

# Policy Analysis

## *The Perils of Picking Technological Winners in Renewable Energy Policy*

**An Energy Probe study**

**by Michael J. Trebilcock and James S.F. Wilson\***

March 5, 2010

---

\*Michael Trebilcock, Professor of Law and Economics, University of Toronto Faculty of Law. James Wilson, AB (*magna cum laude*) (Harvard), JD (University of Toronto).

We are indebted to Don Dewees, Edward Iacobucci, Andrew Green, Rod Taylor and Larry Solomon for comments on an earlier draft.



## Table of Contents

<b>1. Introduction</b>	<b>3</b>
<b>2. Context for Discussion</b>	<b>4</b>
<b>3. The Perils of Picking Winners</b>	<b>8</b>
<b>a. Picking Technologies (Wind Power)</b>	<b>8</b>
<b>b. Picking Applications of Technologies (Corn-Based Ethanol)</b>	<b>14</b>
<b>c. Picking Products (The Chevrolet “Volt”)</b>	<b>18</b>
<b>4. A Winner Neutral Approach</b>	<b>19</b>
<b>a. Price Signals</b>	<b>20</b>
<b>b. Direct and Indirect Public Investments in R&amp;D (And Other Stages Of Development)</b>	<b>21</b>
<b>c. Public Investments in Infrastructure</b>	<b>24</b>
<b>d. Market Integration</b>	<b>25</b>
<b>e. The Role of Subsidies</b>	<b>26</b>
<b>5. Who Decides and How?</b>	<b>28</b>
<b>6. Conclusion</b>	<b>31</b>
<b>Endnotes</b>	<b>33</b>

# 1. Introduction

Policymakers, for the most part, have accepted the scientific consensus on the man-made causes of global warming, including the likely effects and potential costs of global warming,<sup>1</sup> and they have accepted as calamitous the prospect of failing to combat it.<sup>2</sup> Policy-makers have then shifted their focus from the severity of the problem to deciding what to do about it. Because the production and consumption of energy accounts for a substantial portion of greenhouse (GHG) emissions, energy policy will play a central role in this discussion.<sup>3</sup> In particular, most policy makers believe that the planet's growing energy needs cannot be met at a sustainable rate of GHG emissions using existing technologies. As a consequence of this, policy-makers face three basic imperatives: (1) curbing greenhouse GHG emissions by reducing demand for energy, while increasing the supply of "clean" energy from currently available sources, and (2) hastening the transformation of how we produce and consume energy, by fostering innovation;<sup>4</sup> while (3) ensuring that domestic economic interests are protected in the transition to a "green" economy – a political as well as a practical matter.<sup>5</sup> In order to increase the supply of clean energy as well as the demand for it (and to reduce demand

for energy overall) policy-makers are adopting three basic policy measures: 1) conservation initiatives; 2) price signals, delivered through cap-and-trade regimes and/or carbon taxes; and 3) technology policies – that is, public investments (subsidies, taking various forms)<sup>6</sup> plus financial and regulatory incentives for private investment in the research and development, demonstration, deployment and commercialization of currently available and next-generation clean energy technologies – sometimes targeted at particular technologies, sometimes targeted at all of them.

In theory, these three basic measures (conservation initiatives, price signals and technology policies) can be designed to provide strong positive reinforcement for each other as well as the overarching goals of policy-makers (curbing emissions, fostering innovation and protecting domestic interests). In practice, conflicts will arise. In this paper, we discuss some of the conflicts that may arise because of widespread reliance on one form of technology policy – public subsidies for currently-available green energy technologies<sup>7</sup> – and we propose a means of avoiding these conflicts by adopting an alternative approach to technology policy that excludes these forms of public subsidies: a "winner neutral" approach that prioritizes public investments that many different market actors can benefit

**Conflicts may arise because of widespread reliance on one form of technology policy – public subsidies for currently-available green energy technologies**

**It is difficult to “pick winners” for technological reasons; and it is difficult to avoid trying, for political reasons**

from as they compete to discover and develop “winning” (i.e. environmentally friendly and economically viable) energy technologies.

The plan of the paper is as follows.

In Part 2 we set out the context for discussion, highlighting the ways in which technological uncertainty and political calculations can shape (and ultimately distort) the renewable energy policy choice set. In Part 3, we illustrate the potential folly of the picking winners approach. Using the example of wind power generally, we highlight the difficulty of determining which technologies will prove to be environmentally friendly in a given jurisdiction. Using the example of corn-based ethanol in North America, we highlight the costs of public investments in specific applications of commercialized technologies that turn out to be environmentally unfriendly. Using the example of a recent rebate program for a single class of electric cars in Ontario, we highlight the political calculations involved in product-specific subsidies for clean energy technologies. In Part 4 we provide an outline of what a “winner neutral” approach to renewable energy policy might look like, emphasizing public investments in public goods such as R&D, energy storage technologies, and advanced electricity grid infrastructure, along the lines set out in the context for discussion, below. In Part

5, we turn to questions of process. We contrast how two governments that are currently in the process of establishing comprehensive green energy policies and legislative schemes – the United Kingdom and Ontario – have (and have not) demonstrated transparency in these processes, and the potential consequences of this for the administrative bodies that are responsible for implementing elements of these green energy policies. Part 6 concludes.

## **2. Context for Discussion**

The motivation for this paper is the recent steps taken by the government of Ontario to develop and refine a comprehensive renewable energy policy.<sup>8</sup> Nonetheless, it is hoped that our discussion will also shed light on the choices faced in many other jurisdictions. Public subsidies for currently-available green energy technologies raise two basic problems: it is difficult to “pick winners” (i.e. to identify in advance the technologies that will deliver expected benefits), for technological reasons; and it is difficult to avoid trying, for political reasons. We will review each of these in turn. First, there is room for doubt about the environmental friendliness of some currently available clean energy technologies, which may do more harm than good when their full life cycle is taken into account (corn-based ethanol

being a notorious example) or (as in the case of wind power) because their costs may outweigh their benefits (in economic as well as environmental terms) when context-specific considerations are taken into account, beginning with the quality of the resource in question (i.e. the wind, at proposed sites) but also including a given jurisdiction's existing energy generation mix and infrastructure. Intermittent renewable energy sources such as wind may require backup sources of power generation and sophisticated grid infrastructure in order to provide reliable clean power to the grid; these factors may ultimately determine whether wind power is "clean" in a given jurisdiction. Moreover, the degree to which wind power can be fairly characterized as a clean power alternative may depend on the alternative forms of clean power that wind displaces. In some cases, especially where investments in clean backup generation and new infrastructure are not practicable, cleaner and more cost-effective alternatives to wind power may be available, such as investing in the generation of, or buying from neighboring jurisdictions, hydro or nuclear power, or natural gas.<sup>9</sup> Put another way, not every form of renewable energy may be good for the environment and not every jurisdiction may be particularly well-suited to every form of renewable energy, depending on the kinds of complementary investments that

are required and the alternative forms of clean power that may be available. A second problem with public subsidies is that political considerations transform the "picking winners" approach into an attractive gamble. So that politicians are able to take credit for curbing GHG emissions while "creating" green jobs (i.e. fostering the conditions in which firms can hire new workers and contract for services), policy-makers are under considerable pressure to associate existing natural resource and labour endowments with currently available clean energy technologies, notwithstanding concerns about the environmental impact of these technologies or the long-term viability of these jobs (indeed, it is not clear that policy-makers and politicians will always agree on what actually constitutes a green job).<sup>10</sup> Again, corn-based ethanol subsidies, which have provided a boon to North American farmers and the politicians who support them, provide a cautionary example.<sup>11</sup> For similar reasons, some jurisdictions have adopted costly public support for perceived technological "winners" – such as wind power – with mixed success (in environmental as well as economic terms). This becomes especially problematic when governments take credit for abating emissions using the proxy of increased production of energy from renewable energy sources, regardless of whether these abatements are being

**Intermittent renewable energy sources such as wind may require backup sources of power generation**

**Public subsidies for technologies that do not “pan out” may harm the environment**

realized in fact. The same pressures may also undermine environmentally-friendly policies that would create non-domestic jobs, such as importing clean energy and clean energy technologies from other jurisdictions, and instead favour higher-cost local sourcing. Short-term political calculations may also forestall costly, but cost-effective and environmentally-friendly, investments in “public goods” such as “smart” infrastructure<sup>12</sup> and energy storage technologies,<sup>13</sup> especially when the beneficiaries of these investments cannot be identified in advance. In addition, political calculations have forestalled attempts to reduce subsidies to fossil fuels, and to use prices to reduce demand for energy produced from fossil fuels, through the imposition of cap-and-trade regimes or carbon taxes (although this may be changing). In summary, political concerns play a role in the downgrading of environmental priorities (i.e. emissions abatement) to a secondary or merely implied effect of “green policies” that prioritize job creation and other distributional concerns. As we will emphasize throughout this paper, this re-ordering of priorities may be insupportable in light of the long term goal of abating GHG emissions. In the words of a 2005 report of the (Canadian) National Round Table on the Environment and the Economy points out, “the present policy debate

often tends to assume an inherent substitutability between sustainable energy initiatives...and this assumption may not always hold true”; in fact, “the pursuit of [various] objectives of a sustainable energy strategy, without a specific long-term carbon emission reduction objective, may lead to perverse emission impacts”.<sup>14</sup>

In light of these concerns, in this paper we take as our starting point the potential downsides to public investments in technologies that cannot deliver on their promised benefits, both in terms of GHG emissions abatement and otherwise. Public subsidies for technologies that do not “pan out” may harm the environment while diverting resources from more environmentally-friendly alternatives. They also may create a risk of “locking in” technologies that damage the environment, owing to interest group politics and other features of path dependency.<sup>15</sup> In the longer term they may waste valuable resources of time, money and public will, thereby risking the government’s capacity to respond to beneficial technological developments.<sup>16</sup> In summary, a failure to articulate the real costs and tradeoffs involved in the transition to a green economy, coupled with aggressive action based on untested assumptions or short-sighted political calculations, may have deleterious effects for the environment as well as environmental policy in the long

term.

What this means in practice is that we favour a “winner neutral” policy approach, whereby the government invests heavily in basic research and development and pilot projects involving clean energy technologies; as well as other public goods such as smart infrastructure, both directly and through support for venture capital financing of the clean technology industry, while creating a regulatory and legislative environment that encourages conservation (through price signals) and spurs private investment in clean energy technology, thus leveraging market activity to discover and bring to market technological innovations as rapidly as possible. We also highlight, in North America, the role that enhanced integration of energy markets can play in meeting the demand for clean energy. We contrast this with the “picking winners” approach, whereby the government adopts subsidies and other forms of direct financial and regulatory support for early-generation technologies – especially where governments have not attempted to forecast the net environmental benefits (and other promised benefits) accruing to these technologies over their full life cycle, and to identify and prioritize complementary changes in policy and other investments that may be required to help ensure that the government’s

environmental and other goals are likely to be achieved as forecast. To summarize: if our ultimate goal is to abate emissions as rapidly and cost-effectively as possible while laying the groundwork for a green energy future, as well as to advance ancillary goals that will help to sustain this progress, such as saving resources and creating green jobs, then the picking winners approach runs a considerable risk of failure. In contrast, winner-neutral policies may help us to realize our environmental and ancillary goals as efficiently as possible.<sup>17</sup> Finally, we advocate transparency in the process of developing green energy policies and laws. Because climate change policies will require substantial trade-offs specific to each jurisdiction, we argue that it is imperative that governments be transparent in setting their goals and priorities based on the best evidence available, and be candid with the public about the connections and potential conflicts that may arise between these goals and priorities. In particular, from an administrative law perspective, we suggest that it is incumbent upon the executive to set clear goals and priorities so as to provide adequate guidance to administrative bodies in the energy sector, as the mandates of these bodies change to encompass a wide range of social values.

**We advocate transparency in the process of developing green energy policies and laws**

**A reliable estimate of the cost of wind power, compared with other sources of energy, is difficult to ascertain**

### **3. The Perils of Picking Winners**

#### **Picking Technologies (Wind Power)**

In this section we review the costs, environmental benefits and potential for job creation associated with generating electricity from wind power.<sup>18</sup> We close with a comment on the question of substitution – i.e. which resources wind power will be displacing, and the value of that displacement from an economic and environmental perspective.

Setting aside hydro, wind power is one of the most mature of the currently available renewable energy technologies. A recent review of the literature estimating the cost of producing electricity from wind power concludes that a reliable estimate of the cost of wind power, compared with other sources of energy, is difficult to ascertain because of differing assumptions about which inputs should be included in the cost of production and the appropriate discount rates (associated with wind as well as other power sources).<sup>19</sup> Other factors affecting the cost will include the level of market penetration of wind power in a given jurisdiction and the sophistication of the existing electricity grid.<sup>20</sup> But the quality of the resource (i.e. the wind) and the cost of production are the number one and two factors affecting the cost of wind power.<sup>21</sup> The

Global Wind Energy Council (GWEC), an industry body, and Greenpeace International estimate the cost of wind power at 6.3-9.5cents/kWh at high wind speed sites, and 9.5-14.3cents/kWh at low wind speed sites.<sup>22</sup>

While costs may be declining, and because wind farms are capital intensive, the viability of the industry relies to a large extent on government subsidies and policy certainty. The major national investors in wind power are Denmark, Germany and Spain. A brief prepared by the consulting firm Bain & Company suggests that four policy instruments have combined to establish wind turbine manufacturing (and associated technological clusters) in these countries, which together account for more than half of the wind industry's workforce in the European Community: (1) support schemes to reduce commercial uncertainty (e.g. feed-in tariffs); (2) investments in infrastructure, such as grid improvements; (3) expedited planning consents (e.g. single-window approaches to the regulatory approvals process); and (4) encouraging the participation (economic and otherwise) of local communities in the development of wind farms ("generated either through opportunities for participation in ownership of wind farms or through tax revenues paid to local authorities by wind farms for tangible benefits to the community").<sup>23</sup> Similar policies are



being adopted in North America.<sup>24</sup>

In terms of the environmental costs and benefits of wind power, GWEC estimates that a wind farm can repay its environmental costs (i.e. the GHG emissions produced in the manufacture, installation and servicing of the wind farm over an average 20 year lifecycle) within three to six months.<sup>25</sup> It is often said that after a wind farm is installed it requires no fuel, but this is misleading. Wind is an intermittent resource, which raises two basic issues from a supply management perspective: in order to be a reliable source of power to the grid, wind power needs backup or storage. In terms of day-to-day back-up, from an environmental perspective, wind would ideally be paired with hydro which can be “ramped” up and down quickly with low GHG emissions. Dirtier forms of back-up may offset the environmental benefits of adopting wind altogether<sup>26</sup> while other forms of power generation (such as nuclear) are not suitable for back-up at all. It is also possible to “smooth” the supply of wind by connecting geographically dispersed wind farms to the electricity grid, although the degree to which this is possible depends on the quality of the resource and the availability of appropriate sites.<sup>27</sup> Connecting remote wind farms to the grid will involve trade-offs in terms of the cost and quality of the resource. Improved forecasting methods may also

make wind power more predictable and therefore the supply of electricity from wind farms easier to manage. In terms of storage, whether the wind blows when power is needed is a wholly site-specific issue; where there is a mismatch between supply and demand, the wind resource is unusable because (as of yet) there are no commercially viable means of storing energy from wind farms, apart from hydro-pump storage. Hydro-pump storage is relatively inefficient, new facilities are costly and whether they are viable depends on the hydro resource. Wind power that is not needed can be sold to neighboring jurisdictions, although whether this is possible will depend on the quality of the integration of the neighboring grids, may not be cost-effective, and may be impractical where both neighbors are wind power producers and both are looking for a market for excess power. All of these considerations weigh into the balance both in terms of the economic cost of wind power but also its environmental impact, primarily because of the kinds of power relied upon for back-up and how much back-up is ultimately required. On the negative side of the environmental ledger, industrial wind turbines may also have adverse impacts on birdlife and other forms of wildlife, farm animals, wetlands, and viewsheds, and potentially adverse health effects on neighbouring residents arising from

