealth of the resource. UK energy policy is interesting as much for its failures as for its recent success in alleviating the market distortions.

The three case study jurisdictions are substantially different from Nova Scotia, and these differences may challenge the relevance of the lessons learned. All three case study jurisdictions

are larger in terms of geographical size, total electrical demand, and population than Nova Scotia, and therefore a policy tool shown to be effective in the three case studies may not be effective in Nova Scotia. However, there are two arguments that support the relevance of lessons learned from these large jurisdictions. First and foremost, wind power development is a global industry. Jurisdictions, even the smallest, compete with the largest and most successful for new investment from global wind power developers. Therefore, policies that create an attractive investment environment for wind power developers in any one country are likely to be effective in another. Second, the interprovincial and international integration of North American electricity systems increase the effective demand for electricity in small jurisdictions. The Nova Scotia transmission system is interconnected with the large electricity markets in the Atlantic US through the New Brunswick grid. The capacity of Nova Scotia-New Brunswick intertie is currently limited, but in future the trade capacity to New Brunswick or directly to the US may be enhanced to dramatically increase the effective demand. By virtue of the demand from interconnected jurisdictions, Nova Scotia's electricity system may in fact resemble that of a much larger nation's. Undeniably the three case studies are significantly different Nova Scotia, but wind power developers scour the globe in search of attractive returns on investment, and their decisions are not significantly impacted by the size or the population of the country in which they invest.

Canadian jurisdictions have not been included among the case studies because the historical relationships between energy policy and wind power development are not easily identified. Canadian utility-scale wind energy development began as early as 1993 with the installation of more than 50 turbines in Alberta's Cowley Ridge. This was to be the last utility-scale development in Canada until 1999 when construction of Le Nordais Wind Farm in Quebec's Gaspé region. Canada's development of wind energy can be characterized as turbulent, where large single projects are brought on line followed by lengthy periods of inactivity (CanWEA, 2004). Without being able to observe and identify trends in wind power development, it is difficult to identify any relationship between energy policy and its success in alleviating market distortions.

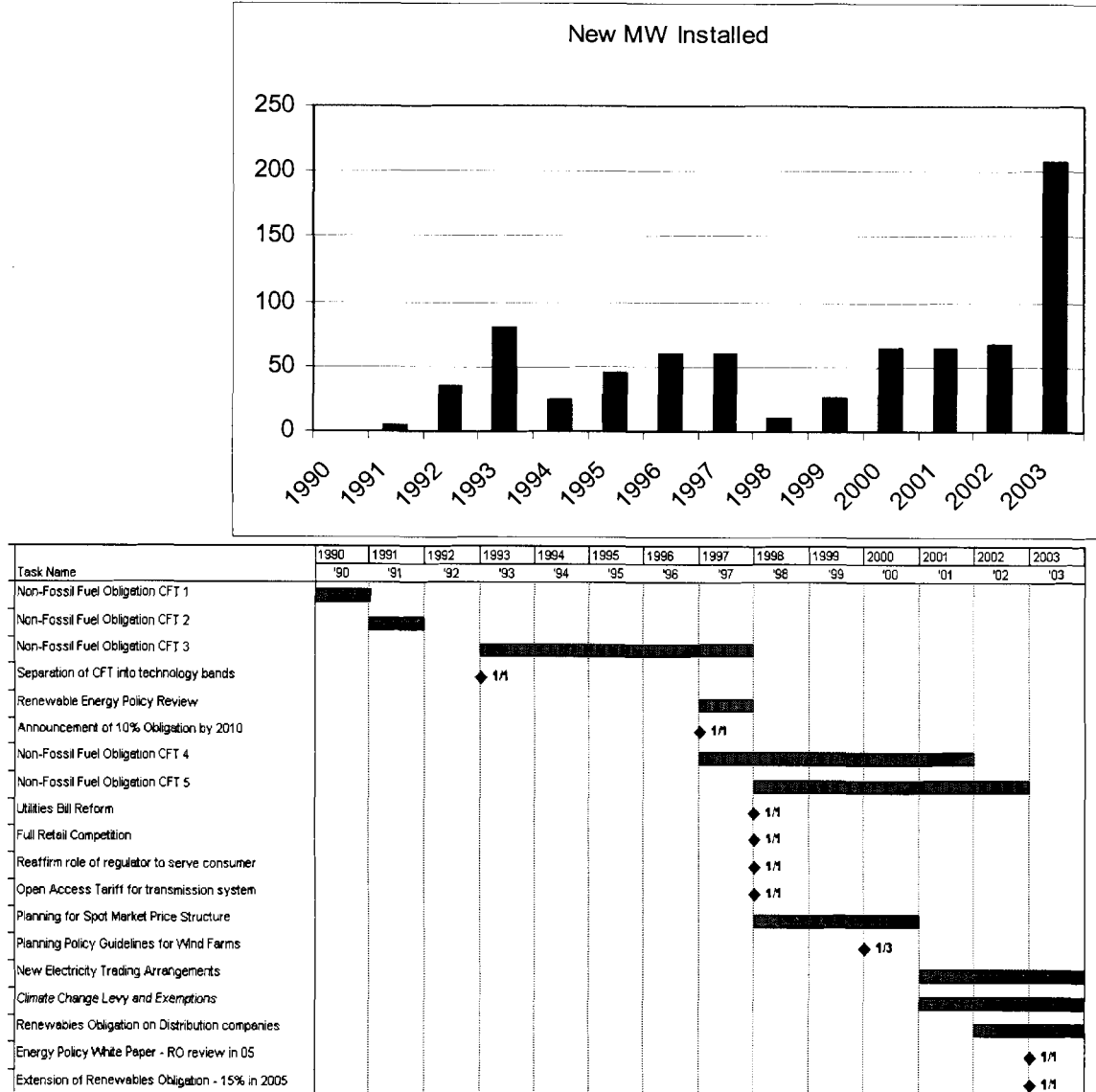
In contrast, the wind power development trends in the three selected European case studies will be analysed in the following section. Each jurisdiction has a history of wind power development extended back to 1990. This historical development will be mapped against changes in energy policy to identify the crucial constituents of a successful wind power development policy.

## **4 Case Study Results**

In section 3, I introduced the analytical model and identified the UK, Germany and Denmark as appropriate case studies. Each jurisdiction has demonstrated success in developing their wind resource, and in this section I investigate what policy tools they used to achieve this success. Specifically, I map the changes in the way the federal governments use energy policy tools against the development of new wind power facilities. If the introduction, amendment, or termination of an energy policy tool is accompanied in time with an increase or decrease in new wind power development, then I judge the energy policy tool to have a relationship with wind power development. At the end of this section, these relationships are summarized and the applicability of that relationship to Nova Scotia is evaluated.

## 4.1 Case Study #1: United Kingdom

Figure 8 UK Energy Policy and Wind Power Development Timeline



Data Source: IEA, 2004; IEA, 2002; Mitchell, 2004 & Oliveira, 2004;

UK energy policy since 1990 is renowned for two significant achievements: being the first to initiate the liberalization of generation markets, and being near last among European countries in terms of wind power development, despite the richest wind resource and policies designed specifically to support its advance. The policy centrepiece to support wind power development throughout the 1990s was the Non-Fossil Fuel Obligation (NFFO). The NFFO was designed as a bidding system whereby renewable power producers were annually invited to compete for long-term power purchase contracts. Distributors awarded fixed-price contracts to all bidders whose offered price was below a predetermined cap price, up until an **obligation** capacity was contracted. The obligation targets were not enforced by a penalty against non-compliant distributors.

As figure 9 reveals, wind power growth under the NFFO regime saw a relatively stable increase of approximately 50 MW annually – well below the annual targets that ranged between 600 – 1700 MW. The NFFO was widely considered a failure. The reasons for the failure can be summarized as follows:

- The cap price that set the upper boundary of acceptable bids was too low. Wind power producers who won contracts at prices below the cap price discovered they would be unable to recover their investment, and projects were never built (Mitchell, 2004).
- The annual NFFO caused a concentrated flurry of wind power prospecting around the time that the bidding process was initiated. The sudden growth on wind monitoring stations across the landscape alarmed many community groups, and mobilized the public to oppose wind power development through the municipal planning process (Mitchell, 2004).
- Power purchase contracts of only 6 years imposed significant price and quantity risk on the developers, increasing the costs of financing.

In 1998, changes to the market structure introduced **wholesale and retail market competition**. This saw wind power growth fall to less than 10 MW for the year. Despite the new opportunities for wind power generators to sell their production in the wholesale and retail markets, the new market structure also put an end to the practice of long-term take-or-pay contracts with the utilities. Energy Policy was moving towards the introduction of New

Electricity Trading Arrangements (NETA). NETA compelled generators to make hourly offers to a central trading pool, outlining the amount of electricity they had to sell and at what price. Generators who failed to fulfil their commitments were forced to buy from the market at the marginal clearing price. This structure would penalize intermittent generators like wind power producers. While NETA was discussed between 1998 – 2000, private industry was reluctant to build new wind power resources (Gorini de Oliveira, 2004). This reveals the sensitivity of wind power development to policy uncertainty, and the industry's demand for long-term power purchase contracts.

In 2002, the Renewables Obligation (RO) was introduced to replace the dysfunctional NFFO. The RO imposed a **renewable portfolio standard (RPS)** on all distribution companies to acquire **renewable energy credits (REC)**. Accredited renewable energy generators were awarded one REC for every MWh produced. Distributors were required to acquire RECs equivalent to 3% of their total electricity sales in 2002, and that proportion would increase to 10% by 2010. Upon the introduction of the RO in 2002, wind development in UK failed to demonstrate the growth that was expected in light of the new and significant revenues from the tradeable REC program. Without the certainty of an expanding demand for RECs beyond 2010, wind developers faced large price risk for the 12 years of the wind project life beyond 2010 and were reluctant to build (Mitchell, 2004). Only in 2003, when the RPS obligation was extended to 15% of consumption by 2015 did the industry respond with a large spike in development throughout the UK. Electricity market analysts assert that the UK is the premier market for wind energy investment due to the long-term supports offered by the RO (Ernst & Young, 2005).

