Green Energy: An Ontario Perspective

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Overview of Presentation

- Policy Development in Ontario
- Review of the Danish Experience
- Review of the German Experience
- Recent Criticisms of Ontario’s approach
  - Environmental Criticisms
  - Political Criticisms
  - Economic Criticisms
- Implications
Policy Development in Ontario

- Green Energy Act introduced in the Ontario Legislature in February, 2009
- Passed in May, 2009
- The culmination of a policy development process established in 2003
Policy Development in Ontario

Rationale for Policy

• Environmental Stewardship
  • Reduce ghg emissions
  • Phase out coal

• Industry Innovation and Leadership
  • Supply equipment to expected US market

• Emulate European experiences
Policy Development in Ontario

Main Elements of Policy

• “Steamlined” approval process

• Feed in tariffs
Policy Development in Ontario

• The Green Energy Act was proposed by the Ontario Green Energy Alliance, a coalition of environmental groups, the Ontario Sustainable Energy Association, trade associations, equipment manufacturers and developers.

• According to Deborah Doncaster, Executive Director of the Community Power Fund, and founding Executive Director of the Ontario Sustainable Energy Association,

  “This government likes Acts. We wrote the legislation.”
# Feed in Tariffs in Ontario

*Feed in Tariffs - Ontario, August 13, 2010*

<table>
<thead>
<tr>
<th>Production System</th>
<th>Size</th>
<th>Contract Price (¢/kwh)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Biomass</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>≤10 MW</td>
<td>13.8</td>
</tr>
<tr>
<td></td>
<td>&gt;10 MW</td>
<td>13.0</td>
</tr>
<tr>
<td><strong>Biogas</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-Farm</td>
<td>≤100 kW</td>
<td>19.5</td>
</tr>
<tr>
<td></td>
<td>&gt;100 kW ≤250 kW</td>
<td>18.5</td>
</tr>
<tr>
<td>Off Farm</td>
<td>≤500 kW</td>
<td>16.0</td>
</tr>
<tr>
<td></td>
<td>&gt;500 kW ≤10MW</td>
<td>14.7</td>
</tr>
<tr>
<td></td>
<td>&gt;10 MW</td>
<td>10.4</td>
</tr>
<tr>
<td><strong>Waterpower</strong></td>
<td>≤10 MW</td>
<td>13.1</td>
</tr>
<tr>
<td></td>
<td>&gt;10 MW</td>
<td>12.2</td>
</tr>
<tr>
<td><strong>Landfill Gas</strong></td>
<td>≤10 MW</td>
<td>11.1</td>
</tr>
<tr>
<td></td>
<td>&gt;10 MW</td>
<td>10.3</td>
</tr>
<tr>
<td><strong>SolarPV</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rooftop</td>
<td>≤10 kW</td>
<td>80.2</td>
</tr>
<tr>
<td></td>
<td>&gt;10 kW ≤250 kW</td>
<td>71.3</td>
</tr>
<tr>
<td></td>
<td>&gt;250 kW ≤ 500 kW</td>
<td>63.5</td>
</tr>
<tr>
<td></td>
<td>&gt;500 kW</td>
<td>53.9</td>
</tr>
<tr>
<td>Ground Mounted</td>
<td>≤10 kW</td>
<td>64.2</td>
</tr>
<tr>
<td></td>
<td>&gt;10 kW ≤10MW</td>
<td>44.3</td>
</tr>
<tr>
<td><strong>Wind</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onshore</td>
<td></td>
<td>13.5</td>
</tr>
<tr>
<td>Offshore</td>
<td></td>
<td>19.0</td>
</tr>
</tbody>
</table>
Feed in Tariffs in Ontario

• According to Keith Stelling
  • the average producer price paid for electricity from other conventional sources in 2009 was 3.23 cents per kwh

• it will cost $5 billion to construct the additional transmission lines and infrastructure to collect electricity anticipated under the Green Energy Act
## Wind Energy in Ontario