**Connecting remote wind farms to the grid will involve trade-offs in terms of the cost and quality of the resource**

**Wind power cannot make a major contribution to base-load power because it generates so little electricity**

persistent exposure to low-intensity noise and vibrations.<sup>28</sup>

In terms of job creation, we observe that most of those employed in the industry are employed in manufacturing turbines, although the industry supports labour associated with consulting and siting and, to a lesser extent, installation and maintenance;<sup>29</sup> wind farms are designed to be controlled remotely, with minimal maintenance. The indirect effect of subsidies for wind power on jobs may be negative or neutral. Subsidies for wind power are usually financed (directly or indirectly) through higher taxes or electricity prices, or both. Although higher electricity costs are critical to the success of conservation and efficiency initiatives, these also put considerable pressure on jobs in electricity-intensive sectors; conversely, lowering the price of electricity may increase consumption, thereby offsetting the environmental benefits of adopting renewables.<sup>30</sup> In response to these concerns, several European countries have exempted industry from higher electricity costs associated with subsidies for renewable energy; these exemptions may erode the environmental benefits of adopting renewables.<sup>31</sup>

In summary, in a best case scenario, wind may become cost competitive with power from fossil fuels in the medium term.<sup>32</sup> In order to capture the environmental benefits of wind

power, in the best of all possible worlds it would be paired with clean sources of backup power, improvements to the electricity grid and investments in R&D for enabling technologies such as battery storage. Over time, with improvements in wind forecasting and storage capacity, and advances in grid technology, wind may become a reliable part of the energy mix, including community and home generation. The contrary view is that wind power cannot make a major contribution to base-load power because it generates so little electricity – i.e. to make a major impact one would have to cover much of the country-side with wind-turbines.<sup>33</sup> With respect to peak load power, the argument is that wind power cannot be relied upon because of its intermittency, which implies the need for fossil fuel back-up generation (as the current Ontario government has apparently acknowledged, at least implicitly, in directing the construction of new natural gas generation plants to replace existing peaking coal plants); the only other alternative is better integration with neighbouring markets with hydro power and ideally non-coincident peaks (or stored hydro). Apart from these broad conclusions, however, the lesson we draw from reviewing the literature is that whether wind will be reliable, environmentally-friendly and cost-effective in the near term, in any given jurisdiction, will depend on the

wind resource itself as well as the existing energy mix and sophistication of the grid, including storage capacity and prospects for regional integration. In any event, in any jurisdiction, a basic question that remains to be asked (as with any other alternative source of energy) is what forms of energy generation is the green alternative replacing and/or displacing? Where investments in wind power promise marginal environmental and economic benefits, this question becomes more acute. For example, Ontario already relies heavily on hydro and nuclear power –sources of energy that are desirable in terms of GHG emissions.<sup>34</sup> Recognizing the downsides of relying on nuclear power, we note that Quebec has massive hydro resources. In the winter of 2008-2009, demand for energy dropped sufficiently to produce an energy surplus in Ontario, which was sold to the northern United States at a loss.<sup>35</sup> In this context, and in light of the province's ambitious carbon abatement goals,<sup>36</sup> politicians in Ontario might choose to prioritize investments in an enhanced east-west electricity grid connection between Quebec and Ontario (and perhaps in the longer term, Manitoba, Newfoundland and Labrador),<sup>37</sup> rather than forecasting substantial GHG emissions abatements based on the provision of subsidies for small-scale renewable energy projects (among other

initiatives), especially absent compelling evidence to demonstrate that the most mature of these technologies, such as wind power, are environmentally friendly and cost effective in Ontario.<sup>38</sup> In particular, in an Ontario context there are doubts about the costs of wind power relative to conventional forms of electricity generation; its likely impact on carbon emissions in the province; its net impact on employment in the province (given its likely higher costs); and its environmental and health impacts.<sup>39</sup> Many of these issues have been cast into sharp relief in a recent detailed study by the Centre for Policy Studies in Copenhagen, Denmark (CEPOS): *Wind Energy: The Case of Denmark*.<sup>40</sup> While proponents of wind power often claim that almost 20 percent of Danish electricity is generated by wind power, in fact over the last five years only about 9 percent of domestic electricity consumption has been accounted for by wind power, with the balance of surplus power exported to Norway and Sweden. Spot prices for exports are substantially lower (often zero) than the subsidized prices guaranteed to Danish wind turbine operators whereas imported balancing power from these countries typically costs substantially more. Wind power exported to Norway and Sweden supplants largely carbon-neutral electricity from hydro or nuclear in the Nordic countries. To the extent

**Ontario already relies heavily on hydro and nuclear power –sources of energy that are desirable in terms of greenhouse gases**

**Based on the total subsidies to the Danish wind industry, the average subsidy for the 28,000 workers employed in this sector equals US \$9,000 to \$14,000 per year**

that it has saved any carbon emissions in Denmark, this comes as a subsidy cost of about \$124 per tonne of carbon – one of the most expensive carbon reduction strategies in the world.

In order to keep Danish industry competitive, electricity to industry is hardly taxed at all so that the disparity between what householders and industry pay for their electricity is very large – Danish householders pay 2.5 times more than Danish industry. Even before taxes, the average consumer price for wind generated electricity is 50 percent higher than that from fossil fuel-generated electricity.

Based on the total subsidies to the Danish wind industry, the average subsidy for the 28,000 workers employed in this sector equals US \$9,000 to \$14,000 per year. However, this average subsidy does not reflect the actual cost of the additional job creation. In most cases, creating a job in the wind sector has only moved that job from another sector and not resulted in any additional job creation. A very optimistic ball park estimate of real net jobs created is around 10 percent of the total wind power work force, or 2,800 jobs. In this case, the actual subsidy for the additional jobs created is US \$90,000 to \$140,000.

The study finds that the energy technology sector in Denmark from 1999 to 2006 underperformed the broader manufacturing sector in

Denmark by an average of 13 percent in terms of value added. The study finds that Danish GDP is approximately \$270 million lower than it would have been if the wind sector workforce was employed elsewhere. The Danish Economic Council concluded in a report in 2006: “The wind power expansion in the 1990s is an example of a policy that was unprofitable from society’s point of view, even taking the economic advantages that the wind business enjoyed into consideration.” The CEPOS study concludes: “Denmark needs a proper debate and a thorough reappraisal of the technologies that need to be invented, developed, and costed before forcing the country into a venture that shows a high risk of turning into an economic black hole.”

Similar conclusions have been reached in a recent study focused on Germany, *Economic Impacts from the Promotion of Energies: The German Experience (Final Report)*, conducted by the Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI).<sup>41</sup> The study finds that on-shore wind in Germany requires feed-in tariffs that exceed the per-kWh cost of conventional electricity by up to 300 percent to remain competitive. Wind power subsidies may total USD \$28.1 billion for wind converters installed between 2000 and 2010. In 2008 the price mark-up due to the subsidization of green

electricity was US 2.2 cents per kWh, meaning subsidies account for about 7.5 percent of average household electricity prices. The carbon abatement cost for green power is approximately USD \$80 per tonne.

The study also finds that while employment projections in the renewable energy sector convey seemingly impressive prospects for gross job growth, they typically obscure the broader implications for economic welfare by omitting any accounting of off-setting impacts. These impacts include job losses from crowding out of cheaper forms of conventional energy generation, indirect impacts on upstream industries, additional job losses from the drain on economic activities precipitated by higher electricity prices, and diverting funds from other, possibly more beneficial investments. Per worker subsidies for renewable energy in Germany run as high as US \$240,000. The study further suggests that popular claims about the technological innovation benefits of Germany's first actor status are unsupportable. In fact, the regime appears to be counter-productive in that respect, stifling innovation by encouraging producers to lock-in to existing technologies. In conclusion, the study asserts that while Germany's promotion of renewable energies is commonly portrayed in the media as setting a "shining example

in providing a harvest for the world", instead the national first mover provides a cautionary tale of costly environmental and energy policies devoid of economic and environmental benefits.

We ourselves caution against generalizing too broadly and applying the lessons of one jurisdiction to another without close attention to context: as Tom Adams observes, "[g]libly importing analysis and conclusions from other jurisdictions without examining the context is regrettably the norm" in discussions of wind power, in spite of the importance of context – e.g. the quality of a given jurisdiction's wind resource, existing energy mix, grid and grid integration.<sup>42</sup> Nonetheless, these strong negative opinions about the prospects for wind power generation as a major alternative source for base load power generation, let alone peak load generation (i.e. as distinct from a small-scale supplemental source of energy) in Denmark and Germany should serve as their own form of caution to policymakers eager to emulate the apparent success of public subsidies for wind power in these countries. In *The Vanishing Face of Gaia: A Final Warning*, for example, distinguished earth scientist James Lovelock charges that "Europe's massive use of wind as a supplement to base-load electricity will probably be remembered as one of the great follies of the twenty-first century".<sup>43</sup> In any case, it seems

**Popular claims about the technological innovation benefits of Germany's first actor status are unsupportable**

## **Biofuels production is heavily dependent on public subsidies and other forms of financial and regulatory support**

reasonable to us to conclude on the basis of evidence to date that promoting wind power in any given jurisdiction will involve important trade-offs, in terms of emissions abatement, job creation and costs that are particular to each jurisdiction. As we argue below, these tradeoffs deserve close scrutiny and should be reflected in the political discussion over whether to offer public subsidies for wind power generation in every jurisdiction. At a minimum, a frank assessment of the costs and benefits may highlight potentially cleaner and/or more economically productive and cost-effective alternatives to wind power in at least some jurisdictions, and will help to ensure that any given set of policies will yield the expected benefits.

### **Picking Applications of Technologies (Corn-Based Ethanol)**

In this section we review the costs, environmental benefits and potential for job creation associated with producing biofuel (ethanol) from corn, while emphasizing the role that subsidies have played in creating a market for this form of biofuel and the political cost of reducing or eliminating these subsidies in light of widespread reliance on these subsidies by agricultural producers. There are three basic categories of biofuels, which are used as an additive or alternative (in specially designed engines)

to conventional fossil fuels: ethanol produced from sugars and starches in cereal crops (such as corn, sugar cane and sugar beet); “second generation” ethanol, which is not yet commercially available, produced from cellulosic material (such as crop waste, wood and grasses); and diesel made from fatty acids (i.e. vegetable oils and animal fats, such as soybean, rapeseed and other vegetable oils, and used frying oils). Biofuels are extremely costly to produce, owing to the relatively low energy density of the feedstock and the vast amount of it that is required to produce useable quantities of fuel. Added to these basic costs is the expense of producing, transporting, storing and distributing the fuel, and the specialized infrastructure that is needed to do all of these things (biofuels are refined in coal or gas plants, but the finished fuels cannot be handled in the same way as conventional gas or diesel).<sup>44</sup> The costs of producing ethanol may be partly offset by the sale of byproducts such as vegetable oil and livestock feed.<sup>45</sup> As a consequence of its high cost, biofuels production is heavily dependent on public subsidies and other forms of financial and regulatory support. The OECD describes three main categories of support:<sup>46</sup> (1) budgetary support measures, i.e. supports that directly affect the public budget, such as tax breaks and spending measures targeted at producers, retailers or consumers,

which may be available at every stage of the supply chain;<sup>47</sup> (2) blending or use mandates, which are generally neutral for public budgets, but result in higher fuel prices for consumers; and (3) trade restrictions, which also result in higher fuel prices for consumers. Considering the degree of public support required to produce biofuels, a common method of evaluating their cost is to calculate the cost per unit of fossil energy or GHG avoided.<sup>48</sup> The OECD estimates that (as of 2008) budgetary support, mandates and trade restrictions had reduced net GHG emissions and fossil fuel use (in most transport sectors) by less than 1% of their respective totals, at a rough cost of between US\$0.80 and \$7 per litre of fossil fuel avoided.<sup>49</sup> In the Canadian context, a recent estimate concludes that ethanol from corn requires between \$0.50-0.70 per litre in subsidies to avoid a litre of energy produced from fossil fuels: “enough to purchase the displaced fuels with the subsidy alone”.<sup>50</sup> The OECD also emphasizes the broader impact of these policies. While cautioning that the medium-term impacts on agricultural commodity prices should not be overestimated, the report concludes that “future policy developments matter: with full implementation of the recently enacted US Energy Independence and Security Act and the currently proposed new EU Directive for Renewable Energy, close to

20% of global vegetable oil production and more than 14% of world coarse grain output could shift to biofuels production” with a corresponding effect on global food prices, biodiversity and other environmental consequences.<sup>51</sup> We note, further, that trade restrictions protect domestic suppliers and producers of biofuels at the expense of lower-cost alternatives from abroad and may have the effect of limiting the development of alternatives domestically.

The basic proposition in favour of biofuels, from an environmental perspective, is that the feedstock absorbs from the atmosphere about the same amount of carbon dioxide that it releases when it is burned as fuel. Whether this is accurate or not depends on the energy density of the feedstock, how and where it is cultivated, how it is refined into fuel, and how it is consumed (the “lifecycle” of the fuel). There is considerable debate over how to calculate the environmental impact of the lifecycle of different feedstocks.<sup>52</sup> At a basic level, because of the relatively low energy density of biofuels, a great deal of land is required for feedstock production; environmental impacts associated with production thus include nutrient and pesticide runoff. Fossil fuels are necessary for the cultivation and refinement of biofuels, and the transportation of biofuels once they are refined. The cultivation of feedstocks for biofuels worldwide

**Close to 20% of global vegetable oil production and more than 14% of world coarse grain output could shift to biofuels production**

**The environmental cost of biofuels should include “indirect land-use change”, meaning deforestation in other parts of the world**

also has significant consequences for biodiversity as well as the displacement of food production. Some scholars argue that the environmental cost of biofuels should include “indirect land-use change”, meaning deforestation (the destruction of valuable carbon sinks) in other parts of the world.<sup>53</sup> In terms of consumption, the GHG emissions produced in burning biofuels depends on the blend. Some of these considerations may be mitigated, as follows. In terms of energy density, and overall environmental impacts, cellulose-based biofuels show considerable promise, but none are yet commercially available.<sup>54</sup> The same is true (to a greater and lesser extent) of the broad range of “second generation” biofuels currently being proposed – a term encompassing everything from biofuels made from crops grown on degraded or non-ideal farmland to biofuels made from plant wastes or specially designed crops. In terms of first generation biofuels, the OECD estimates that ethanol produced from sugar cane (the dominant feed stock in Brazil) can be 80% cleaner than conventional fossil fuels, but this effect is substantially offset by the extent of deforestation involved in clearing land for sugar production. By contrast, ethanol produced from corn, which is overwhelmingly favoured in North America, is generally less than 30% cleaner than traditional fuels.<sup>55</sup> Ethanol produced from wheat, sugar

beet or vegetable oils fall between these extremes, and may be anywhere from 30 to 60% cleaner than ordinary fossil fuels. In any case, as we have noted, the same broader environmental impacts (such as deforestation) are associated with each of these alternatives.