#### **4.1.1 General Conclusions**

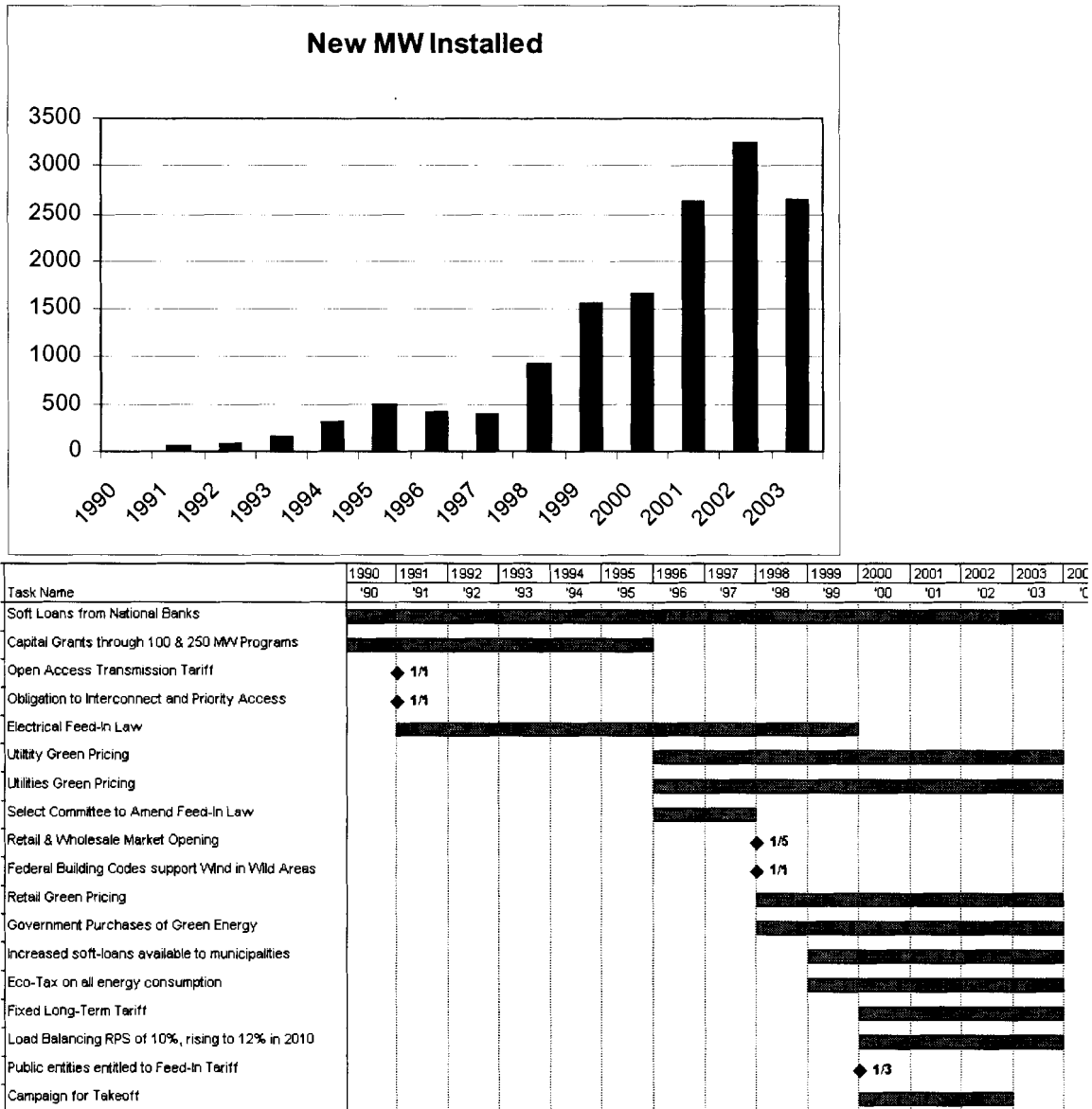
- Wind power developers anticipate and respond to potential changes in energy policy. Policies that mandate periodic review hamper wind power development.
- Obligation systems must provide assurance of long-term demand. This assurance can be communicated individually to wind power producers through long term power purchase contracts, or industry-wide through a guarantee of an expanding aggregate market demand over time.
- Retail competition does not directly provide much stimulus for effective demand of wind power. The two years following the introduction of retail competition

coincided with a decline in new wind power development compared to the timeframe prior to competition.

- Planning policy guidelines are effective in reducing community obstacles for new development.

## 4.2 Case Study 2: Germany

Figure 9 German Energy Policy and Wind Power Development Timeline



Data Source: IEA, 2004; EWEA, 2003; IEA, 2002; Johnson, 2004 & Oxera, 2005;



Germany has pursued a Renewable Energy **Feed-In Tariff** (REFIT) as the primary policy tool to support development of wind power. Initiated in 1991, the Electricity Feed-In Law (EFL) obliged distributors to interconnect wind power generators and purchase their electricity at premium prices. The premium price for wind-generated electricity was 90% of the previous year's retail electricity price. Electricity distributors passed the cost premium for REFIT onto their consumers through a levy applied to all electricity consumers. The levy increased consumers rates to by approximately \$4 US / MWh in 2000 (Stenzel et al, 2003).

A number of other federal support mechanisms were co-ordinated with the REFIT to foster wind power development in the early 1990s. Recognizing the potential for wind power to contribute to both environmental and economic development objectives, both federal and regional governments initiated programs to kickstart wind power development through **capital grants** and **production tax credits**. The federal government also provided consistent support for **RD&D** throughout the 1990s, with wind-related RD&D investments peaking in 1996. Federal wind RD&D investment averaged \$16 M US throughout the 1990s, focused primarily on financing demonstration projects. **Third-party finance** was available to wind power developers through the national banks, sponsored by the federal Environment and Energy-Saving Programme. Starting in 1990, Deutsche Ausgleichsbank provides loans to private renewable energy projects at interest rates 2% below market levels over attractive credit terms. A total of 50% of the project capital could be financed through these government sponsored soft-loans. In coordination with the consumer-sponsored REFIT, government action in the 1990s made Germany the globally premiere nation for wind power development (IEA, 2004).

In 1996, distributors were sanctioned to offer consumers a **green pricing** option, in which consumers could voluntarily pay more for their power to directly support additional renewable power plants. Distributors used the premiums to build new wind power plants. In 1998, electricity retailers also offered green pricing options. The total number of consumers signed up for green pricing programs was approximately 280,000 in 2001, with relatively steady growth since 1996. In absolute terms, less than 0.1% of total consumption was sold through green pricing programs, but the additional green power sold by 2001 was between 100 and 690 GWh, or an equivalent of 6 – 40 MW of new wind power (Lauber, 2004).

By 1998, one of the primary obstacles to further wind power development was the paucity of available land in which to build new facilities. Germany is a densely populated country with strict regulations banning development in pristine rural areas. In 1998, **the federal**

**building codes** were amended to exempt wind power facilities from the general ban on building in undeveloped areas.

Throughout the early 1990s, wind power development in Germany rose at steady rates. During this period, the regulated electricity sector was characterized by regional monopsony public utilities, which were obliged to purchase the wind-generated electricity at premium rates. Pressure to adopt liberalized markets throughout the EU culminated in the introduction of **retail competition** in Germany in 1998

Retail competition began to drive electricity costs down from their peak in 1996-1997. Because the EFT paid wind developers premiums proportional to the annual average cost of power, there was a new risk of developers failing to recover their investment. Further, a legacy of the EFL was that consumer power prices in Northern Germany, where more of the wind power was developed and therefore the utilities had more premiums to pay, were higher than they were in Southern Germany. To address this price volatility risk that threatened new wind development and to distribute the burden on consumers fairly across the country, the EFT was replaced by the Renewable Energy Sources Act (EEG) in 2000.

Within the new de-integrated market structure, the EEG obliged distributors to offer fixed prices to wind power producers rather than prices linked to the fluctuating retail consumer prices. The fixed-price would be available only until 10% of the total consumption was met by renewable sources. The obligation is tracked through an accounting of **Renewable Energy Certificates** (REC), however they are not tradable and represent a system primarily to facilitate an Eco-Tax rebate to renewable generators. This obligation will rise to 12% by 2010, in line with the targets set by the EU.

A number of other energy sector reforms were executed in 1999 that sought to explicitly account for the environmental externality and move to greater liberalization in the energy market. First, an **Eco Tax** was applied on all electricity purchases. Some of the revenues are cycling back to wind power generators as a **production tax credit**. Second, the costs of grid balancing were transferred to the utility, but costs of interconnection and transmission expansion were to be born by project developer.