### Electricity Production from Wind in Ontario

<table>
<thead>
<tr>
<th>Current Installed Capacity</th>
<th>Additional Planned Capacity</th>
<th>Actual Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amaranth Wind Farm (200 MW)</td>
<td>2010</td>
<td>132 MW</td>
</tr>
<tr>
<td>Prince Wind Projects (I and II) (189 MW)</td>
<td>Byron Wind Project (64.5 MW)</td>
<td>12.2% of capacity, during record setting heat wave!</td>
</tr>
<tr>
<td>Kingsbridge Wind Power (40 MW)</td>
<td>Raleigh Wind Centre (78 MW)</td>
<td>11 am to 12 noon, September 2, 2010</td>
</tr>
<tr>
<td>Ripley Wind Power Project (76 MW)</td>
<td>2011</td>
<td></td>
</tr>
<tr>
<td>Kruger Energy Port Alma Wind Power Project (101 MW)</td>
<td>Raleigh Wind Centre (78 MW)</td>
<td></td>
</tr>
<tr>
<td>Underwood Wind Farm (182 MW)</td>
<td>Greenwich Wind Farm (99 MW)</td>
<td></td>
</tr>
<tr>
<td>Port Burwell Wind Farm (99 MW)</td>
<td>Talbot Wind Farm (99 MW)</td>
<td></td>
</tr>
<tr>
<td>Wolfe Island Wind Power Project (198 MW)</td>
<td>Kruger Energy Chatham Wind Project (101.2 MW)</td>
<td></td>
</tr>
<tr>
<td><strong>Total Installed Capacity – September 2, 2010</strong></td>
<td><strong>Total Additional Capacity by 2012</strong></td>
<td></td>
</tr>
<tr>
<td>1085 MW</td>
<td>569.7 MW</td>
<td></td>
</tr>
</tbody>
</table>
Review of the Danish Experience

WIND ENERGY
THE CASE OF DENMARK
Review of the Danish Experience

- **Claim** – Denmark generates ~20% of its electricity demand from wind energy
- **Reality** – total wind production/total consumption ~ = 20%. But ½ to ¾ of the electricity generated from wind in Denmark over the last 5 years is not consumed in Denmark
  - Wind energy production is not synchronized with demand
  - Surplus wind electricity is exported (at a low price) when production is high and demand is low and then electricity is imported (from Norway and Sweden) at a higher price when demand is high.
  - The technical feasibility of the Danish system is made possible by integrated electricity trading arrangements with Sweden and Norway, whose hydroelectric capacity are used to cover Danish surpluses and shortages
Review of the Danish Experience

• Danish electricity prices are the highest in the EU
• The implicit export subsidy for Danish wind energy is estimated as over 900 million euros from 2001-2008
• Wind energy in Denmark has reduced ghg emissions at a cost of ~$124 per metric ton of CO₂
• Many 10 to 15 year old turbines are past their useful life
• The Danish turbine manufacturing industry has a strong global position, as a result of domestic subsidies. But it would not be able to compete without these subsidies.
  • The subsidy per job created is ~ $90,000 to $140,000
  • Value added per employee is 13% below the Danish national average
Review of the Danish Experience

Wind mills built from 1978 – 2009 (first quarter)

Source: Naturlig Energi, June 2009
Review of the Danish Experience

“Achieving own-consumption of all its wind power is technically impossible in the short term and will remain entirely hypothetical until electricity consumption rises and new technical and demand-side solutions have been developed and implemented. In most cases, these have yet to be even invented, let alone proven and costed.”