Taking these considerations into account, the question of how governments evaluate the environmental impact of biofuels policies becomes integral to the policy discussion. In the United States, under the Energy Independence and Security Act (EISA, 2007)<sup>56</sup> the Environmental Protection Agency (EPA) is required to establish mandatory lifecycle GHG reduction thresholds for renewable fuels (renewable fuels need to show a 20% improvement in GHG emissions over standard fuels). With respect to ethanol, the EPA has recently proposed, for discussion, a variety of possible methods for conducting the lifecycle analysis.<sup>57</sup> In particular, the EPA estimates that, over a 30 year lifecycle, ethanol produced from corn will be between 5% and 35% dirtier than conventional fossil fuels (depending on whether the ethanol is produced using natural gas or coal); over a 100 year life cycle, the Agency estimates that ethanol produced from corn will be between 13% and 16% cleaner than conventional fossil fuels<sup>58</sup> – a meager achievement and, in light of the proposed time frame, essentially meaningless.<sup>59</sup> A striking



implication of these estimates is that under neither scenario would corn-based ethanol be approved as an alternative fuel under EISA. Nonetheless, under proposed rules 15 billion gallons of “first-generation” biofuels – almost double the most recent annual output of the industry – would be exempted from the approvals process, regardless of their emissions.<sup>60</sup>

A recent review of public support for biofuels in Canada, conducted for the International Institute for Sustainable Development (IISD), concludes that “the Canadian federal government’s rationale for supporting biofuels is predicated on there being net environmental benefits from this approach” and that “the broader suite of environmental impacts that might arise from accelerated biofuels production is not currently taken into account in Canadian policies.”<sup>61</sup> By contrast, the report notes that British Columbia includes environmental criteria in its assessment of requests for support, and that Quebec has “turned away from support for ethanol production from corn and instead is focusing on cellulose ethanol production from its forest and household waste.”<sup>62</sup> The province of Ontario subsidizes production through the Ontario Ethanol Growth Fund (OEGF) and has in place a 5% ethanol mandate for gasoline. In terms of environmental impacts of support for biofuels, the Ontario

Ministry of the Environment states on its web site that “[r]egulating the use of ethanol in gasoline will lead to cleaner air in Ontario and play a key role in reducing greenhouse gases”, and that “Ontario’s 2007 target for ethanol will reduce annual greenhouse gas emissions by about 800,000 tonnes, equivalent to removing 200,000 cars from the road”, with no mention of the potential trade-offs involved.<sup>63</sup>

Subsidies and other forms of financial and regulatory support for corn-based ethanol in North America are popular because they enable politicians to associate existing resources (farmers and farmland) with something they can characterize as green energy technology and the creation of green jobs. The consequences of this support provide a cautionary example of the trade-offs involved in support for early generation technologies that may do more harm than good, economically and environmentally, when their full lifecycle is taken into account, locally as well as globally. The biofuels case provides a dramatic example of the environmental cost of politically saleable policies that obscure their true social cost, as well as the opportunity cost of finding other ways to achieve social goals. In the best case scenario the advantage of producing ethanol from corn are marginal, from an environmental perspective; by comparison, the advantages of producing

**The biofuels case provides a dramatic example of the environmental cost of politically saleable policies that obscure their true social cost**

**The government's decision to subsidize a single product in spite of all other alternatives is highly problematic**

ethanol from other crops are substantial. Tacit acknowledgment by policy-makers of these considerations is implied by the trade measures that have been taken in the U.S. to protect domestic producers of corn-based ethanol from producers of sugar cane-based ethanol in Brazil – notwithstanding the environmental costs of both forms of production. Meanwhile, it is unlikely that governments in North America will reverse course, except in modest ways, given the power of farmers' lobbying groups and their vested interest in ethanol production and refinement. As we have seen, the United States is "grandparenting" corn-based ethanol production regardless of lifecycle accounting. Other governments also appear to be changing course, in modest steps. In Ontario, the current premier suggested, during the most recent provincial election campaign, that he would raise the ethanol mandate for gasoline from 5% to 10% by 2010, but this has yet to happen – it has been suggested, because of the environmental impact.<sup>64</sup>

**Picking Products (the Chevrolet "Volt")**

So far we have provided a preliminary basis for evaluating the potential value of subsidies for a specific, currently available green energy technology (wind power) as well as a specific form of green energy

technology (corn-based ethanol), in order to highlight the tradeoffs that may be involved in the decision to subsidize these in a given jurisdiction; in closing we note that governments may also choose to subsidize specific green energy technology products. In the spring of 2009, for example, the government of Ontario announced its goal to ensure that one in twenty passenger vehicles in the province are electric by the year 2020 ("1 in 20 by 2020").<sup>65</sup> To further this goal the province has announced a lucrative rebate (up to \$10,000) for consumers who purchase a plug-in hybrid or battery electric vehicle, beginning in the summer of 2010.<sup>66</sup> These specifications however, are so narrow as to apply to only one currently-available product, the Chevrolet "Volt".<sup>67</sup> Although competing automakers have plans to develop similar vehicles, the political "optics" of the announcement were unmistakable: the premier announced the rebate while standing in a Chevrolet dealership.<sup>68</sup> A variety of other measures the government is proposing to encourage adoption of electric vehicles is largely in accord with the winner-neutral approach that we favour.<sup>69</sup> Nonetheless, the government's decision to subsidize a single product in spite of all other alternatives is highly problematic. Moreover, as one commentator has observed, while "[e]lectric vehicle technologies are an incredibly exciting

development in the automotive sector and could be a very significant part of its future”, these funds could be channeled into an array of broader research into “any and all technologies that could yield a greener automotive sector”,<sup>70</sup> or even by providing rebates for fuel-efficient vehicles, more broadly defined (the same commentator asserts that “[f]or half the price of a subsidized plug-in, a consumer can buy dozens of other vehicles that offer exceptional fuel efficiency, are guaranteed to last 15 to 20 years and have a very well-defined and low-cost maintenance cycle”).<sup>71</sup> Finally, if the policy is predicated upon or designed to anticipate a *quid pro quo* between automakers and the province, which is heavily reliant on (and invested in) automotive manufacturing,<sup>72</sup> this may never be fulfilled; at the very least, the government is reported to have secured no commitments from GM to build the Volt in Ontario.<sup>73</sup>

In any case, regardless of doubts about the merits of a particular technology (the same commentator questions the cost and performance of currently-available electric cars),<sup>74</sup> we close with a larger question. We have suggested that, in theory, green policy choices (conservation initiatives, price signals and technology policies) can provide strong positive reinforcement for each other as well as the overarching goals of policy-makers (curbing emissions, fostering

innovation and protecting domestic interests in the transition to a “green” economy) but that, in practice, policy choices inevitably involve tradeoffs. Our discussion of wind power and corn-based ethanol provide a basis for evaluating whether subsidies for these technologies and applications, respectively, are providing cost-effective support in terms of any of these policy goals. Product-specific subsidies provide a dramatic example of the same quandary. All of these forms of support invariably reflect political calculations and merit close scrutiny for the benefits and tradeoffs that they embody, so that apparently green political commitments – express and implied – do not provide cover for substantively regressive politics. In the next Part, we will describe an alternative approach to balancing these over-arching policy goals that will involve winners as well as losers, except that the winners and losers cannot be identified in advance.

#### 4. A Winner Neutral Approach

The Stern Review (among other policy documents) advocates subsidies for commercialized clean energy technologies.<sup>75</sup> We note, however, that a common posture among governments is to characterize increased production of renewable power as a proxy for cutting emissions, or a goal in its own right,

**If the policy is predicated upon or designed to anticipate a *quid pro quo* between automakers and the province, this may never be fulfilled**

## **Subsidies designed to increase renewable power should be evaluated against winner-neutral policy instruments**

without being forthcoming about the degree to which any given increase in renewable power is expected to cut emissions, lay the foundation for a low carbon future, and create green jobs. We have attempted to demonstrate, in Part 2, that we cannot assume that any given increase in renewable power is necessarily doing all of these (or, as the case may be, any of them). In the next Part we stress the need for transparency in the policy and legislative development process, for these very reasons. In this Part we suggest that, as a matter of default, subsidies designed to increase renewable power should be evaluated against winner-neutral policy instruments and, if adopted, designed in a relatively winner-neutral way, so that market forces can determine which technologies will achieve social goals at a reasonable cost within the frameworks that governments can establish. Where the government chooses more intrusive measures to increase renewable power (for example, to take advantage of an opportunity to become a market leader), we stress the importance of being clear about the trade-offs introduced by these measures. Otherwise, we caution that fiscally progressive policies (subsidies for renewables) may end up masking fundamentally regressive positions (providing opportunities for rent-seeking at the expense of social goals) while reducing future policy flexibility. In the

remainder of this Part we provide a brief overview of the theoretical and practical bases for the major winner-neutral policy options that governments have at their disposal: price signals; investments in R&D and the commercialization of innovative technologies, via direct support and through support for venture capital; and investments in smart infrastructure. We also highlight the potential of electricity market integration to match supply and demand. We close with a discussion of how, in any event, subsidies can be designed in a relatively winner-neutral way.

### **Price Signals**

A full discussion and comparison of cap-and-trade regimes and carbon taxes lies beyond the scope of this paper.<sup>76</sup> We adopt a common shorthand for comparing them: that cap-and-trade regimes provide emissions certainty by placing a legal limit on emissions (with some uncertainty around the prices) while taxes provide price certainty (with some uncertainty around carbon abatement). What this means in practical terms is that cap-and-trade establishes a market for carbon emissions abatement – not its proxies (i.e. uptake of renewable energy technologies) – while carbon taxes are credited with raising awareness among consumers of carbon emissions associated with their activities and changing their behaviour.

We also note that proponents for both approaches claim that one or the other can be designed in a way that is comparatively more simple, transparent, and easy to compare across international borders, and difficult to manipulate within them.<sup>77</sup> Opponents of taxes complain that they are complex to design and easy to manipulate (because they are inherently difficult to design and – as a related matter – vulnerable to loopholes). Proponents of taxes claims they are simple to design (we can tax a small number of upstream polluters), comprehensive (because they cover the entire economy) and clear (both in providing a stable price on carbon and a reliable revenue stream that can be earmarked for offsetting tax reductions or public expenditures – in comparison with the fluctuating prices and revenues associated with cap-and-trade). Carbon taxes can be taken into account in setting carbon tariffs at international borders – although they will create trade frictions.<sup>78</sup> Proponents of the tax approach argue that they are the only appropriate way to force consumers to internalize the shift in perspective necessary to achieve emissions targets, while opponents characterize them as a distraction from the work of swiftly reducing emissions. Cap-and-trade schemes may also be criticized for being complex to design and administer, likely to foster consumer backlash in

response to rising energy costs, and easily manipulated because new permits can be issued to lower prices. Cap and trade schemes provide a basis for generating revenues from auctions of permits, but in reality some detractors argue that they provide an opportunity for political horse-trading in the initial allocation of permits. Regardless, as Paul Krugman observes, how the permits are initially allocated has distributional effects but makes little difference in terms of the long-term environmental outcome.<sup>79</sup> In the international context, cap-and-trade approaches are championed as providing a clearer basis for harmonization of approaches on an accountable basis. Many scholars advocate a combination of both approaches.<sup>80</sup>

### **Direct and Indirect Public Investments in R&D (and other stages of development)**

To make the case for public investments in research and development we begin with a brief review of the stages, beginning with basic research and development, of commercializing clean energy technology; the risks associated with each stage; and the corresponding availability of public and private funding at each stage.<sup>81</sup> The basic progress from R&D to commercialization of new technologies is commonly broken into five stages, beginning with three stages of R&D (fundamental research, applied

**Proponents of the tax approach argue that they are the only appropriate way to force consumers to internalize the shift in perspective necessary to achieve emissions targets**

**The importance of public funding for basic research, on one hand, and pilot projects, on the other, cannot be overstated**

research and technology development and demonstration) followed by two stages of product commercialization and market development (these stages involve the design and expansion of commercialization capabilities and the proof of operational and economic models for commercialization, and finally a process of scaling up production in order to drive and meet market demand).<sup>82</sup> At each stage of the process, companies seek different sources of funding (according to the type and degree of risk at each stage: technological in the early stages, operational in the later stages, with financial and market risks varying throughout the process), and their managers and investors develop different skills and competencies. Funding at the first two stages of R&D are generally provided by governments, sometimes with a focus on fostering relationships among researchers and entrepreneurs in innovation “clusters” (centers of research and commercialization).<sup>83</sup> At the final stages of research (i.e. development & demonstration) and during the early commercialization stages, public equity markets, angel investors, and venture capital (VC) firms begin to enter the market, joined by banks and private equity firms in the final stages of commercialization.<sup>84</sup> In the remainder of this section, we will set out two basic means of providing public support for

R&D and commercialization: funding for R&D and support for VC firms to make early-stage investments.

The importance of public funding for basic research, on one hand, and pilot projects, on the other, cannot be overstated. The U.S. Energy Secretary Steven Chu, for example, has declared that, in terms of technology policies, we require “Nobel-level breakthroughs” in critical areas (in particular, electric batteries, solar power and the development of new crops that can be turned into fuel).<sup>85</sup> By way of further example, in a recent letter to U.S. President Barack Obama, 34 Nobel Prize winners underscored this point, reminding the president that “stable R&D spending is not a luxury. It is in fact necessary because rapid scientific and technical progress is crucial to [reducing greenhouse gases at an affordable cost]”.<sup>86</sup> In particular, the scientists expressed concern that, in spite of the president’s stated commitment to establish “a Clean Energy Technology Fund of \$150 billion over ten years that could be funded from receipts collected from a greenhouse gas cap and trade program”, the cap-and-trade bill that was proposed in the spring of 2009<sup>87</sup> “provides less than one fifteenth of the amount [the president] proposed for federal energy research, development, and demonstration programs” and “provides no stable, specific funding for sustained research” in

the Department of Energy.<sup>88</sup> Moreover, in a recent report proposing a clusters model for national investments in research, the Brookings Institution notes that “the [U.S.] federal government spends less than 1 percent of its R&D budget on energy—a level less than one-fifth of expenditures in the 1970s and 1980s”.<sup>89</sup>

Canadian entrepreneurs face an array of opportunities for public investment but on a modest scale.<sup>90</sup> In spite of the diversity of opportunities, the overall commitment to R&D funding in Canada, and province by province, is relatively modest. For instance, Sustainable Development Technology Canada (SDTC),<sup>91</sup> established by the federal government in 2001 to become “the primary catalyst in building a sustainable development technology infrastructure in Canada”,<sup>92</sup> controls just over \$1 billion in funding that is strategically directed, with nearly half of the funds earmarked for next-generation biofuels projects.<sup>93</sup> This support is targeted at the technology development and demonstration phase of R&D (from pilot to full scale projects), otherwise known as the “pre-commercial” gap in funding, and these investments are leveraged with other sources of investment, primarily private.<sup>94</sup>

Governments can also support private R&D by participating in the venture capital (VC) market, through “funds

of funds” – that is, by investing in VC funds that invest, in turn, in clean technology companies. Indeed, although clean energy technology is the fastest-growing area of venture capital investment worldwide,<sup>95</sup> and early stage investments are a substantial focus of the market,<sup>96</sup> different jurisdictions exhibit a variety of gaps in financing, depending on factors such as the direct and indirect involvement of the government in the VC market, tax policy, the regulatory environment and other incentives for investment, the presence of a highly skilled and educated workforce, proximity to large and growing markets, and the size of the local market. A 2005 survey report prepared for a number of Canadian government agencies stressed, above all, the role of skills within the industry – in VC firms as well as their target companies – and the importance of access to capital, noting the relatively small number of active and effective early-stage VC funds in Canada, both in absolute terms as well as in terms of the pool of co-investors necessary to bring venture-backed firms through their successive stages of development.<sup>97</sup> Governments have an important role to play in both respects – by fostering skills development in the industry,<sup>98</sup> and by helping to ensure that there is sufficient capital depth in the market. The government can do so with tax policies designed to encourage investment as