In 2000, public opposition to new wind power developments had again grown into a significant obstacle. Building upon the federal building codes amendments in 1998, the federal government engaged municipalities to jointly develop targets for wind power within their

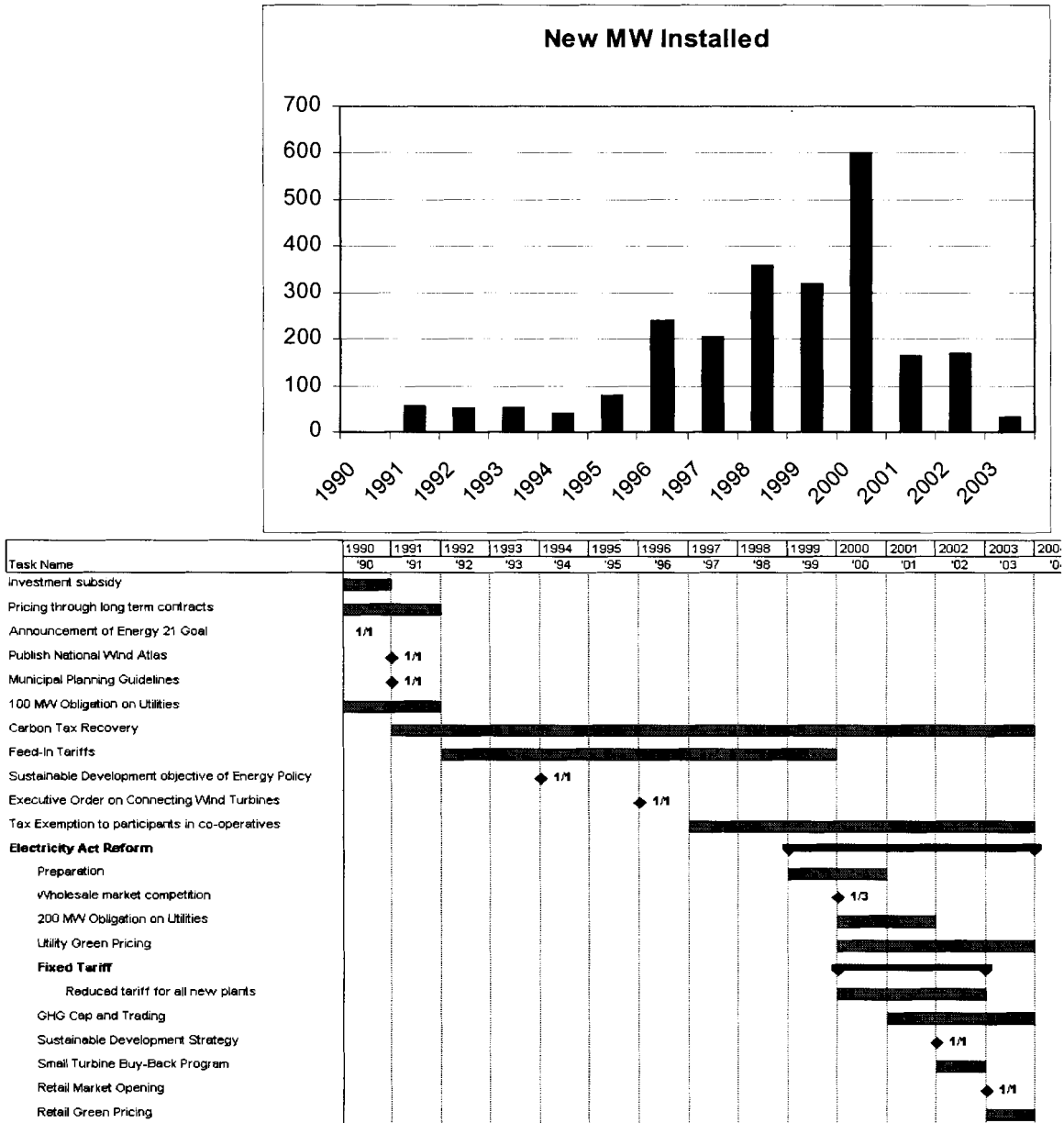
planning district. Municipal plans were ultimately compelled to specifically accommodate wind power expansion. In concert with the municipalities, the federal government began a media campaign to increase **public awareness** about the benefits that wind power represented, and the financial opportunities they offered to rural land holders. This public campaign lasted three years, and ushered in a new boom of wind development.

#### **4.2.1 General Conclusions**

- Wind power industry delays new investments during the deliberation period preceding policy reform. Establishment of the committee to implement competitive market reforms coincides with the development decline between 1996 – 1998.
- Long-term commitments to wind power producers have been a critical driver of development. The formal 20-year power purchase contracts adds to investor certainty against political meddling and also adds to the high certainty of stable future revenues. The certainty attracts investment.
- Exit strategies for the feed-in tariff need to be identified when the policy tool is first implemented. The difficulty of negotiating an appropriate phase-out for the EFL was a contributing factor towards the overhaul of the entire feed-in tariff mechanism. The uncertainty associated with policy reform can be avoided if the phase-out of the feed-in tariff is made explicit at the inception.
- Soft-loans and capital grants play an important support role to the feed-in tariff (Stenzel et al, 2004).
- Policy that proactively engages communities and municipalities has positive effects on wind power growth rates. Engagements with municipalities in the setting of regional wind power targets contributed to development increases in 2000. The public awareness campaigns and the provision of financial incentives for community-sponsored projects was an integral part of the 2000-2003 wind power boom.

### 4.3 Case Study #3: Denmark

Figure 10 Danish Energy Policy and Wind Power Development Timeline



Data Source: IEA, 2004; EWEA, 2003; IEA, 2002; Lauber, 2004; Oxera, 2004 & Tampier, 2002

Like Germany, Denmark pursued an energy policy centred on **feed-in tariffs** for wind power producers throughout the 1990s. Growth was modest but stable throughout the early 1990s, during which time wind power producers also had access to **production tax credits** in the form of a carbon tax recovery credit, and significant support from national laboratories through which **RD&D** funding could be had. RD&D programs provided support to the domestic wind power industry throughout the analysis period by performing design testing and facilitating the transfer of knowledge from the academic to the private sector. The RD&D finance and expertise flowed through the Riso National Laboratory, and was deemed critical to the support of the domestic industry.

In 1996, an executive order to utilities spurred a large and sustained increase in wind power development, driven by small-scale, non-profit and co-operative wind power projects. Utilities were forced to bear the costs of **interconnection, transmission upgrades and ancillary services** for wind power projects. This was the initiating step in enabling community-led wind power development. This was followed in 1997 with **tax exemptions** for owners in co-operative developments.

In 1999, the Danish government began preparations for major energy policy reform within the context of a continental shift towards greater competition and market mechanisms in the electricity industry. Domestically it was felt that the feed-in tariff structure would not be legitimate within the EU, and it was announced that a **renewable portfolio standard** would slowly be phased in to replace it. Underpinning the renewable portfolio standard would be tradable **renewable energy credits** (RECs), with distributors required to acquire RECs equivalent to 20% of consumption by 2003. The REC market was initially scheduled to open in Denmark in 2000, in anticipation of a European market in 2003.

The EU did not condemn the feed-in tariff as was anticipated, but a continental REC trading market did not emerge as Denmark had hoped. The Denmark REC market was delayed, and instead a temporary fixed price was offered to all new generators permitted by January 1<sup>st</sup> 2000. For generators permitted between Jan 1<sup>st</sup> 2000 and 2003, they would receive a much smaller fixed price for a up to 5-years, and then would be paid the wholesale market price plus a relatively meagre **production incentive**. For generators permitted after Jan 1<sup>st</sup> 2003, they would receive the market price plus the production incentive, capped at a relatively modest amount. The large single-year increase of wind power development in 2000 reflects the flurry of development activity to take advantage of the last of the relatively generous fixed feed-in tariff before it was

replaced. Since the much less generous production incentive mechanism and renewable portfolio standard came into effect in 2003, wind power investment in Denmark has practically come to a halt.

#### **4.3.1 General Conclusions**

- The large increase in development in 1996 is attributable to the wealth of small community and non-profit led projects that were enabled by the feed-in tariff and the reduction of interconnection, transmission and ancillary service costs. Regulatory policies contribute to project diversity, and can have significant impacts on the absolute level of development.
- The obligation threshold must be designed such that it creates a long-lived demand for renewable power. The 20% RPS did not provide incentives for new projects because 22% of all electricity was already supplied by wind and hydro power.
- The production incentive since 2000 coincided with the dramatic decline of new wind power projects. Price and quantity risk are both born by project developers. This holds true for the UK system as well, but unlike the UK system, the Danish price paid for electricity is capped at a rate only slightly higher than the wholesale market price of power. Developers are unable to achieve the risk-adjusted return on investment, therefore development has literally come to a halt in Denmark.

#### **4.4 Lessons Learned from the Case Studies**

The tables below summarize the observations from the three case studies in terms of their applicability to Nova Scotia as a means to reduce the market distortions and advance wind power development.

Table 5 REFIT

<b>Fiscal Policy Tool: Feed-In Tariffs (REFIT)</b>	
<b>Observations in Germany and Denmark</b>	<b>Applicability to NS</b>
<ul style="list-style-type: none"> <li>• The REFIT model has had great success in expanding domestic wind power development in Germany and Denmark.</li> <li>• Denmark's decline in 2001 coincided with transition away from REFIT mechanism.</li> <li>• REFIT helps to create markets by combining relative security to entrepreneurs and encouraging a long-term perspective, as evidenced in Germany especially.</li> <li>• REFIT allows innovators to keep the benefits of successful R&amp;D, therefore a greater degree of private R&amp;D investment and technological development is expected. Levels of private R&amp;D investment in Germany and Denmark relative to the UK confirm this.</li> <li>• REFIT itself provides no avenue for the benefits of technological progress to be passed onto the consumer, as evidenced by the windfall profits collected by German and Danish wind developers.</li> <li>• Introducing benchmarking of the REFIT rate to technological progress has proven to be difficult because of political resistance from entrenched wind development companies as evidenced in Germany in 1997. However an exit mechanism is crucial as REFIT cannot be politically tenable over the long-term.</li> <li>• A REFIT mechanism provides stable financing environment for the development and operation of wind turbines.</li> <li>• The fixed price offered in Germany in 2003 is less than the estimated aggregate price collected by UK project developers. Although this may not hold true in the long-term, it indicates that the cost of a REFIT model may be less than the costs of an obligation model with tradable RECs.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Very Applicable</b></li> <li>• Strong track record of success.</li> <li>• REFIT can be calculated to compensate for the externality in Nova Scotia.</li> <li>• Benchmarking rates can be announced at the introduction of REFIT to transfer benefits of technological advance to the consumers.</li> <li>• REFIT can be implemented through existing long-term power purchase contract mechanism to facilitate access to low cost financing for developers.</li> <li>• Cost of supporting REFIT can be financed through retail power price increases.</li> </ul>