CEPOS Report, 2009
Review of the German Experience
Review of the German Experience

• Feed in tariffs introduced in 1991

“. . German renewable energy policy, and in particular the adopted feed in tariff scheme, has failed to harness the market incentives needed to ensure a viable and cost-effective introduction of renewable energies into the country’s energy portfolio”

• By setting prices for different categories defined as renewable rather than setting a renewable price and letting alternative methods of production compete
Review of the German Experience

Table 1: Technology-Specific Feed-in Tariffs in Euro Cents per kWh

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind on-shore</td>
<td>9.10</td>
<td>9.10</td>
<td>9.00</td>
<td>8.90</td>
<td>8.70</td>
<td>8.53</td>
<td>8.36</td>
<td>8.19</td>
<td>8.03</td>
<td>9.20</td>
</tr>
<tr>
<td>Wind off-shore</td>
<td>9.10</td>
<td>9.10</td>
<td>9.00</td>
<td>8.90</td>
<td>9.10</td>
<td>9.10</td>
<td>9.10</td>
<td>9.10</td>
<td>8.92</td>
<td>15.00</td>
</tr>
<tr>
<td>Photovoltaics</td>
<td>50.62</td>
<td>50.62</td>
<td>48.09</td>
<td>45.69</td>
<td>50.58</td>
<td>54.53</td>
<td>51.80</td>
<td>49.21</td>
<td>46.75</td>
<td>43.01</td>
</tr>
<tr>
<td>Biomass</td>
<td>10.23</td>
<td>10.23</td>
<td>10.13</td>
<td>10.03</td>
<td>14.00</td>
<td>13.77</td>
<td>13.54</td>
<td>13.32</td>
<td>13.10</td>
<td>14.70</td>
</tr>
<tr>
<td>Mean Tariff</td>
<td>8.50</td>
<td>8.69</td>
<td>8.91</td>
<td>9.16</td>
<td>9.29</td>
<td>10.00</td>
<td>10.88</td>
<td>11.36</td>
<td>12.25</td>
<td>…</td>
</tr>
</tbody>
</table>

Review of the German Experience

Figure 3: Installed Capacities of Wind Power and PV in 2008 (REN21)

- **Germany**: 23,900 MW (Wind), 5,311 MW (Photovoltaics)
- **U.S.**: 25,170 MW (Wind)
- **Spain**: 16,740 MW (Wind), 3,300 MW (Photovoltaics)
Review of the German Experience

• 2009 policy amendment extended 20 year guarantee of prices to new facilities
• However, German feed in tariffs are stated in nominal terms
• Estimated ghg emission reduction costs of 716 to 1000 euros per metric ton of CO₂ for photovoltaic and 54 euros per metric ton for wind
• Indirect effect of increased consumer prices for electricity reduces employment outside of the electricity production industry
• Innovation stifled by price structure differentiated by renewable energy type
Recent Criticisms of Ontario’s Approach

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

What went wrong with Ontario’s energy policy?

Comparing spin & reality

March 5, 2010

Compiled for CENTRAL BRUCE-GREY WIND CONCERNS ONTARIO

By Keith Stilling, M.A. (McMaster) MNIMH, Dip. Phy.t., MCPP (England)

10 April, 2010

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Recent Criticisms of Ontario’s Approach
Recent Criticisms of Ontario’s Approach

“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.”

Trebilcock and Wilson, March 2010

• Policy in Ontario is often motivated by a desire to replicate European experience, especially Denmark and Germany
Recent Criticisms of Ontario’s Approach

Environmental Criticisms

• The need for backup supply (fossil fuel driven) offsets ghg emissions reductions

• Bird and Bat mortality
  • ~1800 animals at the Wolfe Island wind farm during its first 8 months of operation

• Human health effects from noise and vibration

• Viewscape and property value effects
Recent Criticisms of Ontario’s Approach

Political and Legal Criticisms

• Facility approval process is not subject to existing local zoning and permitting processes

• Also bypass Ontario Energy Board (OEB), the electricity regulatory authority

• Accusations of conflicts of interest between the Government of Ontario and the Ontario Green Energy Act of Ontario
Recent Criticisms of Ontario’s Approach

Economic Criticisms

• Less frequently made, but may be ultimately the most important

• Costly approach to restructuring electricity system

• Infant Industry argument
Simplified Economics of Electricity of Utility Regulation – “Natural Monopoly”
Simplified Economics of Electricity of Utility Regulation – “Natural Monopoly”