**Sustainable Development Technology Canada controls just over \$1 billion in funding that is strategically directed, with nearly half of the funds earmarked for next-generation biofuels projects**

**Large public investments in R&D will be required to bring smart grid technologies to market**

well as partnerships among investors (domestic and international),<sup>99</sup> and by investing in VC funds at arms-length, through funds of funds. Ontario already is involved in the VC market in the form of Labour Sponsored Venture Capital Corporations (LSVCCs); we note that this choice of investment vehicle may involve substantial downsides<sup>100</sup> and should be distinguished from “pure” funds of funds, such as the Teralys Capital Fund, recently established in Quebec.<sup>101</sup>

**Public Investments in Infrastructure**

We have suggested that winner-neutral investments can provide powerful spurs to market activity in the clean technology industry. The energy infrastructure market provides perhaps the most pressing example of the kind of winner-neutral approach we are advocating. The value of infrastructure, in general, in terms of economic development, is well documented.<sup>102</sup> Its value in terms of laying the groundwork for a green economy is essential. In the near future, energy efficient systems may have the potential to interact with each other to sustain the world’s energy needs with close to zero emissions. Energy efficiency will be optimized in the design and use of the spaces that we live and work in, and a “smart” electricity grid will enable utilities to monitor and control energy

consumption according to household preferences (through the manipulation of the energy use of “smart” appliances), and to sell electricity to consumers as well as to buy it back from them (for example, by drawing power from household solar arrays, mini-windmills and the plug-in charges of electric car batteries).<sup>103</sup>

The Ontario “Smart Grid Forum” (an initiative of the province’s Independent Electricity System Operator [IESO]), has proposed a range of measures that the Ontario government can take to hasten this transformation, beginning with shaping the market through legislation, regulation and other measures to create incentives that will accelerate the deployment of smart grid technologies.<sup>104</sup> Depending on the regulatory environment, this will involve a complex set of measures to establish lines of authority and accountability for new energy generation, distribution and storage plans.<sup>105</sup> In addition, large public investments in R&D will be required, in partnership with regulatory agencies, centres of research and the private sector, to bring smart grid technologies to market: technologies that optimize the energy efficiency of existing equipment as well as new, more efficient equipment; technologies that provide information about and influence volume and patterns of consumption (smart meters, consumption management



systems); smart-grid technologies; as well as real-time pricing of electricity, including its environmental costs.<sup>106</sup> In the near term, a recent report by the Ontario Centre for Environmental Technology Advancement (OCETA) notes that major demand drivers for the energy infrastructure market are energy conservation initiatives, energy prices, equipment rebates and incentives and power distribution network upgrades.<sup>107</sup> The OCETA Report states that “Ontario businesses spent approximately five per cent of their capital budgets in 2006 ... on equipment and machinery to improve energy efficiency”<sup>108</sup> and that almost 30 per cent installed or improved their energy efficiency systems.<sup>109</sup> Nonetheless, almost 70 per cent reported “insufficient” ROIs (citing the high cost of equipment and lack of financing) as a barrier to adopting clean technologies; as the Report notes, “[g]iven the highly competitive price of electricity in Ontario, these barriers may come down as equipment costs decline and with more aggressive vendor financing”.<sup>110</sup>

### **Market Integration**

Electricity markets are reasonably well integrated in some parts of Europe, although this is not uniformly true; electricity grids in North America, in contrast, are generally poorly integrated.<sup>111</sup> This balkanization is in part a legacy of their historical

development, where electricity sector development and regulation fell largely within the jurisdiction of states or provinces and were often viewed as instruments of local industrial promotion strategies. In a recent overview of the integration issues, Richard Pierce, Michael Trebilcock and Evan Thomas credit

some combination of the following factors: political reluctance to shared control over a politically sensitive sector of the economy; opposition from entrenched interests that may be worse off following integration; strategic behaviour by governments negotiating the terms of integration; and the transaction costs inherent in large-scale integration that may require expansion of cross-border transmission capacity, increased coordination of system and market institutions and sharing of jurisdiction over a market spanning internal and international boundaries.<sup>112</sup>

Pierce et al. note that, from an economic perspective,

greater integration can increase the gains from specialization and exchange; reduce the distortions in the economy created by the exercise of market power in electricity markets; improve economic signals for consumption and investment; and reduce the costs created by the existence of multiple sets of institutions.<sup>113</sup>

In addition to these benefits, “integration can reduce the cost of maintaining reliability”.<sup>114</sup> Putting this in context, we suggest that better regional integration of electricity markets, coupled with the

**Electricity sector development and regulation fell largely within the jurisdiction of states or provinces and were often viewed as instruments of local industrial promotion strategies**

**If regulators across Canada were to set domestic electricity prices equal to their opportunity costs in surrounding markets, this would induce Canadian consumers of electricity to reduce their demand to its efficient levels**

other measures discussed in this Part, hold out substantial potential for more efficient and environmentally-friendly forms of electricity generation. For example, if regulators across Canada were to set domestic electricity prices equal to their opportunity costs in surrounding markets (as we do with oil, natural gas, and other commodities), this would induce Canadian consumers of electricity to reduce their demand to its efficient levels (with rebates for low-income consumers), and permit hydro-abundant provinces such as Ontario and Newfoundland and Labrador to join B.C., Manitoba and Quebec in exporting clean electricity to the U.S. at a substantial profit, reducing the much higher incidence of fossil-fuel electricity generation in the U.S. and hence GHG emissions in North America more generally.<sup>115</sup> If the U.S. and Canada were to impose carbon taxes or a well-designed cap-and-trade system (as both countries are contemplating, nationally and sub-nationally), our comparative advantage in producing and exporting green energy would be even more strongly accentuated. In light of the stakes involved – environmental and economic – it is indeed worth asking how any jurisdiction can justify the goal of remaining self-sufficient in terms of electricity where it lacks abundant renewable resources that can be exploited to meet the policy goal of an

environmentally responsible and cost-effective system.

### **The Role of Subsidies**

In a comparative review of policies designed to encourage the generation of renewable energy source electricity (RES-E), David Duff and Andrew Green conclude that straightforward subsidies (i.e. grants, loans, tax credits and deductions)<sup>116</sup> are the most common approach,<sup>117</sup> followed by implicit subsidies in the form of guaranteed, preferential price regimes, or Feed-in Tariffs (financed from user fees or general tax revenues),<sup>118</sup> or, in the alternative, regulated quantities (subsidized through taxes paid by consumers or levies on utility companies that fail to meet their quotas, or by higher electricity prices).<sup>119</sup> Procurement (i.e. purchasing by the government)<sup>120</sup> and tax policies<sup>121</sup> have been adopted in some jurisdictions to complement these approaches, but subsidies remain the primary instrument for increasing RES-E. Subsidies may be complemented by expedited approvals processes.<sup>122</sup> These approaches have had a dramatic effect on the supply of RES-E; nonetheless, we note that they have not necessarily had a significant impact on GHG emissions.<sup>123</sup> Duff and Green highlight two situations in which subsidies and regulated price and quantity policies have proven to be “not particularly effective” in environmental

terms: “if they decrease electricity prices or crowd out relatively low emission sources such as natural gas”.<sup>124</sup> As Duff and Green observe, “[c]limate change policy should be focused on reducing emissions of greenhouse gases, not increasing the generation of RES-E for its own sake”.<sup>125</sup>

In this section we observe that subsidies can, in theory, be designed and deployed in a winner-neutral way. Broadly speaking, policy-makers generate incentives by imposing penalties (taxes) or offering “bribes” (subsidies). In theory, in terms of outcomes, there is no distinction between these; a subsidy can replicate the effect of a tax, and vice versa. In practice, in terms of distributional effects, the difference between these instruments is who pays for them. This may involve practical as well as political considerations. For instance, it may be difficult to justify, politically, providing payments to companies to reduce their GHG emissions, rather than taxing them. Conversely, it may be politically palatable to provide payments to private actors engaged in the development of clean energy technologies. In any event, in terms of inputs, from a technological perspective, we note that taxes and subsidies directed toward outcomes rather than inputs would be completely winner-neutral. That is, rather than subsidizing the take-up of specific

technologies as a proxy for GHG emissions abatement, we could provide payments to market players who achieved the desired outcomes – emissions abatements. Subsidies for outcomes rather than inputs would complement the other winner-neutral investments we are proposing. Where policy-makers are committed to subsidizing the installation of renewable energy power generation projects as such (despite our serious reservations about such policies), one means of doing so without favouring one form of clean power generation over another would be to mandate a “renewable portfolio standard” (RPS) for utility companies (requiring a proportion of their power generation overall to come from renewable sources)<sup>126</sup> or to put out competitive public tenders for new construction of power generation projects which favour the most cost-effective clean forms of power generation.<sup>127</sup> For example, we note that Ontario appears to have been overwhelmed by the take-up of its offer of a fixed 20-year feed-in tariff for wind projects under recently revised legislation (described in more detail, below).<sup>128</sup> Given the apparent over-supply of projects, a competitive auction obviously seems preferable so as to elicit the least-cost supply of the quantity of renewable capacity desired.

**It may be difficult to justify, politically, providing payments to companies to reduce their GHG emissions, rather than taxing them**

**We would institutionalize periodic public reviews of renewable energy policy to ensure that whatever policy approach is adopted reflects the best information currently available**

## **5. Who Decides and How?**

The starting point for our discussion has been the way that renewable energy policies (conservation initiatives, price signals and technology policies) may conflict with each other as well as the overarching goals of policymakers – curbing GHG emissions, fostering innovation, and protecting domestic interests in the transformation to a green economy. We have discussed potential sources of these conflicts and policy approaches that may exacerbate or mitigate them. In this Part we discuss, along the same lines, the procedural dimensions of policy- and law-making in the renewable energy context. Because of the pace and unpredictability of technological change, and because of the distorting effect of political considerations on policies and priorities among policies, we would institutionalize periodic public reviews of renewable energy policy to ensure that whatever policy approach and set of choices within that approach is adopted reflects the best information currently available on emerging technologies and comparative experience.<sup>129</sup> Beyond this, we emphasize the importance of transparency in the process of developing renewable energy policies, so that the public can hold politicians accountable for the priorities

that their policies reflect, and the importance of establishing clear goals and guidelines for the administrative bodies in the energy sector that will be involved in implementing renewable energy policies, so that these bodies are able to discharge their responsibilities in line with the basic principles of rationality and fairness that underlie administrative decision-making.<sup>130</sup> A striking illustration of the need for transparency in the policy and legislative development process emerges in the contrast between two such processes currently underway in the United Kingdom and Ontario.<sup>131</sup> The UK's *Renewable Energy Strategy Consultation* (the "Consultation")<sup>132</sup> follows the UK's commitment to increase its production of energy from renewable energy sources to 20 per cent by 2020.<sup>133</sup> The *Consultation*, published in September 2008,<sup>134</sup> set out a variety of possible means to reach the government's goals in the context of a comprehensive policy framework,<sup>135</sup> through a detailed examination of policies directed at conservation, centralized electricity, heat, distributed electricity, transport and bioenergy. The document reviews the role of innovation, the benefits of conservation to business and the wider impacts of policy choices. Specific consultation questions associated with each set of possible policies are included in an appendix.<sup>136</sup> In terms of

the substance of the consultation, the document (1) highlights the fact that a number of policies are already in place; (2) sets out a range of alternatives for action, some of which may contradict policies that are already in place; and (3) explores the trade-offs among the possible alternatives. Indeed, the consultation is explicit that “[m]eeting the UK’s share of the renewable energy target will involve difficult trade-offs and costs.”<sup>137</sup> In contrast, the Ontario *Green Energy and Green Economy Act*<sup>138</sup> consultation process was introduced in the context of a merely nascent policy framework;<sup>139</sup> it consisted of the circulation of a draft Act for discussion, with no background research paper to focus discussion and legislative committee hearings. At the close of the consultation period, a handful of amendments were announced<sup>140</sup> and the Act was passed with substantive regulations still to be circulated for discussion.<sup>141</sup> The absence of a policy paper or background published research review in Ontario is particularly troubling because in crucial respects, we suggest, the government is not being forthcoming about the match between the Act’s specific goals and its provisions, and the trade-offs among these goals,<sup>142</sup> in particular by failing to set out the links between increased RES-E and GHG emissions abatements.<sup>143</sup> These problems are thrown into sharp

relief in the context of the changing mandate of administrative bodies, which brings us to our final point, again using Ontario as an example. The natural gas and electricity sector in Ontario comprises primarily public but also private power generation and distribution companies and transmission operators, all of them subject to the regulation of the Ontario Energy Board (OEB), which acts as an independent administrative tribunal.<sup>144</sup> The historic mandate of the OEB has been to protect consumers with respect to the price, reliability and quality of electricity; this mandate has been enlarged to include regulation in the public interest,<sup>145</sup> and the *Green Energy and Green Economy Act* revises this mandate further to include the promotion of renewable energy projects, among other goals.<sup>146</sup> In spite of these developments, commentators have criticized the government for failing to provide clear guidance to the OEB as to how it should rank or weigh competing social values under the *Act*. In submissions before the legislative committee that considered the Bill, the Ontario Bar Association (OBA) notes these deficiencies along with others that raise basic concerns as to the capacity of the OEB to discharge its obligations in a manner that conforms to the basic process values of administrative law, let alone in a manner that reflects its reformed mandate. The OBA observes

**The absence of a policy paper or background published research review in Ontario is particularly troubling**

**A broad set of exemptions from planning and other approvals processes for renewable energy projects may raise the question whether “a renewable energy project makes sense in terms of its relationship with other land uses”**

that the Bill adopts an “expansive definition of ‘environment’ ... which includes diverse and at times competing elements [that] may bring significant uncertainty to the renewable energy approval process”;<sup>147</sup> a broad set of exemptions from planning and other approvals processes for renewable energy projects that may raise the question, in any given case, whether “a renewable energy project makes sense in terms of its relationship with other land uses”;<sup>148</sup> a “unique” appeals process according to which “[i]t is unclear how the new approvals will be reconciled with existing common law and property rights, such as the law of nuisance”;<sup>149</sup> and a lack of transitional and operational concepts (i.e. grandfathering clauses).<sup>150</sup>

These deficiencies take on special significance when it is recognized, as former counsel to the OEB George Vegh has argued, that “[i]n order to maintain effective regulation, and economic credibility, the OEB will have to articulate principled approaches to dealing with [social and environmental] values”, which it has historically dealt with “as peripheral issues that could be addressed on a discretionary basis”.<sup>151</sup> Vegh cites three basic challenges in this process: first, “the Board will have to reconsider the application of some of its major approaches to public utility regulation”;<sup>152</sup> second, the Board (and the parties that appear before it) will

have to develop a new adjudicative methodology – “[t]he Board will require new ideas, and it is not clear where these ideas will come from”; finally, “the Board will find it difficult to maintain its entitlement to make decisions that are independent from political interference when it exercises its broader mandate”.<sup>153</sup> Related concerns were raised in the consultation process with respect to the Minister’s discretion and the independence of the tribunal, beginning with the very fact that substantive and procedural regulations were made public for discussion only after the *Act* had been passed,<sup>154</sup> but also including the broad scope for Ministerial directives: the *Act* expressly provides that the tribunal’s decisions and orders “shall be consistent with any policies issued by the Minister”,<sup>155</sup> who is at liberty to issue, amend and revoke these policies in respect of renewable energy approvals.<sup>156</sup> It has been suggested, for example, that some threshold requirements be established to limit this authority; specifically, that Ministerial policies be “anchored to the ministry statement of environmental values”, and that the responsibility for determining whether these policies are consistent with that statement of values should rest with the Tribunal.<sup>157</sup> Without articulated criteria for the exercise of Ministerial discretion, government will be at liberty to favour particular proponents and

confer discriminatory subsidies on them, as it has done recently with a major wind power project promoted by Samsung.<sup>158</sup>

Finally, the OBA cites a basic failure of the government to specify what kinds of resources are being allocated to project applications, raising the “particular concern [of] ensuring that the appropriate land use planning expertise and experience is brought to bear on these applications”;<sup>159</sup> with respect to how these applications will be processed, and how these administrative bodies will execute their revised mandate.<sup>160</sup>

Similar ambiguities now surround the mandate of the Ontario Power Authority (OPA), which has the responsibility for contracting for new generation supply in the province, and the Independent Electricity System Operator (IESO), which is responsible for performing (*inter alia*) the generation dispatch function on a merit-order basis in the province, given the expansive role envisaged for Ministerial directives. Finally, the relative roles of the provincial and local (municipal) governments in terms of land use and planning decisions – and a principled basis for distinguishing their responsibilities from each other – remain far from clear.