Table 6 RPS

<b>Fiscal Policy Tool: Obligations/Renewable Portfolio Standard (RPS)</b>	
<b>Observations in UK and Denmark</b>	<b>Applicability to NS</b>
<ul style="list-style-type: none"> <li>• RPS can be structured within an annual bidding process whereby long-term power purchase contracts are awarded regularly to meet the capacity obligation, or within a more competitive REC framework where distributors are obliged to acquire RECs as a function of their total electricity sales on an annual basis</li> <li>• Utilities tend to embrace the RPS as they are able to better able to manage financial risk relative to independent power producers in the competitive framework. Utilities and their subsidiaries are expected to play a large role in an RPS, as is the case in the UK.</li> <li>• RPS systems discourage community-led development, as evidenced in the UK during NFFO 1 and 2, unless technology bands within the RPS are made explicit.</li> <li>• Without smaller or new entrants, there is a lack of diversity in the types of projects.</li> <li>• RPS countries have shown little interest in developing a wind power equipment industry. Only one Vestas manufacturing plant has located in UK, and there is little interest in the UK government playing any more of a role in the development of a domestic industry.</li> <li>• The RPS tends to exclusively reward the technology closest to commercialization.</li> <li>• There is the potential to separate technologies into bands within the RPS, though this separation may be deemed incompatible with the liberal policy culture that underpins a nation inclined towards the RPS, as was the case in the UK.</li> <li>• RPS requires the highest quality wind sites be developed. Lesser quality sites, which may be attractive from an environmental or community development perspective, are left undeveloped, as evidenced in England.</li> <li>• Long-term obligations or long-term price guarantees are required to mobilize the private financing community, as evidenced in the UK. The 2003 extension of the RO to 2015 coincided with a sharp rise in wind power development.</li> <li>• The tranche system in England, where all power purchase contracts were awarded simultaneously at the end of the bidding process, brought flurries of development activity interspersed with long periods of relative inactivity. The large number of planning applications simultaneous with the installation of numerous wind monitoring towers awoke concern among communities and focused public opposition.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Very Applicable</b></li> <li>• Strong evidence of success in UK after 2002.</li> <li>• RPS can be made compatible with long-term power purchase contract system, OR variable length power purchase contracts.</li> <li>• RPS can be used to foster all 980 MW of available technical wind capacity.</li> <li>• Cost of supporting RPS can be financed through retail power price increases.</li> <li>• RPS can be applied to NSPI, municipal distributors and energy retailers.</li> <li>• Cap price for renewables can shadow the value of the externalities.</li> <li>• Wind power, as the lowest cost source of renewable power, will satisfy practically all the RPS target.</li> </ul>



Table 7 REC

<b>Fiscal Policy Tool: Tradable Renewable Energy Certificates (REC)</b>	
<b>Observations in UK, Denmark and Germany</b>	<b>Applicability to NS</b>
<ul style="list-style-type: none"> <li>• The creation of renewable certificate markets is complex, as evidenced by the turmoil in Denmark. Issues to be considered are:               <ul style="list-style-type: none"> <li>○ Certification of renewable facilities</li> <li>○ Monitoring of trade</li> <li>○ Registering of Data</li> <li>○ Lifetime of certificates</li> <li>○ Documentation of consumer quota</li> </ul> </li> <li>• An efficient trading market requires a sufficient number of market participants such that fair competition can be fostered.</li> <li>• RECs in the UK trade for approximately equivalent value as the electricity commodity, greatly increasing the revenues to wind power producers and attracting new development.</li> <li>• RECs can be a tool to assist in the operation of a differentiated tax system where carbon-free energy is exempt from a carbon tax. The REC system will support the information disclosure and facilitate a renewable energy tracking system, as in Germany.</li> <li>• The dearth of new developments in Denmark after 2000 is attributable to uncertainty in the REC market. In fact, Danish wind power equipment manufacturers have sited all of their new plants outside of Denmark since 2000.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Not Applicable</b></li> <li>• 95% of electricity is currently supplied/purchased by NSPI, therefore the market dominance inhibits fair competition.</li> <li>• Retailers are unlikely to be able to compete with NSPI for residential customers because of NSPI's low cost sources of heritage power, therefore NSPI's dominance in the retail side of the market will remain.</li> <li>• The potential gains from fragmenting NSPI into several distribution units is negligible because the total Nova Scotia demand is too small to support efficient competition<sup>11</sup>.</li> </ul>

<sup>11</sup> According to Navigant Consulting, economic generation companies require a portfolio capacity of at least 3500 – 8000 MW. NSPI's total generation capacity is approximately 2200 MW. If NSPI were to be fragmented into several generation companies to reduce market power and to foster competition, none of the generation companies would be of sufficient size to compete efficiently.

Table 8 PTC

<b>Fiscal Policy Tool: Production Tax Credits (PTC)</b>	
<b>Observations in Denmark and Germany</b>	<b>Applicability to NS</b>
<ul style="list-style-type: none"> <li>• Application of PTC in early 1990s in Germany was not associated with large increases in wind power.</li> <li>• Application of PTC in 2000 in Denmark is associated with the rapid decline in new wind power development.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Not Applicable</b></li> <li>• Not a successful mechanism within the cases examined</li> </ul>

Table 9 Capital Grants

<b>Fiscal Policy Tool: Capital Grants</b>	
<b>Observations in Denmark and Germany</b>	<b>Applicability to NS</b>
<ul style="list-style-type: none"> <li>• Capital grants in Germany were used as a tool of social policy to confer advantages on certain projects, especially those with greater domestic industrial involvement (Lauber, 2004). This mechanism is not consistent with competitive principles.</li> <li>• The technology push instruments, such as capital grants and RD&amp;D, tend to be scaled back as liberalization of energy markets proceeds.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Not Applicable</b></li> <li>• May jeopardize potential for trade with US jurisdictions.</li> </ul>

Table 10 Soft Loans

<b>Fiscal Policy Tool: Third Party Finance / Soft Loans</b>	
<b>Observations in Denmark and Germany</b>	<b>Applicability to NS</b>
<ul style="list-style-type: none"> <li>• Some research suggests that the soft loans from Deutsche Ausgleichsbank had the most dramatic influences of any single institution or policy on renewable energy development (Lindley, 1996).</li> <li>• Wind power projects have benefited from access to low-cost financing in those jurisdictions where:             <ul style="list-style-type: none"> <li>○ Revenues are linked to a fluctuating market price of electricity, therefore exposing the developer to price risk, as demonstrated in Germany.</li> <li>○ Sales are not guaranteed by a credit-worthy agent for the life-time of the facility, therefore exposing the developer to quantity risk.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <b>Applicable as a support for RPS.</b></li> <li>• Nova Scotia municipal distributors may not be credit-worthy agents</li> <li>• If RPS mechanism is associated with variable-length power purchase contracts, wind power projects may require soft-loans to be viable.</li> <li>• Soft loans can target smaller projects with sufficient community support and local participation to foster project diversity.</li> </ul>

Table 11 Green Pricing

<b>Regulatory Policy Tool: Green Pricing</b>	
<b>Observations in Denmark and Germany</b>	<b>Applicability to NS</b>
<ul style="list-style-type: none"> <li>• Green Pricing programs have only a small impact, though their usefulness as a public awareness tool is significant.</li> <li>• The new development driven by Green Pricing programs, small though it is in absolute terms, is additional to the development driven by the primary policy tools. This indicates that there is an impure altruism behind people's willingness to pay higher prices for green power, stemming from the 'warm-glow' of supporting clean power rather than an objective evaluation of the environmental benefits of green power.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Very Applicable</b></li> <li>• Green Pricing programs may increase demand for renewable power by as much as 0.1% of the total consumption, or 5 MW of additional wind power capacity.</li> </ul>

Table 12 Competition

<b>Regulatory Policy Tool: Wholesale/Retail Competition</b>	
<b>Observations in Denmark, Germany and the UK</b>	<b>Applicability to NS</b>
<ul style="list-style-type: none"> <li>• In isolation, competition has not evidenced a relationship with increases in wind power development.</li> <li>• Retail sales of green power tend to be through short-term power purchase contracts with end-customers, exposing the developer to price and quantity risk.</li> <li>• Wholesale sales of green power, where the credit rating of the distributor is low, also expose the developer to risk.</li> <li>• Demand from retail and wholesale entities will tend to be for small capacity projects, introducing diversity into the types of projects built.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Applicable as support for RPS mechanism.</b></li> <li>• Can add project diversity to an otherwise utility or large company dominated environment.</li> <li>• Additional wind power development is likely to be negligible, though will contribute to public awareness</li> <li>• Can be coupled</li> </ul>

Table 13 Permitting, Land Use & Interconnection

<b>Regulatory Policy Tool: Permitting, Land Use and Interconnection Codes &amp; Standards</b>	
<b>Observations in Denmark and Germany</b>	<b>Applicability to NS</b>
<ul style="list-style-type: none"> <li>• Obstacles in the municipal permitting process were the primary cost driver in UK, despite long-term power purchase contracts awarded during NFFO 4 – 5. The result was less than 5% of the contracted wind power coming on line, compared to the nearly 60% completion of NFFO 3, with comparable contract terms. Average winning bid rates continued to fall to 3.56 / kWh and 2.88 / kWh in NFFO 4 and 5 respectively.</li> <li>• The rate of project acceptance is highly variable within one country, pointing to the impact of regional planning guidelines. As evidence, only 50% of proposals are accepted in the UK while 90% are accepted in Scotland.</li> <li>• Clear land-use policies in Germany signalled strong government support, prompting greater private sector investment.</li> <li>• Transfer of interconnection costs from developer to grid operator was a strong contributor to growth in Denmark.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Very Applicable</b></li> <li>• Provincial guidance of municipal planning process may help spread best practices.</li> <li>• Land-use guidelines for crown land can be strong signal of legitimacy to wind power industry.</li> <li>• Uncertainty in interconnection charges is especially difficult for small projects to bear.</li> <li>• Transfer of interconnection costs to utility will assist in diversity of project types.</li> </ul>