- **$/unit of Output**
- **Average Cost**
- **Demand**
- **Marginal Cost**
- **Price**
- **Quantity**
Simplified Economics of Electricity of Utility Regulation – “Natural Monopoly”
Solution: Two part tariff

• Set price equal to marginal cost, to determine the level of output

• Add a charge that spreads the red area losses over this output to each customer’s bill
Not So Simplified Economics of Utility Regulation – Subsidies and Externalities

$/unit of Output

Marginal Cost
Average Cost

Quantity
Not So Simplified Economics of Utility Regulation – Subsidies and Externalities

$/unit of Output

Average Cost
Average Cost less Subsidies

Quantity
Not So Simplified Economics of Utility Regulation – Subsidies and Externalities

$/unit of Output

Average Cost less Subsidies
Average Cost less Subsidies plus Externalities
Average Cost

Quantity
Multiple Sources of Supply: The Efficiency Approach

• Hydroelectric
• Nuclear
• Coal
• Natural Gas

Each has its own cost structure
Cost structure determines market share
Multiple Sources of Supply: The Efficiency Approach

$\$/unit of Output

$\$/unit of Output

Demand

Nuclear

Coal

Hydroelectric

$Q_H$

$Q_C$

$Q_N$
Multiple Sources of Supply: The Quota Approach

• Predetermine market shares for certain categories of supply

• Estimate unit costs

• Set “Feed in Tariffs” to attract supply to fill quotas
Implications of the Quota Approach

• Lack of competition among alternative sources of renewable energy

• Higher cost structure

• Problems of estimation of required levels of feed in tariffs
Multiple Sources of Supply: The Quota Approach

$\$/unit of Output

“Renewable”

Demand

Nuclear

Natural Gas

Hydroelectric

Q"R"

QH

QN

QN
Summary

• The accelerated development of wind and more recently solar powered electricity production systems is transforming rural Ontario – and has become one of the most divisive issues in rural policy in the province.

• The motivation for the development of these systems was based on a desire to emulate experiences in other jurisdictions, especially Denmark and Germany, and to promote industrial development in wind and solar electricity production.
Summary

• Recent legislation was developed by a consortium of environmental and commercial interests

• Recent studies of the Danish and German experiences indicate that there are critical limitations to these approaches

• Environmental, legal, political and economic criticisms of Ontario’s approach are emerging
Implications

• It appears that the economic model underlying the Green Energy and Green Economy Act is not sustainable – who will pay for the anticipated higher electricity costs?

  • Taxpayers?
  • Ratepayers?

• Will the financial pressures lead to policy change?

• If yes, who will be left holding the stranded assets?
<table>
<thead>
<tr>
<th>Installed Capacity</th>
<th>Cost per MW</th>
<th>Total Cost</th>
<th>100% capacity</th>
<th>50% capacity</th>
<th>29% capacity</th>
<th>10% capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1085MW</td>
<td>$2.5 million</td>
<td>$2.71 billion</td>
<td>1085 MW x 1000 x $0.135 per kwh x 24 hours = $3.5 million per day, ~$1.78 billion per year</td>
<td>~$638 million per year</td>
<td>~$371 million per year</td>
<td>~$128 million per year</td>
</tr>
</tbody>
</table>

**Producer Revenue per Year/Cost**

|                  |            | 47% | 24% | 14% | 4.7% |
Implications

• Will the hoped for environmental benefits and industry development be realized?

• Do “Infant Industries” ever grow up?

  • The Danish experiences suggests that the answer is no

  • Will the hopes of selling technology into the US market be realized?
Implications

• Need to integrate North American electrical production and consumption systems (I hesitate to call them “markets”)

• The unrecognized difference between electricity production and consumption systems in Europe and in North America

• Supply risk mitigation, Less costly backup supply

• Challenges in interprovincial relations and North American trade policy

• 2011 promises to be an interesting year in Ontario!