## 6. Conclusion

Policy-makers face three basic, competing

grounds for action on climate change: (1) curbing greenhouse GHG emissions; (2) hastening the transformation of how we produce and consume energy; and (3) ensuring that domestic economic interests are protected in the transition to a “green” economy. We suggest that if our ultimate goal is to abate emissions as rapidly and cost-effectively as possible while laying the groundwork for a green energy future, as well as to advance ancillary goals that will help to sustain this progress, such as saving resources and creating green jobs, then providing technology-specific subsidies for renewable energy power generations (“picking winners”) runs a considerable risk of failure, because some currently available clean energy technologies are not green in every jurisdiction, and because public investment in sub-optimal technologies may have the effect of “locking in” these technologies due to interest group politics and other features of path dependence. In contrast, we suggest that “winner-neutral” policies may help us to realize our environmental and ancillary goals as directly and efficiently as possible. In any event, because climate change policies will require substantial costs and trade-offs specific to each jurisdiction, it is imperative that governments be transparent in setting their goals and priorities based on the best evidence available: to inform the

**Ambiguities now surround the mandate of the Ontario Power Authority, which has the responsibility for contracting for new generation supply in the province**

**The UK has done a significantly better job of disclosing a research basis for choosing among policy alternatives than Ontario**

public debate about these choices, to render these choices transparent and to hold politicians accountable for them. In a perfect world, the government would also be raising more profound issues for public discussion: we in Ontario should welcome more far-reaching discussion of how our economy is changing and how energy use will need to change with it, instead of planning for an energy future on the basis of current usage. Finally, from an administrative law perspective, we stress that it is incumbent upon governments to provide clear and transparent legislative and regulatory direction (and resources) to administrative bodies such as, in Ontario, the OEB, the OPA and the IESO, so that the competence, capacity and independence of these bodies can be ensured as they discharge increasingly complex public responsibilities.

In light of these considerations, we close by emphasizing the contrasting approaches that governments in the UK and Ontario have taken to policy and legislative development with respect to renewable energy. Setting aside the merits of any given policy approach, we have suggested that the UK has done a significantly better job of disclosing a research basis for choosing among policy alternatives than Ontario. The Ontario government appears to have moved quickly and decisively on the basis of conventional wisdom. It is also

possible that Ontario's approach reflects a simple political calculus: disclosing policy alternatives may increase the practical chance of taking good decisions but also raises the political cost of taking bad decisions – and may increase the political difficulty of taking any action at all. In any event, politicians in Ontario have made bold predictions in respect of their policies, and in light of the stakes involved these demand to be tested. In particular, Ontario asserts that over the next three years Ontario's renewables policies will not result in increases to consumer electricity bills of more than 1% per year; will create 50,000 jobs in the province; and will significantly reduce the province's carbon emissions, either generally or in respect of electricity generation.<sup>161</sup> Based on the foregoing discussion, we are not confident that all of these assertions can be true at the same time. To the extent the Ontario government is unwilling to test these claims,<sup>162</sup> we propose that the provincial Auditor General or one or more independent think tanks should do so periodically on their own initiative (including cost per ton of carbon abated, and cost per net jobs created). In the final analysis, our current doubts about the efficacy of technology-specific subsidies to further environmental and social goals are irrelevant; what matters is finding solutions to the climate issue as quickly and efficiently as possible, and



this can only be done if all of us are ready to test and correct our assumptions, early and often.

## Endnotes

1 On the science of climate change, see, generally: Intergovernmental Panel on Climate Change (IPCC), Third Assessment Report (2001) and IPCC, Fourth Assessment Report (2007), online: IPCC, <<http://www.ipcc.ch>> [together, “IPCC Reports”]. On the costs of inaction, see: Nicholas Stern, *The Economics of Climate Change: The Stern Review*, (Cambridge, UK: Cambridge University Press, 2007) [“Stern Review”]. For a selection of Stern’s replies to his critics, see e.g.: Simon Dietz and Nicholas Stern, “Note—On the Timing of Greenhouse Gas Emissions Reductions: A Final Rejoinder to the Symposium on “The Economics of Climate Change: The Stern Review and its Critics”, *Rev Environ Econ Policy* 2009 3[1]: 138-140 and Simon Dietz and Nicholas Stern, “Why Economic Analysis Supports Strong Action on Climate Change: A Response to the Stern Review’s Critics”, *Rev Environ Econ Policy* 2008 2: 94-113. For alternative views on the causes and consequences of climate change, see Lawrence Solomon, *The Deniers* (Richard Vigilante Books, 2008).

2 See *ibid.* IPCC Reports and Stern Review. See also, generally: James Lovelock, *The Vanishing Face of Gaia: A Final Warning*, (New York: Allen Lane, 2009) and James Gustave Speth, *The Bridge at the End of the World: Capitalism, the Environment, and Crossing from Crisis to Sustainability*, (New Haven: Yale University Press, 2008). Recent estimates suggest that the consequences of inaction may be (at least) twice as severe as previously estimated, six years ago. See e.g.: A.P. Sokolov, P.H. Stone, C.E. Forest, R. Prinn, M.C. Sarofim, M. Webster, S. Paltsev, C.A. Schlosser, D. Kicklighter, S. Dutkiewicz, J. Reilly, C. Wang, B. Felzer, H.D. Jacoby, “Probabilistic forecast for 21st century climate based on uncertainties in emissions (without policy) and climate parameters”, *American Meteorological Society Journal of Climate* [forthcoming], online: American Meteorological Society <<http://ams.allenpress.com>>.

3 David G. Duff and Andrew J. Green, “A Comparative Evaluation of Different Policies to Promote the Generation of Electricity from Renewable Sources”, in Steven Bernstein, Jutta Brunée, David G. Duff and Andrew J. Green, eds., *A Globally Integrated Climate Policy for Canada*, (Toronto: University of Toronto Press, 2008), 222-246 at 222 [Duff and Green, “A Comparative Evaluation”; Bernstein et al.]. Many jurisdictions around the world are also planning for the generational replacement of base load sources of power generation such as coal and nuclear power; the choice of what technologies are ready to replace these only adds to the urgency of the situation.

4 In other words, we need to bring current technologies to scale and to improve them, cost-wise and environmentally; to develop new and improved “enabling technologies”, such as “smart” infrastructure and batteries for storage of energy from intermittent energy sources; and to develop completely new clean energy technologies – some in their infancy; others to be determined. For evaluations of the variety and relative importance (and cost) of potential mitigation efforts, see e.g. McKinsey & Company, *Pathways to a*

*Low-Carbon Economy: Version 2 of the Global Greenhouse Gas Abatement Cost-Abatement Curve*, (January 2009), online: McKinsey & Company <[http://www.mckinsey.com/clientservice/ccsi/pathways\\_low\\_carbon\\_economy.asp](http://www.mckinsey.com/clientservice/ccsi/pathways_low_carbon_economy.asp)>; for an influential proposal as to the relative abatement potential of various abatement measures, see Robert Socolow, Roberta Hotinski, Jeffery B. Greenblatt and Stephen Pacala, “Solving the Climate Problem: Technologies Available to Curb carbon Emissions”, 46 *Environment* 10, 8–19 (December 2004) (popularizing the concept of “stabilization wedges”).

5 We do not mean to imply equivalence among these three goals (curbing emissions, fostering innovation and protecting domestic interests); indeed, in this paper we explore how the political calculus arising from the imperative to “create” green jobs (i.e. foster the conditions in which firms can hire new workers and contract for services) can retard climate change policies. Nonetheless, we also assume, taking a practical perspective, that green jobs are necessary to sustain economic growth, build the tax revenues that fuel public investments and help to sustain the popular will necessary to pursue climate change policies: see, generally, Jeffrey D. Sachs, *Commonwealth: Economics for a Crowded Planet*, (New York: Penguin, 2008). But we acknowledge that this assumption is itself a matter of serious debate that spans a wide range of opinion, including the propositions that capitalism itself is unsustainable (Speth, *supra* note 2) and that the human race will not survive the effects of climate change (Lovelock, *supra* note 2).

6 See: Duff and Green, “A Comparative Evaluation”, *supra* note 3 at 223-228.

7 Subsidies are by far the most popular form of support for green energy technologies: *ibid.* at 223.

8 See Part 4, *infra*.

9 We acknowledge, without discussing, the ethical implications to reliance on nuclear power, among other concerns; see, generally, Charles D. Ferguson, “Nuclear Energy: Balancing Benefits and Risks”. CSR No. 28 (April 2007), Council on Foreign Relations.

10 In a recent study Prof. Andrew P. Morriss of the University of Illinois and his co-authors emphasize the importance of informed debate about “green jobs” claims by demonstrating that we have no standard definition of what a “green job” is and that widely-cited green job creation estimates may rely on faulty economic models and underlying assumptions. See: Andrew Morris, William Bogart, Andrew Dorchak and Roger Meiners, “Green Jobs Myths”, (March 12, 2009) University of Illinois Law & Economics Research Paper No. LE09-001, Case Legal Studies Research Paper No. 09-15, online: SSRN <[http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1358423](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1358423)>

11 See, e.g., Robert Hahn, “Ethanol: Law, Economics and Policy”, (2008) *Stanford Law and Policy Review* 19(3) 434-471, online: Stanford Law and Policy Review <[http://slpr.stanford.edu/previous/Volume19/Hahn\\_19slpr434.pdf](http://slpr.stanford.edu/previous/Volume19/Hahn_19slpr434.pdf)>

12 See Part 3, *infra*.

13 Storage is critical for intermittent energy sources such as wind and solar because of the problem of mismatch between supply and demand. Current options for storage are limited and new forms of storage (e.g. batteries) need to be developed. See Part 2, *infra*.

14 National Round Table on the Environment and the Economy (NRTEE), “Economic Instruments for Long-term Reductions in Energy-based Carbon Emissions” (2005), online: NRTEE <<http://nrtee-trnee.ca/eng/publications/energy-based-carbon-emissions/full-report/Energy-Based-Carbon-Emissions-FullReport-eng.pdf>>, at 20 (the report

cites initiatives such as: energy efficiency, renewable energy deployment, development of hydrogen technologies and carbon mitigation). See also: Jan Carr, “A Rational Framework for Electricity Policy,” (2010) *Journal of Policy Engagement*.

15 See: Brian Arthur, *Increasing Returns and Path Dependence in the Economy* (Ann Arbor: University of Michigan Press, 1994); Mariana Prado & Michael J. Trebilcock, “Path Dependence, Development, and the Dynamics of Institutional Reform”, (2009) 59 *University of Toronto Law Journal* 341-379, at 350-358.

16 We note that the *Economist* observes, of the carbon tax debate in particular, that “[g]overnments regard subsidies as easier, politically, than taxing carbon. In the short term, they are right; but in the long term, bad policy will raise the costs of decarbonising the world economy, thus increasing the danger of a taxpayers’ revolt—which would be the biggest political difficulty of all”: “Bad policy will boil the planet: Lessons from Britain about how to cut carbon, and how not to”, (October 17, 2009).

17 Some may suggest that investments in early generation technologies such as wind power will have ancillary benefits even if these are not net green – that is, that investments in (e.g.) wind power will require or hasten investments in advanced infrastructure and enhancements of grid integration – and for this reason may be worthwhile. We counter that these investments can and indeed must be made independently of investments in current generation green energy technologies that cannot demonstrably deliver environmental and other promised benefits. Commentators may also insist that investments that do not pan out can still result in benefits, locally and globally, by changing the attitude of consumers, fostering markets for renewable energy and laying the groundwork for next-generation technologies, creating green jobs and spurring international co-operation; we argue, likewise, that each of these benefits can be realized through a winner-neutral approach.

18 For an overview of the wind power industry globally, see, e.g., International Energy Agency (IEA), online: <[www.iea.org](http://www.iea.org)>, and the Global Wind Energy Council (GWEC), online: GWEC <<http://www.gwec.net>>. For an overview of the wind power industries and energy policies generally within the European national leaders in installation (Denmark, Germany and Spain), see: Danish Wind Energy Association (DWEA), online: DWEA <<http://www.windpower.org/en/core.htm>>; Danish Energy Agency (DEA), online: DEA <<http://www.ens.dk/en-us/Sider/forside.aspx>>; German Wind Energy Association (BWE), online: BWE <<http://www.wind-energie.de/en>>; German Energy Agency (DENA), online: DENA <<http://www.dena.de/en>>; Spanish Wind Energy Association (AEE), online: AEE <<http://www.aeolica.es/en>>; Ministry of Industry, Tourism and Trade, online: MITYC <<http://www.mityc.es/energia/en-US/Paginas/Index.aspx>>.

19 María Isabel Banco, “The economics of wind energy”, *Renewable and Sustainable Energy Reviews* 13 (2009) 1372-1382 at 1378 (meta-study).

20 International Energy Agency (IEA), “Variability of Wind Power and Other Renewables: Management Options and Strategies”, (June 2005), online: IEA <<http://www.iea.org/textbase/papers/2005/variability.pdf>> at 3.

21 Banco, *supra* note 19 at 1376.

22 Global Wind Energy Council (GWEC) and Greenpeace International, *Global Wind Energy Outlook 2008*, (2008), online: GWEC <<http://www.gwec.net/index.php?id=92>>.

at 43 [GWEC, *Global Wind Energy Outlook 2008*]; Banco estimates the costs of wind power more narrowly, at between 7.1 and 13.8 cents per kWh (4.5-8.7 ¢cents/kWh): *ibid.*

23 Markus Boettcher, Niels Peder Nielsen and Kim Petrick, "Employment opportunities and challenges in the context of rapid industry growth" (Bain Brief 11/10/08), online: Bain <<http://www.bain.com/bainweb/PDFs/cms/Public/2008-11-01%20BB%20Wind%20energy%202008.pdf>>, at 4-5 ["Bain Study"].

24 See, generally: Chris Decker, "International Approaches to Transmission Access for Renewable Energy", (March 2008), A report for Ofgem, Regulatory Policy Institute (RPI), online: Office of the Gas and Electricity Markets (Ofgem) <<http://www.ofgem.gov.uk>>.

25 GWEC, *Global Wind Energy Outlook 2008*, *supra* note 22 at 46.

26 Arthur Campbell, "Government Support for Intermittent Renewable Generation Technologies", MIT Department of Economics, April 6, 2009, online: MIT <<http://econ-www.mit.edu/files/3563>>. Another recent study suggests that higher penetration of wind power generation may reduce its benefits as optimal sites are exhausted and power generated is wasted because of demand-supply mismatch and the difficulty of storage. See: Monique Hoogwijk, Detlef van Vuuren, Bert de Vries, Wim Turkenburg, "Exploring the impact on cost and electricity production of high penetration levels of intermittent electricity in OECD Europe and the USA, results for wind energy", *Energy* 32 (2007) 1381-1402.