Table 14 Transmission

<b>Regulatory Policy Tool: Rationalization of transmission and ancillary charges</b>	
<b>Observations in Denmark and Germany</b>	<b>Applicability to NS</b>
<ul style="list-style-type: none"> <li>• Transfer of responsibility over ancillary services from the developer to the grid operator is likely to achieve higher efficiencies. The developers' first option for firming power is new open-cycle gas turbine technology. The technology is well understood and has low capital costs. However, studies have shown that grid operators with reservoired hydro power may be able to provide firming power for intermittent renewable sources at a significantly lower cost per kWh than the gas turbine alternative.</li> <li>• Transfer of responsibility over ancillary services from developer to grid operator was a strong contributor to growth in Denmark.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Very Applicable</b></li> <li>• Small NS hydro power resource can be used to support low-cost grid support services.</li> <li>• Reduction in transmission and ancillary service charges will benefit small projects and advance project diversity.</li> <li>• Calculation of transmission and ancillary service costs can be made to favour intermittent resources through a generation-based fee calculation.</li> </ul>

Table 15 Public Awareness

<b>Information Tool: Public Awareness</b>	
<b>Observations in Denmark and Germany</b>	<b>Applicability to NS</b>
<ul style="list-style-type: none"> <li>• Public opposition makes permitting and permission much more difficult, costly and time consuming, as evidenced in the UK.</li> <li>• Public opposition is correlated to local population densities.</li> <li>• Public awareness can also be achieved through green power marketing endeavours as part of green pricing programs.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Not Applicable</b></li> <li>• Low population densities in areas of high wind resource reduce potential for NIMBY</li> <li>• Redundant if combined with Green Pricing and retail programs.</li> </ul>

Table 16 RD&D

<b>Information Tool: Research, Development &amp; Deployment</b>	
<b>Observations in Denmark and Germany</b>	<b>Applicability to NS</b>
<ul style="list-style-type: none"> <li>• Wind development is a global market, meaning that cost-reductions from increased production are not driven by any one jurisdiction. Rather, R&amp;D in the realm of installation and interconnection, which is local, is the only area where cost reductions can be expected.</li> <li>• A key advantage of German wind turbine R&amp;D programmes was a greater emphasis on diversity of effort, that is, of working to acquire knowledge of different forms of the technology, program management strategies and installation approaches. The result was an aggregate wind industry capable of adapting to changes in the international wind deployment market.</li> <li>• The Danish research investment in public academic institutions made it possible to establish a system for collective standards and control of the safety and reliability of wind turbines. The Risø Wind Energy Laboratory's very strict safety requirements, its demands for physical testing of rotor blades, and conservative norms for load calculations, indirectly protected Danish manufacturers from investing in the wrong designs.</li> <li>• The historical development of the Danish wind sector has benefited from the close ties between industry, the Government, and its agents. Close consideration allowed the easy transfer of results from government R&amp;D to commercial usage as well as aiding in providing the new industry with legitimacy. Mechanisms to aid transfer were specifically put in place, and these drew in the involvement of both the Ministries of Energy and of Industry. These R&amp;D efforts were carried out by both public and private sectors and backed with public funds to try to ensure commercial products.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Very Applicable</b></li> <li>• RD&amp;D correlated with domestic industrial development</li> <li>• RD&amp;D should focus on later stages of value chain: financial services, project management, installation, and operations.</li> <li>• Strong academic community in NS is an asset.</li> <li>• Limited government investment is effective tool to provide industry with legitimacy.</li> <li>• Approach similar to Denmark's National Wind Energy Laboratory may aid in the transfer of knowledge and expertise to the Nova Scotia wind energy industry, while building upon the academic assets of the region.</li> </ul>

## 4.5 Summary of Findings

These case studies reveal that energy policy often has an immediate and pronounced impact on the rate of wind power development. In several instances, the initiation, amendment or termination of a specific energy policy tool is associated with a steep increase or decrease in development rates. The nature of the relationship between policy and wind power development is crucial to the development of appropriate policy in Nova Scotia. A review of the most important relationships is described below.

- Long-term political commitment to an energy policy framework is essential. In all three case studies, wind power development rates fall sharply when confidence in the longevity of the existing policy framework falls.
- Long-term guaranteed Feed-In Tariffs with prices sufficient for developers to recover their investment have a strong track record of success in Germany and Denmark. Germany's peak period from 2000 – 2002 is associated with the introduction of the fixed price system. Denmark's nadir in 2003 is associated with the elimination of the fixed-price system in favour of a competitive bidding system.
- The UK NFFO rounds 1 and 2 were unsuccessful for two primary reasons: the cost cap was administered inappropriately, and the power purchase contracts on offer were too short. NFFO round 3 extended the length of the contracts, and spurred some development, but only through introduction of the RO was the cost-cap redesigned.
- The UK made a final and crucial change to the obligation system by reducing the quantity risk through an extension of the RPS target timeline to 2015. Only when the latter step was taken in 2003 did wind development significantly manifest.
- In REFIT or RPS systems where the price paid to generators is linked to variable wholesale prices, the costs of project finance greatly increase such that development rates fall. Additional fiscal policy tools, such as capital grants or low-cost financing, are required to support development in high-risk environments.
- REFIT systems encourage diversity in size and ownership structures of projects. Conversely, RPS systems tend to restrict development to large projects financed by

utilities or large power production companies. To capture the benefits of diversity and community development within an RPS system, regulatory tools such as wholesale/retail competition are required.

- The fixed price of the REFIT must be appropriate to provide wind power developers with a sufficient return on investment. German and Danish experience with fixed prices suggest a REFIT price of approximately \$80 per MWh, declining 1% annually. Prices paid for wind energy will be equivalent to the market price for incremental natural gas within 10 – 20 years<sup>12</sup>.
- Denmark’s sustained increase in development was associated with an executive order to municipalities and utilities to facilitate the permitting and interconnection of wind energy facilities. Aligning interests towards achieving wind power production targets reduces key regulatory barriers manifest in the planning, permitting and interconnection stages.
- Research, Development and Demonstration is appropriate for Nova Scotia within the context of developing a viable domestic wind industry and can complement either a REFIT or RPS-focused framework. Denmark’s Riso National Laboratory is a successful model for generating expertise in the private sector, while bestowing legitimacy on the industry.
- Capacity-based transmission and ancillary service charges impose higher relative costs on small intermittent projects relative to large baseload projects. Reconfiguration of ancillary and transmission charges such that fees are based on approximate electricity output will reduce the relative costs to wind power projects and facilitate their entry.

With these lessons in mind, the range of public policy frameworks that can facilitate the development of the 980 MW of wind power potential can be designed.

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<sup>12</sup> The cost projections of natural gas power are dependent on the cost of natural gas; gains in turbine efficiency; and the “spark spread” which represents the ratio of natural gas prices to electricity market prices. Models predicting the long term price of electricity from incremental natural gas turbines are highly variable, but tend to predict increasing prices relative to the current \$60 – 65 / MWh in 2005.

## 5 Alternatives

The analysis suggests three alternatives (beyond the status quo) for Nova Scotia that would improve prospects of wind power development relative to the status quo. The first is centred around a **REFIT** mechanism that guarantees a fixed price to all permitted wind power producers, complemented by regulatory policies to streamline the permitting and interconnection process, rationalization of the transmission and ancillary service charges, and increased government RD&D. The second alternative incorporates the competitive element of an RPS with the long-term contractual security of a REFIT (**RPS-REFIT Hybrid**). NSPI will award fixed rate long-term power purchase agreements through a periodic competitive bidding process, designed to steadily develop wind power production towards the social optimal of 980 MW by 2020. Wholesale distributors will be required to meet the same RPS obligation as NSPI. Energy retailers will be required to meet a 100% green RPS obligation, restricting the retail market to green power suppliers. A central RPS administrator, with whom the agreements are stored and verified, tracks compliance with the RPS. The suite of regulatory policy tools and RD&D investment complements the RPS. The third alternative focuses on an aggressive **RPS** and flexible-length contracts. NSPI, wholesale distributors and retailers enter into negotiated contracts of variable lengths for both electricity and RECs. This alternative is buttressed by access to low-cost financing for specific projects, the suite of regulatory policy tools, and RD&D investment. I will compare these three alternatives to the existing 2002 Nova Scotia Energy Strategy.

### 5.1 Alternative 1: Maintain 2002 Energy Strategy

- **Obligation:** voluntary renewable electricity target totalling 2.5 percent of NSPI's generation capacity, or approximately 50 MW of reliable capacity, by 2010. The cost premium afforded to renewables in order to meet the RPS is capped at \$20 per MWh relative to the marginal cost of new electricity supply. No penalties for non-compliance.



- **Open Transmission System:** open access to the NSPI electricity transmission system to renewable private power producers irrespective of technology. The cost of interconnection, transmission and ancillary services are related to the capacity energy facilities.
- **Limited Wholesale Competition:** wholesale access between the existing municipal distribution companies and independent power producers. NSPI will wheel power through the grid at no cost.
- **Retail Competition:** direct retail access only for vendors of electricity from renewable resources.
- **Green Pricing:** NSPI will establish a premium green electricity rate structure for all NSPI consumer classes. NSPI will use the premiums to finance the construction or acquisition of new green power that will not be included towards the voluntary target.

## 5.2 Alternative 2: REFIT

- **Feed-In Tariff:** NSPI to provide 20-year power purchase contracts to financially viable wind power project proponents. Rate for all contracts executed in 2005 will equal \$80 per MWh, decreasing by 1% per year for subsequent contracts. Premium contracts will be available until a total of 980 MW of wind power has been deployed.
- **Open Transmission System:** open access to the NSPI electricity transmission system to renewable private power producers irrespective of technology. Adoption of best international practices regarding permitting and interconnection. The cost of interconnection, transmission and ancillary services is related to the annual electrical output the energy facilities.
- **Research, Development & Demonstration:** Wind Energy Research Laboratory established within university cluster that focuses on formal technical training and equipment certification.