27 For example, a recent pair of studies reaches contradictory conclusions on the question of whether smoothing is possible in southern Ontario. Compare: Tom Adams and Francois Cadieux, "Wind Power in Ontario: Quantifying the Benefits of Geographic Diversity", 2nd Climate Change Technology Conference, May 12-15 2009, McMaster University, online: Tom Adams <<http://tomadamsenergy.com>>; GE Energy, "Final Report to: Ontario Power Authority (OPA), Independent Electricity System Operator (IESO), Canadian Wind Energy Association (CanWEA) for Ontario Wind Integration Study", (October 6, 2006), online: IESO <<http://www.ieso.ca/imoweb/pubs/marketreports/OPA-Report-200610-1.pdf>> ["GE Study"]. See also: Ian Rowlands and Carey Jernigan, "Wind Power in Ontario: Its Contribution to the Electricity Grid", (2008) *Bulletin of Science, Technology & Society*, 28(6) 436-453.

28 See, e.g.: "Wind Power – A Cautionary Word", *The Independent* (UK), (August 2, 2009), citing current research on "Wind Turbine Syndrome" and calling for further study. We note that one of the subjects of the editorial, Nina Pierpont, states on her Web site that her "current research does not establish a connection between heart disease and wind turbine exposure [as implied in the editorial], only between a rapid heart rate as part of a panic-like response ... and wind turbine exposure", but that, nonetheless, "there is a substantial body of European (including UK) research showing that environmental noise exposure in general increases the risk for cardiovascular disease" and that "[t]his is an area in need of further research with regard to wind turbine exposure"; see online: Wind Turbine Syndrome <<http://www.windturbinesyndrome.com/?p=2825>>.

29 Bain Study, *supra* note 23 at 5.

30 Duff and Green, "A Comparative Evaluation", *supra* note 3 at 231-232, 238.

31 *Ibid.* at 228.

32 See, e.g., David G. Duff and Andrew J. Green, “Wind Power in Canada”, in *Critical Issues in Environmental Taxation—International and Comparative Perspectives: Volume IV*, (Oxford: Oxford University Press, 2007), edited by Kurt Deketelaere, Janet E. Milne, Larry Kreiser and Hope Ashiabor, 3-38 at 20-23 [Duff and Green, “Wind Power in Canada”].

33 David J.C. MacKay proposes a thought experiment along these lines in the U.K. context; his figures for the peak and average load or capacity factor of wind farms are consistent with other studies. See: David J.C. MacKay, *Sustainable Energy – without the hot air*, (Cambridge: UIT Cambridge Ltd., 2009), online: Without Hot Air <<http://www.withouthotair.com>> at 32-34; see further at 186-202.

34 The Ontario Power Authority (OPA) quantifies the comparative viability and cost of meeting the province’s long-term supply needs in its most recent Integrated Power System Plan (IPSP), noting the comparative advantage of reliance on hydro versus wind power along a number of dimensions. See: IPSP, Exhibit E, Tab 2, Schedule 2, July 7, 2007, “Facilitating the Development and Use of Renewable Energy and Enabling 2010 and 2025 Renewable Targets”, and related Attachments and Exhibits, online: OPA <[http://www.powerauthority.on.ca/ipsp/Page.asp?PageID=122&ContentID=6215&SiteNodeID=320&BL\\_ExpandID=>](http://www.powerauthority.on.ca/ipsp/Page.asp?PageID=122&ContentID=6215&SiteNodeID=320&BL_ExpandID=>). Also see: Exhibit D, Tab 5, Schedule 1, July 7, 2007, “Supply – Renewable Resources”, and related Attachments and Exhibits, online: OPA <[http://www.powerauthority.on.ca/ipsp/Page.asp?PageID=122&ContentID=6214&SiteNodeID=320&BL\\_ExpandID=>](http://www.powerauthority.on.ca/ipsp/Page.asp?PageID=122&ContentID=6214&SiteNodeID=320&BL_ExpandID=>). Regarding the IPSP generally, see further note 38 *infra*.

35 Tyler Hamilton, “Now province pays to give away electricity”, *The Toronto Star*, (April 21, 2009), online: The Star <[www.thestar.com/article/621552](http://www.thestar.com/article/621552)> (quoting a spokesman for the system operator who calls the situation unprecedented, and blames it on a “perfect storm”; citing a drop in demand due to economic activity, conservation efforts and low seasonal consumption, coupled with a surplus of supply due in part to high precipitation [increasing hydroelectric reserves], increased energy from wind and natural gas, and nuclear reactors performing above expectations). We also note that the private nuclear power station operator Bruce Power withdrew applications to build two new stations, citing the recession and declining demand for electricity. See: Maria Canton, “Bruce Power backs off”, *The Sun Times* (Owen Sound), (July 24, 2009), A1, A12.

36 In *Go Green: Ontario’s Action Plan on Climate Change*, published by the current liberal government in August 2007, the province commits to reducing its GHG emissions to six per cent below 1990 levels by 2014, 15 per cent below 1990 levels by 2020, and 80 per cent below 1990 levels by 2050. See online: Ministry of the Environment <<http://www.ene.gov.on.ca/publications/6445e.pdf>> [*“Ontario’s Action Plan on Climate Change”*].

37 See: Richard Pierce, Michael Trebilcock and Evan Thomas, “Regional Electricity Market Integration: A Comparative Perspective” (2007), *Competition and Regulation in Network Industries*, 8(2) 215-257 [Pierce et al.]. We also note that the C.D. Howe Institute has recently proposed that if Quebec increases the price of electricity in the province so as to reflect its actual cost, and raises the carbon tax to promote the consumption of clean energy, this would allow Quebec to export more clean energy to other jurisdictions, lowering GHG emissions globally and laying the groundwork for the

province's productive participation in a multi-jurisdictional cap-and-trade regime. See: Jean-Thomas Bernard and Jean-Yves Duclos, "Quebec's Green Future: The Lowest-Cost Route to Greenhouse Gas Reductions", C.D. Howe Institute, Toronto, *Backgrounders*, No. 118, October 2008 [Bernard and Duclos] The Ontario Power Authority (OPA) has reported in brief on the viability of links with Manitoba and Quebec, recommending further study. See: Integrated Power System Plan (IPSP), Exhibit E, Tab 3, Schedules 5 and 6, July 7, 2007, "Manitoba Purchase Incorporation" and "Quebec/Labrador Purchase Incorporation", online: OPA <[http://www.powerauthority.on.ca/ipsp/Page.asp?PageID=122&ContentID=6215&SiteNodeID=320&BL\\_ExpandID=>](http://www.powerauthority.on.ca/ipsp/Page.asp?PageID=122&ContentID=6215&SiteNodeID=320&BL_ExpandID=>)>; regarding the IPSP generally, see further note 38 *infra*.

38 The Ontario Power Authority (OPA) has commissioned a number of studies identifying the viability of energy generation from wind power and other renewables in Ontario pursuant to ministerial directives requiring it to develop an Integrated Power System Plan (ISPS) for Ontario (see, for example, the GE Study cited in note 27, *supra*). For this purpose the OPA is not directed to forecast the effect of increased supply of power from renewables on GHG emissions abatement, only to outline a cost-effective method of procuring the supplies of renewable power directed by the Minister, subject to guidelines on consultations and standard environmental/socio-economic/cultural impact assessments, etc. For the text of the IPSP and Exhibits (renewables are discussed in Exhibits E and D) see online: OPA <<http://www.powerauthority.on.ca/ipsp/Page.asp?PageID=924&SiteNodeID=320>>. The minister issues directives under s. 25.30 of the *Electricity Act 1998*, S.O. 1998, c. 15. The most recent directive was issued June 13, 2006 and revised September 17, 2007; see online: OPA <[http://www.powerauthority.on.ca/Storage/23/1870\\_IPSP-June13%2C2006.pdf](http://www.powerauthority.on.ca/Storage/23/1870_IPSP-June13%2C2006.pdf)> and <[http://www.powerauthority.on.ca/Storage/83/7831\\_Ministry\\_Directive\\_PSP\\_Sept\\_18\\_08.pdf](http://www.powerauthority.on.ca/Storage/83/7831_Ministry_Directive_PSP_Sept_18_08.pdf)>. By letter dated March 12, 2009 the OPA informed the OEB that it would delay response to the revised directive until after the passage of the *Green Energy and Green Economy Act*, then Bill 150; see online: OPA <[http://www.powerauthority.on.ca/ipsp/Storage/96/9159\\_OPA\\_Letter\\_EB-2007-0707\\_20090312.pdf](http://www.powerauthority.on.ca/ipsp/Storage/96/9159_OPA_Letter_EB-2007-0707_20090312.pdf)>.

In the summer of 2009, the authors wrote to the Ontario Ministry of the Environment requesting, under the *Freedom of Information and Protection of Privacy Act*, R.S.O. 1990, c. F-31, copies of any research undertaken or commissioned by the government regarding the costs and environmental impact of wind power. The Ministry indicated that it had no such research to disclose (paperwork on file with the authors). A similar request to the Ministry of Energy and Infrastructure was pending as of October 28, 2009.

39 See Michael Trebilcock, "Speaking Truth to Wind Power," C.D. Howe Institute, Toronto, *Verbatim*, April 22, 2009.

40 "Wind Energy: The Case of Denmark", Centre for Policy Studies (CEPOS), Copenhagen, Denmark, September 2009.

41 Christoph M. Schmidt, ed., *Economic Impacts from the Promotion of Energies: The German Experience (Final Report)*, (Essen, Germany: Rheinisch-Westfälisches Institut für Wirtschaftsforschung [RWI], 2009), online: RWI <<http://www.rwi-essen.de>>.

42 "Transforming Ontario's Electricity Paradigm: Lessons Arising from Wind Power Integration", Address to

Professional Engineers of Ontario Annual General Meeting (May 9, 2009), online: Tom Adams <[www.tomadamsenergy.com](http://www.tomadamsenergy.com)>, at 3 (citations omitted).

43 Lovelock, *supra* note 2 at 81; see also John Etherington, *The Wind Farm Scam: An Ecologist's Evaluation* (London: Stacey International, 2009).

44 Ethanol is corrosive and when blended into gasoline tends to separate in pipelines; moreover, ethanol has to be shipped from refineries in the interior of North America to the coasts, whereas (at least in the United States) gasoline is typically piped from refineries on the coasts into the interior. Theoretically, dedicated pipelines could be constructed for ethanol products, or existing pipelines could be upgraded to handle ethanol products, but this has not yet been done on a significant scale. At present, ethanol is shipped via rail, truck and barge, which contributes to its high costs (environmental and otherwise). See: Brent D. Yacobucci and Randy Schnepf, "Ethanol and Biofuels: Agriculture, Infrastructure, and Market Constraints Related to Expanded Production", Congressional Research Service (CRS) Report for Congress, March 16, 2007, online: U.S. Department of State <<http://fpc.state.gov/documents/organization/82500.pdf>> at 8-9 ["CRS Report for Congress, 2007"].

45 Brent D. Yacobucci, "Fuel Ethanol: Background and Public Policy Issues", Congressional Research Service (CRS) Report for Congress, Updated October 19, 2006, online: U.S. Department of State <<http://fpc.state.gov/documents/organization/76323.pdf>>, at 5 ["CRS Report for Congress, 2006"].

46 Organization for Economic Cooperation and Development (OECD) and International Energy Agency (IEA), "Biofuel Support Policies: An Economic Assessment", (OECD: September 2008), at 9 ["OECD Report"].

47 Tara Laan, Todd Alexander Litman and Ronald Steenblik, "Biofuels - At What Cost? Government Support for ethanol and biodiesel in Canada" (April 2009), Global Subsidies Initiative (GSI) of the International Institute for Sustainable Development (IISD), online: IISD <[http://www.iisd.org/pdf/2009/biofuels\\_subsidies\\_canada.pdf](http://www.iisd.org/pdf/2009/biofuels_subsidies_canada.pdf)>, at 2 ["IISD Report"].

48 *Ibid.* at 3; OECD Report, *supra* note 46 at 10.

49 OECD Report, *ibid.*

50 IISD Report, *supra* note 47 at 3.

51 OECD Report, *supra* note 46 at 10.

52 For an overview of the highly contested "net energy" debate, see: Roel Hammerschlag, "Ethanol's Energy Return on Investment: A Survey of the Literature 1990-Present", (2006) *Environ. Sci. Technol.* 40, 1744-1750, online: U.S. Department of Energy, Alternative Fuels and Advanced Vehicles Data Center <<http://www.afdc.energy.gov/afdc/pdfs/estreviewofethanolica.pdf>>.

53 See: Timothy Searchinger, Ralph Heimlich, R. A. Houghton, Fengxia Dong, Amani Elobeid, Jacinto Fabiosa, Simla Tokgoz, Dermot Hayes, Tun-Hsiang Yu, "Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land-Use Change", *Science* 29 February 2008: Vol. 319. no. 5867, pp. 1238 – 1240.

54 CRS Report for Congress, 2007, *supra* note 44 at 11-12.

55 OECD Report, *supra* note 46 at 10.

56 *Energy Independence and Security Act of 2007* (H.R. 6) ("EISA"). For a summary of the Act, see: Congressional Research Service, "Energy Independence and Security Act of

2007: A Summary of Major Provisions” (Dec. 21, 2007), online: U.S. Senate Committee on Energy <[http://energy.senate.gov/public/\\_files/RL342941.pdf](http://energy.senate.gov/public/_files/RL342941.pdf)>.

57 Environmental Protection Agency (EPA), “EPA Lifecycle Analysis of Greenhouse Gas Emissions from Renewable Fuels”, EPA-420-F-09-024, May 2009, online: EPA <<http://www.epa.gov/otaq/renewablefuels/420f09024.htm>>.

58 *Ibid.* at 3.

59 Timothy Searchinger (cited *supra* at note 53) quoted in Tom Philpott, “The EPA holds corn ethanol accountable ... sort of”, *Grist*, (May 5, 2009), online: Grist <<http://www.grist.org/article/2009-05-05-epa-ethanol-biofuel/>>.

60 *Ibid.*

61 IISD Report, *supra* note 47 at 4-5.

62 *ibid.* at 5

63 See: Ministry of the Environment (Ontario) (MOE), “Ontario Regulation 535/05 – Ethanol in Gasoline” (Last modified: October 21 2008), online: MOE <<http://www.ene.gov.on.ca/envision/ethanol/index.htm#background>>.