### 5.3 Alternative 3: RPS-REFIT Hybrid

- **Obligation:** Mandatory RPS, where 10% of all electricity sold annually must be generated from renewable sources in 2010. Target increases by 1% per year to 20% in 2020. Target will apply to all load serving entities, including NSPI and all wholesale distributors. NSPI will be compelled to offer renewable generators 20-year fixed price contracts. UARB will track all renewable contracts and independently monitor compliance with RPS. Penalties for non-compliance will be levied against load serving entities at a rate of \$30 / MWh, effectively capping the premium paid to renewable generators. Penalties collected by UARB will finance RD&D investments.
- **Open Transmission System:** open access to the NSPI electricity transmission system to renewable private power producers irrespective of technology. Adoption of best international practices regarding permitting and interconnection. The cost of interconnection, transmission and ancillary services is related to the annual electrical output of the energy facilities.
- **Limited Wholesale Competition:** wholesale access between the existing municipal distribution companies and independent power producers. NSPI will wheel power through grid at no cost.
- **Retail Competition:** direct retail access only for vendors of electricity from renewable resources.
- **Green Pricing:** NSPI will establish green electricity rate structure for all NSPI consumer classes. Premiums will be used to acquire renewable generation beyond the requirement of the RPS.
- **Research, Development & Demonstration:** Wind Energy Research Laboratory established within university cluster that focuses on formal technical training and equipment certification.

## 5.4 Alternative 4: RPS

- **Obligation:** Mandatory RPS, where 10% of all electricity sold annually must be generated from renewable sources in 2010. Target increases by 1% per year to 20% in 2020. Target will apply to all load serving entities, including wholesale distributors and retailers. NSPI will negotiate the terms of all contracts with prospective energy suppliers. UARB will track all renewable contracts and independently monitor compliance with RPS. Penalties for non-compliance will be levied against load serving entities at a rate of \$30 / MWh, effectively capping the premium paid to renewable generators. Penalties collected by UARB will finance RD&D investments.
- **Soft Loans:** Low-cost financing will be made available to wind power projects owned by non-profit co-operatives.
- **Open Transmission System:** open access to the NSPI electricity transmission system to renewable private power producers irrespective of technology. Adoption of best international practices regarding permitting and interconnection. The cost of interconnection, transmission and ancillary services is related to the annual electrical output of the energy facilities.
- **Limited Wholesale Competition:** wholesale access between the existing municipal distribution companies and independent power producers. NSPI will wheel power through grid at no cost.
- **Retail Competition:** direct retail access only for vendors of electricity from renewable resources.
- **Green Pricing:** NSPI will establish green electricity rate structure for all NSPI consumer classes. Premiums will be used to acquire renewable generation beyond the requirement of the RPS.
- **Research, Development & Demonstration:** Wind Energy Research Laboratory established within university cluster that focuses on formal technical training and equipment certification.

## 6 Evaluation

Three new alternatives have been designed in the last section that incorporate the lessons learned from the three case studies to effectively overcome the obstacles in the electricity market. Each alternative takes a different approach in implementing the best practices, and as such, each will have different impacts in areas of concern quite apart from the rate of wind power development. In order to determine if any of the alternatives is an improvement from the status quo in a holistic sense, the three new alternatives and the status quo must be compared within a multi-attribute framework that encompasses all the relevant objectives of the 2002 Energy Strategy. The Energy Strategy outlines five strategic objectives.

- Promote the growth of renewable energy sources
- Development of domestic manufacturing and consulting industries to support energy development
- Competitive electricity markets
- Low rate impact
- Equity among all residents

As is often the case with complex policy, pursuit of any one objective may entail a sacrifice of one or more of the others. Effective policy is therefore one that considers the trade-offs among the different objectives and achieves a positive balance in accord with the social priority of the objectives. The following evaluation seeks to make explicit the contribution of each alternative towards the multiple objectives in order to illustrate the trade-offs and to facilitate informed policy design.

## 6.1 Growth of Renewable Energy Sources

The primary objective of the energy strategy is to facilitate generation from the abundant clean and renewable sources in Nova Scotia. This paper has argued that the appropriate measure of success for this objective is the capacity of wind power developed relative to the technical potential.

**Alternative 1: Maintain 2002 Energy Strategy.** The voluntary obligation can be expected to achieve the 50 MW renewable target, all or nearly all of which will be met from wind energy sources. Annual requests for proposals from NSPI to meet forecasted load growth will likely yield power purchase contracts for all 50 MW of wind power by 2006<sup>13</sup>. Green Pricing and private retail sales of additional wind power can be expected to have minimal impact, yielding not more than 10 MW of wind power by 2010. The total expected wind power development by 2010 is approximately 60 MW, with negligible potential for growth in the absence of a long-term source of reliable demand.

**Alternative 2: REFIT.** Introduction of the REFIT can be expected to spark a rush of wind power development in the short term, with a slow decline in growth rates over the medium and long term. For the first 3-5 years, wind power production will exceed the 1% load growth rate, leaving idle some of NSPI's high-cost oil and natural gas facilities as supply exceeds demand. Although the amount of development is highly uncertain, the large low-cost resource potential and low-risk environment is very likely to result in wind power development throughout much of the northern and southern coastal areas of Nova Scotia, limited primarily by access to construction manpower. As much as 700 MW of wind power may be developed by 2010, securing high value fixed-price contracts and occupying most of the best quality resource sites<sup>14</sup>. All or nearly all of the 980 MW technical capacity will be developed by 2020.

**Alternative 3: RPS-REFIT Hybrid.** The 10% RPS, under a best-case scenario, will deliver the target 490 MW of wind power by 2010, contracted at long-term prices less than the

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<sup>13</sup> In 2005, NSPI contracted for the first utility-scale wind power project in order to meet the renewable target. A private wind power developer will deliver power to NSPI from a 30 MW wind power project located on the southwest coast starting in 2005.

<sup>14</sup> This projection is based on several factors. First, long-term power purchase contracts in Ontario in 2005 that offered less than \$65 per MWh successfully attracted more than 300 MW of new large scale wind power projects. The proposed Nova Scotia structure has a similar risk profile, indicating that \$80 per MWh is generous for projects that can achieve economies of scale, and sufficient for smaller-scale projects. Second, the quality of the wind resource in Nova Scotia is superior to the resource in Ontario, bolstering the confidence in this projection.

cap value<sup>15</sup>. The steady increase in the obligation will yield a steady increase in wind power development, culminating in all of the 980 MW of capacity by 2020.

**Alternative 4: RPS.** Similar to alternative 3, the 10% RPS will yield the target 490 MW of wind power by 2010 under a best-case scenario. However, the likelihood of achieving this level of development is less relative to alternative 3, because the price and quantity risk are higher if the power purchase contracts are of a shorter duration. In light of the additional risk, a probability-adjusted projection results in an approximation of 300 – 400 MW of wind power by 2010<sup>16</sup>. The supply of wind power may continue to lag behind the RPS target, and by 2020, 600 - 980 MW may be developed.

## 6.2 Development of domestic support industries

One of the social benefits of wind power is the potential for employment in manufacturing and consulting. Manufacturing capacity, technical expertise and intellectual property must be developed within Nova Scotia in order to preserve this benefit. A proxy for measure of this objective can be the degree that the policy framework fosters private sector investment in innovation.

**Alternative 1: Maintain 2002 Energy Strategy.** In the absence of sustained domestic growth potential, negligible investment in innovation can be expected.

**Alternative 2: REFIT.** The feed-in tariff structure permits the private sector to keep the economic rents associated with innovation, thus providing incentives for international and domestic companies to make long-term investments in knowledge and skills in Nova Scotia.

**Alternative 3: RPS-REFIT Hybrid.** Strong competition among prospective wind power suppliers to offer the lowest-cost power will foster inhibit technological diversity and risky long-term investments in knowledge. The necessity to underbid competitors will prompt developers to purchase equipment from established international manufacturers, limiting the

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<sup>15</sup> This optimistic outcome is not guaranteed. However, if the RPS demand for wind power is equal to supply, then the aggregate price offered to wind power of the market price for conventional power plus the cap price will be roughly equal to \$80 / MWh. Considering the risk profile for wind project developers is low, the price is likely to be sufficient to attract the target level of development.

<sup>16</sup> This estimate merely seeks to recognize the greater risks born by the developers relative to alternative 3, and therefore the higher prices required to meet their return on investment. Further study of the cost curve of new wind power in Nova Scotia is required to refine this estimate.

growth of innovation in Nova Scotia. Once long term contracts have been won, developers have incentives to find innovative ways to reduce operations and maintenance costs, and this may spark some limited investment in innovation.

**Alternative 4: RPS.** Competition at the bidding stage and the constant threat of being undersold will severely limit the freedom of prospective developers to invest in innovation. Contracts are likely to be won exclusively by large international wind development and utility companies with established expertise. The soft-loan program will promote some project diversity, but the scale of investment in innovation is likely to be negligible. This high risk structure is likely to yield the lowest absolute development of domestic support industries.

### 6.3 Competitive Electricity Markets

Competition in the electricity markets is assumed to accompany economic efficiency. However, another reason to develop competitive markets is to facilitate participation in the broad North American electricity market. The New England offers significantly higher electricity prices than Nova Scotia and is a target export market. The US Federal Energy Regulatory Commission (FERC) requires Canadian electricity exporters conform to minimum standards of competition in order to participate in interstate trade<sup>17</sup>. Satisfaction of this objective requires meeting the minimum standards outlined by FERC.

**Alternative 1: Maintaining 2002 Energy Strategy.** The Open Transmission System policy, which outlines technical standards and cost schedules for all prospective grid-connected generators irrespective of resource, meets FERC minimum standards as they are currently defined.