64 In July 2008, it was reported by the *Toronto Star* that Ontario Premier Dalton McGuinty “said he was rethinking his commitment to increase the ethanol content in gasoline to 10 per cent by 2010, given the dubious environmental benefits of the biofuel and the impact it’s having on food prices”: Maria Babbage, “McGuinty backtracks on ethanol promise”, *The Toronto Star*, (July 9, 2008), online: Toronto Star <<http://www.thestar.com/News/Ontario/article/457143>>

65 “The rebate will be available for plug-in hybrid and battery electric vehicles purchased after July 1, 2010 and will provide between \$4,000 and \$10,000 towards the purchase of an electric vehicle depending on the vehicle’s battery capacity. The high-end of the rebate would be the highest in Canada and amongst the highest in the world”: Government of Ontario, News Release, “A Plan For Ontario: 1 In 20 By 2020”, (July 15, 2009), online: Government of Ontario <<http://news.ontario.ca/mto/en/2009/07/a-plan-for-ontario-1-in-20-by-2020.html>> [“A Plan For Ontario: 1 In 20 By 2020”]

66 *Ibid.*; see also: Government of Ontario, News Release, “McGuinty Government Making It Easier To Buy Electric Vehicles”, (July 15, 2009), online: Government of Ontario <<http://www.news.ontario.ca/opo/en/2009/07/ontario-leading-the-charge.html>>

67 Editorial, “Dubious subsidy for electric cars”, *Toronto Star*, (July 17, 2009), A20

68 Greg Keenan and Karen Howlett, “Electric car rebate sparks criticism”, *Globe and Mail*, (July 23, 2009), online: Globe and Mail <<http://www.theglobeandmail.com/globe-investor/electric-car-rebate-sparks-criticism/article1219477>>

69 To encourage early-adopters, the government will permit electric vehicle purchasers to use High-Occupancy Vehicle (HOV) lanes for a limited time (5 years), regardless of the number of passengers in the vehicle; the province will purchase electric cars for its own fleet of Ontario Public Service vehicles; and Ontario will work with private sector companies and the province’s electricity utilities to construct infrastructure for charging electric vehicles: “Ontario is working with the private sector and electricity organizations to develop business models for recharging facilities that will work within Ontario’s regulated electricity market”: Government of Ontario, “A Plan For Ontario: 1 In 20 By 2020”, *supra* note 65.

70 Dennis Desrosiers, “Incentives for plug-ins a subsidy for failure?”, *Toronto Star*, (July



17, 2009), A21

71 *Ibid.*

72 Keenan and Howlett, *supra* note 68.

73 The Globe and Mail reports that the premier of Ontario announced that (paraphrasing) “Ontario would like auto makers to manufacture electric cars in the province. If residents purchase enough of these vehicles, that will give the province bargaining clout with the auto makers”. Keenan and Howlett, *supra* note 68.

74 Desrosiers, *supra* note 70 (“We have no idea what the life cycle maintenance cost will be for one of these electric vehicles; we do not know whether they will be reliable or can withstand our harsh winters”).

75 Stern Review, *supra* note 1.

76 See, generally, William Nordhaus, *A Question of Balance*, (New Haven: Yale University Press, 2008) and Jeffrey Simpson, Mark Jaccard and Nic Rivers, *Hot Air: Meeting Canada's Climate Change Challenge*, (Toronto: McClelland and Stewart, 2007). For a foundation to the literature distinguishing between carbon taxes and cap-and-trade, see: Martin Weitzman, “Prices vs. Quantities”, (1974) *Review of Econ Studies* 41: 477-91; for a more recent overview, see William Nordhaus, “To Tax or Not to Tax: Alternative Approaches to Slowing Global Warming,” (2007) *Review of Environmental Economics and Policy*, 1, 26-44. For a recent proposal regarding the design of carbon taxes (noting that many of the same issues arise regardless of whether we adopt a tax or a cap-and-trade regime), see Gilbert E. Metcalf and David A. Weisbach, “Design of a Carbon Tax”, (January 8, 2009) University of Chicago Law and Economics Working Paper Series, online: SSRN <[http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1324854](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1324854)>.

77 For a snapshot of the current debate, see e.g. “Putting a Price on Carbon: An Emissions Cap or a Tax?”, *Yale Environment* 360, (May 7, 2009), online: *Yale Environment* 360 <<http://e360.yale.edu/content/feature.msp?id=2148>> (with contributions from Frances Beinecke, Eileen Claussen, Baruch Fischhoff, Charles Komanoff, Fred Krupp, Roger A. Pielke Jr., Jeffrey D. Sachs and Robert N. Stavins).

78 Joost Pauwelyn, “U.S. Federal Climate Policy and Competitiveness Concerns: The Limits and Options of International Trade Law”, Working Paper No. 07-02, Nicholas Institute for Environmental Policy Solutions at Duke University [Nicholas Institute], April 2007, online: Nicholas Institute <<http://www.nicholas.duke.edu/institute/internationaltradelaw.pdf>>; Paul-Erik Veel, “Carbon Tariffs and the WTO: An Evaluation of Feasible Policies,” (2009) 12 *Journal of International Economic Law* 749.

79 Paul Krugman, “The Perfect, the Good, the Planet”, *New York Times*, (May 17, 2009), online: NY Times: <<http://www.nytimes.com/2009/05/18/opinion/18krugman.html>>.

80 See, e.g., Stern Review, *supra* note 1; Sachs, *supra* note 2.

81 A wide variety of firms call themselves “clean technology companies”, including consulting firms and companies that have adopted environmentally sound manufacturing processes, and companies that use clean technology that is developed by other companies (including many alternative power generation companies). See: Ontario Centre for Environmental Technology Advancement (OCETA), Russell-Mitchell Group and Sustainable Development Technology Canada (SDTC), *The 2009 OCETA SDTC Cleantech Growth & Go-to-Market Report*, (2009), online: Clean Technology Report <<http://cleantechnologyreport.ca/>> at 23 [“OCETA Report”].

82 *Ibid.* at 24 (Fig. 1-1).

83 Clusters are designed to: “Foster partnerships to pursue cutting-edge, applications-oriented research among multiple participants and disciplines”; “Develop and rapidly transfer highly innovative technologies into the marketplace”; “Build the knowledge base and human capital necessary to address the nation’s energy challenges”; and Encourage regional economic development by spawning clusters of nearby start-up firms, private research organizations, suppliers, and other complementary groups and businesses”: James Duderstadt, Gary Was, Robert McGrath, Mark Muro, Michael Corradini, Linda Katehi, Rick Shangraw, and Andrea Sarzynski, “Energy Discovery-Innovation Institutes: A Step Toward America’s Energy Sustainability”, Metropolitan Policy Program at Brookings (Feb. 2009), online: Brookings Institution <[http://www.brookings.edu/-/media/Files/rc/reports/2009/0209\\_energy\\_innovation\\_muro/0209\\_energy\\_innovation\\_muro\\_full.pdf](http://www.brookings.edu/-/media/Files/rc/reports/2009/0209_energy_innovation_muro/0209_energy_innovation_muro_full.pdf)> at 3-4 [Brookings].

84 *Ibid.* at 40 (Fig. 2-8: Sources of Financing for Clean Technology Companies).

85 A claim made in speeches as well as numerous interviews; see, e.g.: John M. Broder and Matthew L. Wald, “Big Science Role Is Seen in Global Warming Cure”, *New York Times*, (Feb. 11, 2009), online: New York Times <<http://www.nytimes.com/2009/02/12/us/politics/12chu.html>>.

86 Paul Berg et al., Letter to the Honourable Barack H. Obama (July 16, 2009), online: Federation of American Scientists (FAS) <[http://www.fas.org/press/\\_docs/Nobelista%20Letter%20-%2007162009.pdf](http://www.fas.org/press/_docs/Nobelista%20Letter%20-%2007162009.pdf)>; see also, Federation of American Scientists (FAS), News Release, “34 U.S. Nobel Laureates Urge Inclusion of President Obama’s \$150 Billion Clean Energy Technology Fund in Climate Legislation”, (July 16, 2009), online: FAS <[http://www.fas.org/press/news/2009/july\\_nobelista\\_letter\\_to\\_obama.html](http://www.fas.org/press/news/2009/july_nobelista_letter_to_obama.html)>

87 *The American Clean Energy and Security Act* (H.R. 2454)

88 In particular, “in the Department of Energy’s (DOE) Office of Science, or for the energy research and associated technology development programs of DOE (at the Energy Efficiency and Renewable Energy, Electricity Deliverability, Fossil, and Nuclear offices).” Berg et al., *supra* note 86.

89 Brookings, *supra* note 83 at 3-4. Advocating the clusters approach, Brookings charges that U.S. public energy research efforts are “based on an obsolete research paradigm. Most federal energy research is conducted within ‘siloes’ labs that are too far removed from the marketplace and too focused on their existing portfolios to support ‘transformational’ or ‘useinspired’ [sic] research targeted at new energy technologies and processes”; Brookings proposes that “[t]he federal government should create a national network of several dozen e-DIIs. An interagency process should establish the network and competitively award core federal support. . . . augmented with participation by industry, investors, universities, and state governments”: *Ibid.*

90 For example, in 2005, the Innovative Solutions Division of the Science and Technology Branch, Environment Canada, titled a subsequently cited presentation, “‘Show Me The Money’ (A guide through the funding program maze)”, setting out ten major sources of federal funding for innovative energy projects, of varying scale and duration. See: online: British Columbia Environment Industry Association (BCEIA) <[http://www.bceia.com/documents/resources/1\\_Show\\_me\\_the\\_Money\\_-\\_A\\_Guide\\_Through\\_the\\_Funding\\_Program\\_Maze.pdf](http://www.bceia.com/documents/resources/1_Show_me_the_Money_-_A_Guide_Through_the_Funding_Program_Maze.pdf)>. The OCETA Report, *supra* note 81 at 150-

156, names another dozen sources of funding in Ontario alone.

91 online: British Columbia Environment Industry Association (BCEIA) <[http://www.bceia.com/documents/resources/2\\_%20SDTC\\_-\\_Partnering\\_for\\_Real\\_Results.pdf](http://www.bceia.com/documents/resources/2_%20SDTC_-_Partnering_for_Real_Results.pdf)>

92 See online: SDTC <<http://www.sdtc.ca/en/about/index.htm>>

93 *Ibid.*

94 *Ibid.* Since 2001, after thirteen funding rounds, SDTC has allocated just over \$375 million to more than 150 projects, leveraged with more than \$900 million from other partners (84% percent of it from private sources), for a total project value of \$1.3 billion.

95 While the recession has affected the market, it has grown steadily for the past seven years; between 2007 and 2008 alone, from roughly US\$6.1b to US\$8.4 b – a single-year increase of nearly 40 per cent. The OCETA report values the investment opportunity in Ontario alone at \$1b. OCETA Report, *supra* note 81 at 21 and 77.

96 In 2005 the consulting firm Macdonald & Associates noted a substantial increase, in the preceding decade, of seed, start-up and early-stage investments involving new businesses in innovative sectors including the clean technology industry (as well as, for example, the communications, IT and life sciences industries), representing “a fundamental shift in industry focus towards early-stage activity”. Macdonald & Associates Limited, “Growing the Businesses of Tomorrow: Challenges and Prospects of Early-Stage Venture Capital Investment in Canada” (March 2005), report prepared for The Business Development Bank of Canada (BDC), Industry Canada and the Ontario Ministry of Economic Development and Trade (MEDT), online: SME Financing Data Initiative (Industry Canada) <[http://www.sme-fdi.gc.ca/eic/site/sme\\_fdi-prf\\_pme.nsf/vwapj/EarlyStage\\_VC\\_Eng.pdf/\\$FILE/EarlyStage\\_VC\\_Eng.pdf](http://www.sme-fdi.gc.ca/eic/site/sme_fdi-prf_pme.nsf/vwapj/EarlyStage_VC_Eng.pdf/$FILE/EarlyStage_VC_Eng.pdf)>, at 4-5.

97 *Ibid.* at 4-5 and 5-7. See also: Industry Canada, “Canadian Venture Capital Activity: An Analysis of Trends and Gaps (1996–2002)” (May 2004), online: SME Financing Data Initiative (Industry Canada) <[http://www.sme-fdi.gc.ca/eic/site/sme\\_fdi-prf\\_pme.nsf/vwapj/VentureCapital\\_e.pdf/\\$FILE/VentureCapital\\_e.pdf](http://www.sme-fdi.gc.ca/eic/site/sme_fdi-prf_pme.nsf/vwapj/VentureCapital_e.pdf/$FILE/VentureCapital_e.pdf)>, and, generally, Cécile Carpentier, Maher Kooli and Jean-Marc Suret, “Initial Public Offerings: Status, Flaws and Dysfunctions” (April 2003), online: SME Financing Data Initiative (Industry Canada) <[http://www.sme-fdi.gc.ca/eic/site/sme\\_fdi-prf\\_pme.nsf/vwapj/PrimaryIssues\\_e.pdf/\\$FILE/PrimaryIssues\\_e.pdf](http://www.sme-fdi.gc.ca/eic/site/sme_fdi-prf_pme.nsf/vwapj/PrimaryIssues_e.pdf/$FILE/PrimaryIssues_e.pdf)>.

98 A recommendation of the OCETA Report, *supra* note 81 at 74.

99 *Ibid.* at 77-79.

100 Generous tax breaks to venture capital funds “may exacerbate, not mitigate,” capital gaps, by distorting the market. For instance, Douglas Cumming and Jeffrey McIntosh analyze subsidies for LSVCCs, finding that they may “lower the LSVCCs’ required rate of return, allowing [them] to out-bid other types of funds (even those with tax-exempt investors),” thereby driving up deal prices and lowering returns in the market overall (“[i]f institutional investors are risk averse and commit capital prior to knowing the increase in LSVCC fundraising in any given year, then institutional investors overestimate the extent LSVCC funding, and reduce their commitments to private venture capital funds”): Douglas J. Cumming and Jeffrey G. McIntosh, “Crowding Out Private Equity: Canadian Evidence” (September 2003 Draft), online: SSRN <[http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=323821](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=323821)>, at 4.

101 The Fund was established in the spring of 2009 to finance private VC funds investing in technology companies, with an emphasis on life sciences, information technology and clean technology, with \$200m from the government of Quebec and slightly larger contributions from the Caisse de Dépôt et placement du Québec (an institutional funds manager working primarily with public and private pension and insurance plans; net assets roughly \$120 billion) and the Solidarity Fund FQL (a development capital company investing RRSPs; net assets roughly \$6 billion), to be topped up with contributions from private investors and institutions. See: Caisse de Dépôt et Placement du Québec [Caisse de Dépôt], News Release, “The Caisse de Dépôt et Placement du Québec, the Solidarity Fund QFL and the Québec Government Join Forces to Create the Teralys Capital Fund”, (April 27, 2009), online: Caisse de Dépôt <[http://www.lacaisse.com/en/nouvelles-medias/Documents/Communique\\_fonds\\_Teralys\\_Capital\\_2009-04-27\\_VA.pdf](http://www.lacaisse.com/en/nouvelles-medias/Documents/Communique_fonds_Teralys_Capital_2009-04-27_VA.pdf)>.

102 In the Canadian context, see, generally: Wulong Gu and Ryan Macdonald, “The Impact of Public Infrastructure on Canadian Multifactor Productivity Estimates”, (2009) *The Canadian Productivity Review* 21 (Cat. No. 15-206-XWE2008021), online: Statistics Canada <<http://www.statcan.gc.ca/pub/15-206-x/15-206-x2008021-eng.pdf> > (finding that between 1962 and 2006, roughly one-half of the total growth in multifactor productivity in the private sector was the result of growth in public infrastructure). See also: Tarek M. Harchaoui, Faouzi Tarkhani and Paul Warren, “Public infrastructure in Canada: Where do we stand?” (2003) *Insights on the Canadian Economy* 5 (Cat. No. 11-624-MIE2003005), online: Statistics Canada <<http://www.statcan.gc.ca/pub/11-624-m/11-624-m2003005-eng.pdf> > (evaluating the development of public infrastructure in Canada and its contribution to Canada’s standard of living and the performance of Canadian businesses).

103 See: Independent Electricity System Operator (IESO), “Enabling Tomorrow’s Electricity System” (Report of the Ontario Smart Grid Forum, February 2009), online: IESO <[http://www.ieso.ca/imoweb/pubs/smart\\_grid/Smart\\_Grid\\_Forum-Report.pdf](http://www.ieso.ca/imoweb/pubs/smart_grid/Smart_Grid_Forum-Report.pdf)> [“IESO Report”].