**Alternative 2: REFIT.** The Open Transmission System policy meets FERC minimum standards.

**Alternative 3: RPS-REFIT Hybrid.** The Open Transmission System policy meets FERC minimum standards.

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<sup>17</sup> According to a statement by FERC, "To export electricity directly to United States customers, Nova Scotia must meet FERC's reciprocity requirements, including non-discriminatory, open transmission access, and access to wholesale markets."

**Alternative 4: RPS.** The Open Transmission System policy meets FERC minimum standards.

## 6.4 Rate Impact

The various objectives should be met at minimum economic cost. The alternatives can be measured in this regard based on the expected cost of supporting the policy tools.

**Alternative 1: Maintain 2002 Energy Strategy.** The rate impact will be minimal by virtue of the small amount of wind power development and the stringent \$20 per MWh cost cap. Satisfying the 50 MW RPS will require additional annual expenditures of not more than \$2.6 million. When incorporated into the rate base, the total rate impact will not be more than 0.26% by 2010.

**Alternative 2: REFIT.** The rate impact will be significant by virtue of the large volume of high-price contracts awarded during the first 3-5 years of the policy. By 2010, approximately 700 MW of wind power will be purchased by NSPI at a \$20 premium<sup>18</sup>. NSPI's additional annual expenditure in 2010 to support these premiums will be approximately \$37 million<sup>19</sup>. When incorporated into the NSPI rate base, the total rate impact for the REFIT will be approximately 3.7% in 2010<sup>20</sup>.

The cost of the Wind Energy Research Laboratory can be financed through an electricity rate increase or through provincial tax measures. The Riso National Laboratory in Denmark, after which the Nova Scotia RD&D program is modelled, has an annual operating budget of \$100 million, 41% of which is sponsored from the Danish Ministry of Science, Technology and Innovation. The scope of Riso National Laboratories activities includes industrial technology and bioproduction, in addition to nuclear and other forms of clean energy. Since the scale of the Nova Scotia Wind Energy Research Laboratory is restricted to wind energy research and will leverage existing university infrastructure, I estimate \$5 million annually for the RD&D program,

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<sup>18</sup> The price paid for wind power will range from \$80 - \$72 / MWh, with an average price for all wind power of \$76 in 2010. The market price for conventional incremental power in 2010, as previously discussed, is difficult to model, but can be assumed to remain at approximately today's price of \$50 - \$60 / MWh.

<sup>19</sup> Assuming an installed capacity of 700 MW in 2010, the annual wind energy output will be 1.8 TWh.

<sup>20</sup> NSPI total revenue requirements are projected to grow at 1% annually, and reach approximately \$1 billion in 2010. The rate impact of the policy measure is expressed as a fraction of the total revenue requirement.



to be financed from NSPI general revenues. The total rate impact in 2010 will therefore total 4.2%.

**Alternative 3: RPS-REFIT Hybrid.** The prices paid to wind power producers are uncertain under this scenario. Considering the wealth of low-cost wind power potential and the strong competitive incentives to develop only the lowest-cost resources, it can be assumed that the premium price for wind power will be less than the cap price of \$30 / MWh. A reasonable estimate of the premium may be \$10 per MWh more than contracts for conventional sources of power<sup>21</sup>. By 2010, the additional annual expense to support 490 MW of power will be approximately \$13 million. When incorporated into the NSPI rate base, the rate impact of the RPS is 1.3% in 2010.

As discussed in alternative 1, the RD&D investment will require an additional \$5 per year. The total rate impact for this alternative is 1.8%

**Alternative 4: RPS.** The prices paid to wind power producers are again difficult to model for this scenario. The UK experience with variable-length power purchase contracts reveals that average contract prices increase relative to the prices paid for long-term contracts. This can be explained by developers requiring a higher price to ensure a return on investment over a shorter contract period, and also to account for the higher costs of financing in a higher risk environment. Therefore, the premiums paid to wind power developers in the short term will be higher relative to Alternative 3, likely to approach the cap price of \$30 / MWh. Assuming that 350 MW are developed, the rate impact for the RPS will be approximately \$27 million in 2010.

Over the long term, the flexibility afforded to NSPI in negotiating contracts allows the benefits of technological innovation to be locked in for consumers. Alternative 4 can be considered a more socially cautious or prudent approach relative to Alternative 3 whereby the regulated utility retains broader options over the long term and is protected from locking into high-priced power purchase contracts over long periods. There is therefore a tradeoff: a slightly higher rate impact relative to Alternative 3 over the short term, and a lower rate impact relative to Alternative 3 over the long term

As the RPS obligation of 490 MW is not met under this scenario, the load serving entities are required to pay a penalty of \$30 / MWh. The penalty is collected by the UARB and used to

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<sup>21</sup> Further study of the cost curve of large wind power projects at the most attractive resource sites is required to refine this estimate.

finance the RD&D programs. In 2010, \$10 million is allocated to the RD&D programs through the penalty recycling mechanism.

Tax payers are likely to support the soft loan programs. The social cost of providing low cost loans is unknown, but likely to be trivial considering only non-profit co-operatives are eligible.

The total cost of this alternative in terms of rate impact is 3.7% in 2010, though it will have a lower rate impact relative to Alternative 3 over the long term.

## 6.5 Equity across all residents

The various policy options will distribute the financial, social and environmental impacts across the population in different ways. In an ideally equitable scenario, individuals who incur the costs of the policy also receive benefits of at least equal value. While some benefits and costs are distributed evenly across individuals, there are some concentrated costs and benefits. The parties effected by concentrated costs and benefits for each policy are listed below.

**Alternative 1: Maintain 2002 Energy Strategy.** The financial costs of supporting the wind power premium is distributed evenly among rate-payers. The burden of lost aesthetic value due to wind power development is likely to be shared among residents in the north and south tip of the Province. These same residents are the chief beneficiaries of small increases in employment and land rents. Overall, the small costs and benefits are shared equitably.

**Alternative 2: REFIT.** Akin to Alternative 1, the financial costs are shared evenly among rate-payers. The REFIT model is likely to yield a diversity of project types and project sizes, therefore the geographic impact will be distributed across all coastal areas. Unlike Alternative 1, the large profits that accumulate to wind power developers under the REFIT model constitutes a transfer from ratepayers to the relatively few owners of the projects. The size of the transfer is unknown, though UK studies show that approximately 50% of the premium paid to wind power producers is a transfer (Oxera, 2005).

**Alternative 3: RPS-REFIT Hybrid.** Again, financial costs are shared among ratepayers. The RPS model has been shown to favour large-scale projects concentrated in areas of the highest resource quality. The geographic impacts will be heavily concentrated in the north of the province, diminishing the aesthetic appeal of the area around Cape Breton Island. The

economic benefits of development are likely to flow out from the area and disperse among owners and employees of international wind turbine manufacturers and service companies. There are therefore inequitable regional effects.

**Alternative 4: RPS.** Most of the financial costs are shared among ratepayers, with a small fraction of the total cost shifted to taxpayers through their financing of soft-loans. The high-risk environment will heavily favour large international companies, which are better suited to manage risks, and will harvest the richest wind resources. Again, the geographic impact will be concentrated in the north of the Province, mitigated to some extent by the small co-op and community projects with access to soft-loans that will be dispersed around the province.

## 6.6 Evaluation Matrix

*Table 17 Evaluation Matrix*

Alternative	Renewable Capacity	Industry Development	Competition	Rate Impact	Equity
1. 2002 Energy Strategy	Low – 60 MW in 2010; 60 MW in 2020	None	Yes	Low - <0.026% in 2010	Equitable
2. REFIT	High – 700 MW in 2010; 980 MW in 2020 Strong certainty	High	Yes	High – 4.2% in 2010, and increasing	Large transfer from ratepayers to owners of wind power projects.
3. RPS-REFIT Hybrid	High – 490 MW in 2010; 980 MW in 2020 Moderate certainty	Low	Yes	Moderate – 1.8% in 2010	Negative geographic impact in Cape Breton
4. RPS	Moderate – 300-400 MW in 2010; 600- 980 MW in 2020 Moderate certainty	Very Low	Yes	High – 3.7% in 2010, but declining	Negative geographic impact in Cape Breton, small benefit to communities with strong wind resources.

## 7 Recommendations

This analysis reveals that international best policy practices can be applied to Nova Scotia to advance the declared objective to meet a significant percentage of the domestic electricity demand from wind power. Unequivocal increases in development can be achieved through regulatory reforms that level the playing field between renewable and conventional sources of power. These changes include:

- Streamlining the wind power permitting process.
- Standardized interconnection costs for new generators based on annual generation rather than capacity.
- Transmission and Ancillary Service charges based on projected annual generation.
- Research, Development and Demonstration investment, focused on formal training and equipment certification.

Beyond these unambiguously beneficial regulatory policies, the central fiscal policy must be politically determined. The current Energy Strategy's conservative RPS does not create the long-term investment climate required for wind power development at a scale commensurate with the wind resource. Only a fraction of the cost-competitive wind power is likely to be developed under the current Energy Strategy. Superior fiscal policy tools are available, however a decision from among the alternative energy policy frameworks requires an evaluation of the trade-offs between objectives. An energy policy framework that includes a REFIT, RPS, or RPS-REFIT Hybrid will develop the entire 980 MW of technical wind power potential by 2020 with medium to high probabilities. The REFIT model will also promote innovation and domestic employment in support industries, but will also have relatively high rate impacts beyond the status quo and may create political difficulties in light of the large financial transfers to the private sector. The RPS has lower aggregate costs, but yields little or none of the employment benefit, and imposes a significant burden on residents on the north coast of the Province. Some of the employment

benefit can be captured using a RPS-REFIT Hybrid approach, but at a slightly higher long-term cost.

The selection of fiscal policy tool requires the Ministers of the Province to deliberate upon the relative weights of the various objectives of the Energy Strategy. The evaluation matrix in Section 6.6 provides a framework for evaluating the four alternatives. Politically determined weightings for each of the objectives allow decision-makers to compare the impacts of each alternative across all five dimensions. Discussions among Ministries of Industry, Environment, Finance and Energy about the relative importance of the Energy Strategy's five objectives is a prerequisite for determining the central fiscal policy tool to drive forward wind power development in Nova Scotia.

## 8 Conclusion

The current Energy Strategy is a conservative step towards developing the wind power potential in Nova Scotia over the short-term. However, analysis of international best practices reveals that long-term political commitments to market-pull fiscal measures and regulatory reform are essential for the development of wind power to approach the technical potential. A vibrant domestic wind power industry also requires inputs of political legitimacy and long-term investor security, which require bold moves from the political leadership in terms of policy and RD&D investment. This analysis has revealed that the Energy Strategy, in order to deliver upon its objective to facilitate a significant development of the wind resources, must be bolder and invest in the foundations of a clean energy future. Specifically, the political leadership must seek to create a long-term, stable energy policy framework that can be relied upon to provide predictable support to wind power developers over a multi-decade timeframe.

There are low-hanging fruit to be plucked through regulatory reform. Political engagement with the municipal and regulatory agencies that administer the permitting and interconnection procedures will reduce some of the key uncertainties facing wind power developers. Executive orders to the system operator to establish production-based transmission and ancillary service tariff structures transfers risks and costs from intermittent power generators to the utility, where they can be more efficiently managed. Also, commitment to practically-focused RD&D, in partnership with academia and the private sector, reduces the long-term costs of wind power in Nova Scotia while increasing the probability of Nova Scotians capturing economic rents of wind power development through increased employment. These three efforts are quick-wins based on international best practice.

This analysis has also made explicit the contributions of the various policy options towards the multiple objectives of the Energy Strategy. There is no unequivocally best option, but the trade-offs among the objectives can now be discussed at the political level to facilitate informed decision-making. Leaders in the Ministries of Industry, Finance, Environment and Energy must deliberate upon the relative weights of the Energy Strategy's objectives to identify which policy alternative best advances the priorities of this government.

# Bibliography

## Works Cited

- Canadian Wind Energy Association (2003). *Low Impact Renewable Energy options for a clean environment and healthy Canadian economy*. Retrieved September 10, 2004, from [www.canwea.ca](http://www.canwea.ca)
- Dale, L. et al. (2004). Total cost estimates for large-scale wind scenarios in UK. *Energy Policy*, 32, 1949-1956.
- European Wind Energy Association (EWEA) (2003). *On the future of EU support systems for the promotion of electricity from renewable energy sources*. Retrieved December 9, 2004, from [www.ewea.com](http://www.ewea.com)
- EWEA (2004). *Windforce 12: a blueprint to achieve 12% of the world's electricity from wind power by 2020*. Retrieved June 3, 2004, from [www.ewea.com](http://www.ewea.com)
- Extern-E (1998). *Power Generation and the Environment – a UK Perspective*. Retrieved September 14, 2004, from [www.externe.jrc.es](http://www.externe.jrc.es)
- Grubb, M. & Meyer, N. (1993). Wind Energy: Resources, Systems and Regional Strategies in Johansson, T.B., eds., *Renewable Energy: Sources for Fuels and Electricity*. Washington: Island Press.
- Fouquet, R. (1998). The United Kingdom demand for renewable energy in a liberalised market. *Energy Policy*, 26, 281-193.
- Hoogwijk, M. (2004). Assessment of the global and regional geographic, technical and economic potential of onshore wind energy. *Energy Economics*, 26, 889-919.
- International Energy Agency (IEA) (2001). Long-term research and development needs for wind energy for the time frame 2000 to 2020. Paris: Author.
- IEA (2002). *Energy Policies of IEA Countries*. Paris: Author.
- IEA (2003). *Renewables for Power Generation: Status and Prospects*. Paris: Author.

- IEA (2004). *Energy Statistics Manual*. Paris: Author
- Jaccard, M. (1995). Oscillating Currents: the changing rationale for government intervention in the electricity industry. *Energy Policy*, 23, 579-592.
- Jaccard, M. (2001). The renewable portfolio standard: design considerations and an implementation survey. *Energy Policy*, 29, 263-277.
- Johnson, A. & Jacobsson, S. (2004). *The Emergence of a Growth Industry: A Comparative Analysis of the German, Dutch, and Swedish Wind Turbine Industries*. Goteburg: Chalmers University of Technology Press
- Kerr, T. (2005). *EPA's role in fostering the US Renewable Energy Market*. Presentation to Vancouver Board of Trade, Vancouver.
- Lauber, V. (2004). REFIT and RPS: options for a harmonized Community framework. *Energy Policy*, 32, 1405-1414.
- Mitchell, C. (2004). Renewable Energy Policy in the UK 1990 – 2003. *Energy Policy*, 32, 1935-1947.
- Nova Scotia Utility and Review Board (2004). *Notice of Application and Direct Evidence of NSPI, in the matter of an approval for an Open Access Transmission Tariff*. Retrieved November 19, 2004, from [www.nspower.ca](http://www.nspower.ca)
- Oliveira, R. & Tolmasquim, M. (2004). Regulatory performance analysis case study: Britain's electricity industry. *Energy Policy*, 32, 1261-1276.
- Oxera Consulting. (2004). *Renewable support policies in selected countries*. Retrieved February 3, 2005, from [www.dti.gov.uk/renewables/renew\\_2.2.5.htm](http://www.dti.gov.uk/renewables/renew_2.2.5.htm)
- Oxera Consulting (2005). *What is the potential for commercially viable renewable energy technologies?* Retrieved February 3, 2005, from [www.dti.gov.uk/renewables/renew\\_2.4.6.htm](http://www.dti.gov.uk/renewables/renew_2.4.6.htm)
- Platts Research and Consulting (2002). *Wind Energy: Integrating an intermittent resource*. Boulder, CO: Author.
- Pollution Probe (2004). *A Green Power Vision and Strategy for Canada*. Retrieved December 20, 2004, from [www.pollutionprobe.org](http://www.pollutionprobe.org)
- Tampier, M. (2002). *Green Power Policies: A Look Across Borders*. Retrieved May 22, 2004, from [www.pollutionprobe.org](http://www.pollutionprobe.org)



Tampier, M. (2004). *Green Power in Canada: Workshop Series*. Retrieved May 22, 2004, from [www.pollutionprobe.org](http://www.pollutionprobe.org)

Tol, R. (2004). The marginal damage costs of carbon dioxide emissions: an assessment of the uncertainties. *Energy Policy*, 33, 2064-2074.

Wijk, A. (1993). *Wind Potential in the OECD Countries*. University of Utrecht.

## **Works Consulted**

Beenstock, M. (1995). The stochastic economics of windpower. *Energy Economics*, 17, 27-37.

Brandt, U. (2004). Fighting Windmills: The Coalition of Industrialists and Environmentalists in the Climate Change Issue. *International Environmental Agreements: Politics, Law and Economics*, 4, 327-337.

Brown, M. (2001). Market failures and barriers as a basis for clean energy policies. *Energy Policy*, 29, 1197-1207.

Cambridge Energy Research Associates (2005). *Window of Opportunity: Is it too late to enter the renewable energy market in North America?* Cambridge: Author.

Gagnon, L., Belanger, C. & Uchiyama Y. (2001). Life-cycle assessment of electricity generation options: The status of research in year 2001. *Energy Policy*, 30, 1267-1278.

European Renewable Energy Council (EREC) (2004). *Renewable Energy Policy Review: United Kingdom*. Brussels: Author.

Fischer, C. & Newell, R. (2004). *Environmental and Technology Policies for Climate Change and Renewable Energy*. Retrieved July 29, 2004, from [www.rtf.org](http://www.rtf.org)

Hadjilambrinos, C. (2000). Understanding technology choice in electricity industries: a comparative study of France and Denmark. *Energy Policy*, 28, 1111-1126.

Hughes, L. (2004). *Submission to the Law Amendments Committee: Bill 87, An Act Respecting Electricity*. Halifax: Dalhousie University.

IEA (2004). *IEA Wind Energy Annual Report 2003*. Paris: Author.

Imperial College of London (2003). *Review of renewable energy development in Europe and the US*. Retrieved from [www.dti.gov.uk](http://www.dti.gov.uk)

- Marbek Resource Consultants (2004). *Case Study on Renewable Grid-Power Electricity*. Retrieved October 12, 2004 from [www.nrtee-trnee.ca](http://www.nrtee-trnee.ca)
- Menanteau Philippe, Finon Dominique & Lamy Marie-Laure. (2003). Price versus Quantities: choosing policies for promoting the development of renewable energy. *Energy Policy*, 31, 799-812.
- Meyer, N. (2003). European schemes for promoting renewables in liberalised markets. *Energy Policy*, 31, 665-676.
- Middtun A. & Koefoed A. (2003) Greening of electricity in Europe: challenges and developments. *Energy Policy*, 31, 677-687.
- Navigant Consulting. (2002). Issue Paper Series: Nova Scotia Electricity Marketplace Governance Committee. Toronto: Author
- Nova Scotia Energy Strategy: Seizing the Opportunity* (2002). Retrieved February 9, 2004, from [www.gov.ns.ca/energy](http://www.gov.ns.ca/energy)
- Pape, A. (1999). *Lost opportunities: Canada and Renewable Energy*. Retrieved March 10, 2004, from [www.pembina.org](http://www.pembina.org)
- Powering Nova Scotia's Economy: A Public Discussion Paper of the Province's Energy Strategy*. (2001). Retrieved February 9, 2004, from [www.gov.ns.ca/energy](http://www.gov.ns.ca/energy)
- United Nations Environment Programme (UNEP) (2000). *Natural Selection: Evolving Choices for Renewable Energy Technology and Policy*. Paris: Author.
- Whitmore, J. 2003. *Green Power Programs in Canada*. Retrieved March 10, 2004, from [www.pembina.org](http://www.pembina.org)