104 IESO Report, *ibid.* at 6 (“Key Recommendations”).

105 *Ibid.*

106 OCETA Report, *supra* note 81 at 53; Donald Dewees, “The Price Isn’t Right: The Need for Reform in Consumer Electricity Pricing,” C.D. Howe Institute Backgrounder, No. 124, January, 2010.

107 *Ibid.*

108 *Ibid.* at 52 (latest available figures).

109 *Ibid.*

110 *Ibid.*

111 See: Pierce et al, *supra* note 37.

112 Pierce et al., *supra* note 111 at 216.

113 *Ibid.* at 215-216

114 *Ibid.*

115 See e.g. Bernard and Duclos, *supra* note 37.

116 Both direct and indirect subsidies can be targeted at consumers, producers of RES-E, and producers of RES-E technology.

117 Duff and Green, “A Comparative Evaluation”, *supra* note 3 at 223.

118 *Ibid.* at 224-6

119 *Ibid.* at 226-7

120 Duff and Green, “Wind Power in Canada”, *supra* note 32 at 24-27.

121 Duff and Green, “A Comparative Evaluation”, *supra* note 3 at 227-8.

122 See, generally, Decker, *supra* note 24; Bain Study *supra* note 23.

123 Duff and Green, “A Comparative Evaluation”, *supra* note 3 at 230-2, 238.

124 Duff and Green, *ibid.* at 238

125 *Ibid.*

126 See, e.g., Lori Bird, Mark Bolinger, Troy Gagliano, Ryan Wise, Matthew Brown, and Brian Parsons, “Policies and Market Factors Driving Wind Power Development in the United States”, (2005), 33 *Energy Policy* 1397 (analyzing policy approaches in twelve states, including Texas and California, and finding that, “[o]f the various State policy drivers, the RPS appears to be the most effective. But a variety of financial incentives can also wield a great deal of influence. Any State policy must, however, operate in the general context of the wind resource, transmission constraints, and market rules, which ultimately may bound any new investment in wind”, at 1407).

127 This was an approach adopted (briefly) in Ontario; see: Ian H. Rowlands, “The Development of Renewable Electricity Policy in the Province of Ontario”, Draft, (29 August 2006), online: University of Waterloo, Faculty of Environment <[http://www.fes.uwaterloo.ca/research/greenpower/Rowlands\\_OntarioRE\\_Policy.pdf](http://www.fes.uwaterloo.ca/research/greenpower/Rowlands_OntarioRE_Policy.pdf)>.

128 See e.g. Tyler Hamilton, “Province freezes Great Lakes energy proposals”, *The Toronto Star*, (October 23, 2009), online: Toronto Star <<http://www.thestar.com/comment/article/714699>>. Ontario has not been accepting new applications for wind power projects (both land and offshore) since December of 2008, due to a high level of interest and pending approval and permitting standards, as well as a review of site release policies to ensure that they are aligned with the new legislation. The Ministry has indicated that it intends to complete its review by March 2010. E-mail from Stefanie Millon, spokesperson for the Minister of Natural Resources, to the authors (Oct. 29, 2009, 01:35:41 PM EDT) (on file with the authors).

129 Policy reviews imply a pre-commitment to policy course corrections and therefore policy uncertainty, which many blame for underinvestment in renewable energy technologies where these hinge on subsidies and other government programs of support. We suggest that this might be an inherent weakness to the picking winners approach. Nonetheless, even where subsidies are adopted, we note that reviews can be incorporated into the subsidization model so as to tailor subsidies to market realities, as discussed in Part 3.

130 See, generally: Beverly McLachlin, “The Roles of Administrative Tribunals and Courts in Maintaining the Rule of Law”, [1998-1999] 12 *Can. J. Admin. L. & Prac.* 171 at 173-175

131 Although the comparison may seem inapt because the UK is a unitary state, the provinces in Canada “exercise effective control over energy policy”: Mark S. Winfield with Clare Demerse and Johanne Whitmore, “Climate Change and Canadian Energy Policy”, in Bernstein et al., *supra* note 3 at 261-92 at 263; see also, Duff and Green, “Wind Power in Canada”, *supra* note 32 at 9 (noting the limited formal federal role

in electricity policy, coupled with influence that can be exercised through tax and spending powers). Nonetheless, the process for policy and legislative development and implementation in Ontario is relatively disjointed as compared with that of the United Kingdom. Since 2008, energy and climate change policy in the United Kingdom are handled in a single Department of Energy and Climate Change (DECC). In Ontario, various ministries are responsible for implementing the government's environmental policies. A Climate Change Secretariat was created in 2008, although its powers are not clearly defined. The Environmental Commissioner of Ontario also performs some oversight functions; see further, note 162 *infra*.

132 This commitment was made pursuant to the EU Renewable Energy Directive. See online: DECC <[http://www.decc.gov.uk/en/content/cms/consultations/cons\\_res/cons\\_res.aspx](http://www.decc.gov.uk/en/content/cms/consultations/cons_res/cons_res.aspx)>.

133 The UK's target is to generate 15% of its energy from renewable sources by 2020.

134 The strategy is scheduled for publication in summer 2009: Consultation, *supra* note 133.

135 DECC's policy and legislative work build on the Energy White Paper (2003) (online: BIS <<http://www.berr.gov.uk/energy/whitepaper/2003/page21223.html>>) and Energy Review Report (2006), (online: BIS <<http://www.berr.gov.uk/energy/whitepaper/review/page31995.html>>) and a more recent Energy White Paper (2007) (online: BIS <<http://www.berr.gov.uk/energy/whitepaper/page39534.html>>) which sets out the UK's international and domestic energy strategy. Two pieces of legislation have been passed since the new department was created: the *Energy Act 2008* (which implemented the legislative aspects of the *2007 Energy White Paper*) and the *Climate Change Act 2008* (which established legally binding targets for emissions cuts, a carbon budgeting system, the creation of an independent expert body to advise Government on carbon budgets, and an array of governmental reporting requirements). In November 2008, the Government introduced the *Planning Act 2008*, which addresses approvals matters for energy infrastructure projects. See, generally, online: DECC <<http://www.decc.gov.uk/>>.

136 The consultation process as a whole conformed to the UK Code of Practice on Consultation (a "general policy on formal, public, written consultation exercises") which requires (among other things) that "consultation responses should be analysed carefully and clear feedback should be provided to participants following the consultation": Code of Practice on Consultation, online: BERR <[www.berr.gov.uk/files/file47158.pdf](http://www.berr.gov.uk/files/file47158.pdf)>, at 4-5.

137 Consultation, *supra* note 132 at 8. With respect to biofuels, for example, the consultation raises the possibility of "requiring all biofuels to meet strict sustainability criteria, to limit adverse impacts on food prices, or other social and environmental concerns".

138 S.O. c. 12; the *Green Energy Act* is Sched. A. to the *Green Energy and Green Economy Act*.

139 *Ontario's Action Plan on Climate Change*, *supra* note 36, sets out emissions reduction targets and broad goals with respect to energy policy (i.e. commitments to conservation and renewable energy), transit (as distinguished from energy policy), job creation (through subsidies for the development, use and sale of green technologies and businesses) and protecting green spaces, but major initiatives have subsequently been developed outside of the plan. These include a recent bill designed to empower the

government to develop a cap-and-trade regime and the *Act* under discussion.

140 Government of Ontario, News Release, “Ontario Continues To Strengthen Proposed Green Energy Act”, (April 25, 2009), online: Government of Ontario <<http://www.news.ontario.ca/mei/en/2009/04/ontario-continues-to-strengthen-proposed-green-energy-act.html>> [“Ontario, News Release re: Amendments”].

141 Environmental lawyer Dianne Saxe (and co-author of the Ontario Bar Association’s submissions to the legislative committee hearings in respect of the bill, discussed below) described this as “a stunningly quick transformation from ‘an intriguing idea’ ... to law in less than nine months”: Dianne Saxe, online: Saxe Environmental Law News <<http://envirolaw.com/2009/05/15/green-energy-act-passed/>>.

142 In submissions to the legislative committee considering the *Act* (discussed further below), the Ontario Bar Association “urge[d] the government to be clear and transparent about the goals it wishes to achieve, and how each element of [the Bill] will promote those goals”. See: Ontario Bar Association (OBA), “Submission on the Proposal for the Green Energy Act EBR Registry Number 010-6017”, (March 26, 2009), online: OBA <[http://oba.org/en/pdf/oba\\_bill150\\_greenenergyact\\_mar09.pdf](http://oba.org/en/pdf/oba_bill150_greenenergyact_mar09.pdf)> at 2 [“OBA Submissions”].

143 *Ontario’s Action Plan on Climate Change*, *supra* note 36 at pp. 6-9, 21-22.

144 The OEB is empowered and directed pursuant to the *Ontario Energy Board Act, 1998*, S.O. 1998, c. 15 and the *Electricity Act, 1998*, S.O. 1998, c. 15, Sched. A, among others; see online: OEB <<http://www.oeb.gov.on.ca/OEB/Industry+Relations/Legislation>>. Subject to the regulation of the OEB, the Ontario Power Authority (OPA) is responsible for planning and procuring the province’s electricity supply (other players include public and private power generation companies, including provincially-owned Ontario Power Generation [OPG], which provides nearly three quarter’s of the province’s power from hydroelectric, nuclear and fossil fuel stations, and the privately-owned Bruce Power, which operates a nuclear generating station; and public and private transmission operators and distribution companies, including the provincially-owned Hydro One). The Independent Electricity System Operator (IESO) is responsible for the reliability of the power system as a whole (matching supply and demand). The IESO also operates the real-time spot market electricity market. For a capsule summary of the development of these arrangements, see Duff and Green, “Wind Power in Canada”, *supra* note 32 at 10-13.

145 See online: OEB, <<http://www.oeb.gov.on.ca/OEB/About+the+OEB/Our+Mandate>>.

146 *Green Energy and Green Economy Act*, *supra* note 138, Sched. D, s. 1.

147 OBA Submissions, *supra* note 142 at 2-3

148 *Ibid.* at 3

149 *Ibid.* at 6-9

150 *Ibid.* at 5-6

151 George Vegh, “The *Green Energy and Green Economy Act*: Green Energy Unbounded”, (February 24, 2009), online: University of Toronto, Faculty of Law, Faculty Blog <[http://utorontolaw.typepad.com/faculty\\_blog/2009/02/the-green-energy-act-green-energy-unbounded.html](http://utorontolaw.typepad.com/faculty_blog/2009/02/the-green-energy-act-green-energy-unbounded.html)>, at 1-2; See also, Consumers Council of Canada, “Brief of the Consumers Council of Canada to the Standing Committee on General

Government Regarding Bill 150” (April 22, 2009), on file with the authors.

152 Vegh, *ibid.* at 14-15 (“For example, the Board will have two sets of economic analysis: one that applies to conventional facilities and one for renewable facilities; if so, how can this distinction be coherently maintained in an integrated electricity system where electrons are fungible after they are produced?”).

153 *Ibid.* at 15 (“The claim for independence is stronger when a regulator is making technocratic decisions. Once the regulator is making political decisions – i.e., those involving a wider range of values than economic efficiency – it is unrealistic not to expect the government to weigh in with its own views on these issues”).

154 Some of these concerns were acknowledged in the revised *Act*; for example, it was clarified “that procurement directives under the new directive authority focus only on renewable energy, energy efficiency and conservation”: Ontario, News Release re: Amendments, *supra* note 141.

155 See: *Green Energy and Green Economy Act*, *supra* note 138, Sched. G Environmental protection Act, s. 145.2.2.

156 *Ibid.*, s. 47.7(1).

157 Alliance to Protect Prince Edward Island County (APPEC), Notes on Bill 150 – Schedule A – Green Energy Act, 2009, on file with the authors, at 11.

158 See Randall Denley, “Deal Turns Ontario into Third World Province”, *Ottawa Citizen*, January 24, 2010.

159 OBA Submissions, *supra* note 142 at 6

160 *Ibid.* at 10 (asking, for example, whether “the government [is] willing to fund an unlimited amount of the most expensive types of power, such as solar electricity, before maximizing less expensive options, such as conservation”).

161 Widely reported: see e.g. Lee Greenberg, with files from Joanne Laucius (*The Ottawa Citizen*), “McGuinty imposes green regime on Ontario”, *Financial Post*, February 24, 2009, online: Financial Post <<http://www.financialpost.com/scripts/story.html?id=1322078&cp=1>>. The government stresses that its estimates assume the complementary effects of the government’s policies; that, for example, the jobs claim “most certainly depend[s] upon the creation of enhanced manufacturing capacity in the province of Ontario” and “opportunities to build a much greater domestic supply chain in the province of Ontario”; see: Ontario, Legislative Assembly, *Official Report of Debates (Hansard)*, No. 112 (23 February 2009) at 1319 (Hon. George Smitherman) and No. 113 (24 February 2009) at 1010 (Hon. Dalton McGuinty); for access to the full set of debates, see online: Legislative Assembly of Ontario <[http://www.ontla.on.ca/web/bills/bills\\_detail.do?locale=en&BillID=2145&detailPage=bills\\_detail\\_debates&Intranet=>](http://www.ontla.on.ca/web/bills/bills_detail.do?locale=en&BillID=2145&detailPage=bills_detail_debates&Intranet=>)>. But see: London Economics, “Examining the Potential Cost of the Ontario Green Energy Act, 2009: A study prepared for the Official Opposition in Ontario by London Economics LLC”, April 30, 2009 (copy on file with the authors) (the government argues, in reply, that the London Economics study fails to credit the role of the government’s conservation initiatives in reducing the burden of electricity costs on consumers; see, e.g., Ontario, Legislative Assembly, *Official Report of Debates (Hansard)*, No. 143 (30 April 2009) at 1050 (Hon. George Smitherman)).

162 Ontario has instituted a series of annual reports tracking implementation of its *Action Plan on Climate Change*, *supra* note 36; the first annual report was published



in 2009 (see: *Ontario's Climate Change Action Plan: Creating Our Sustainable Future, Annual Report 2007-2008*, (2009), online: Ministry of the Environment <<http://www.ene.gov.on.ca/publications/6869e01.pdf>>). In addition, the *Green Energy Act* assigns responsibility for extensive reporting on the government's implementation of the *Act* itself to the Environmental Commissioner of Ontario (ECO), an independent body appointed by the legislative assembly (see: Environmental Commissioner of Ontario (ECO), *Building Resilience: Annual Report 2008-2009*, (October 2009), online: ECO <[http://www.eco.on.ca/eng/uploads/eng\\_pdfs/2009/ar2008.pdf](http://www.eco.on.ca/eng/uploads/eng_pdfs/2009/ar2008.pdf)>, at 32-33). We hope that the ECO review process will be rigorous. We note, however, that in the government's Action Plan and in its first annual report (both *supra*), there is little indication that Ontario has forecast what contribution the province's supply of renewable energy has made or will make toward its emissions abatement goals, and the ECO, in its inaugural review of the government's activities, fails to object to this omission; see: *Progress in a Climate of Change: A Review of Ontario's Climate Change Action Plan Annual Report 2007-2008, A Special Report to the Legislative Assembly of Ontario*, (December 10, 2008), online: ECO <[http://www.eco.on.ca/eng/uploads/eng\\_pdfs/2008/Progress%20in%20a%20Climate%20of%20Change%20Final.pdf](http://www.eco.on.ca/eng/uploads/eng_pdfs/2008/Progress%20in%20a%20Climate%20of%20Change%20Final.pdf)> at 5-6. We allow that it may be too early to report on the impact of Ontario's renewable energy policies, but it is nonetheless essential that we forecast that impact on the basis of the best evidence available.

