POWERWEDGES Wind & Cogeneration Opportunities for Alberta

Thought Leaders' Forum – March 30, 2010

- Pre-forum discussion paper -

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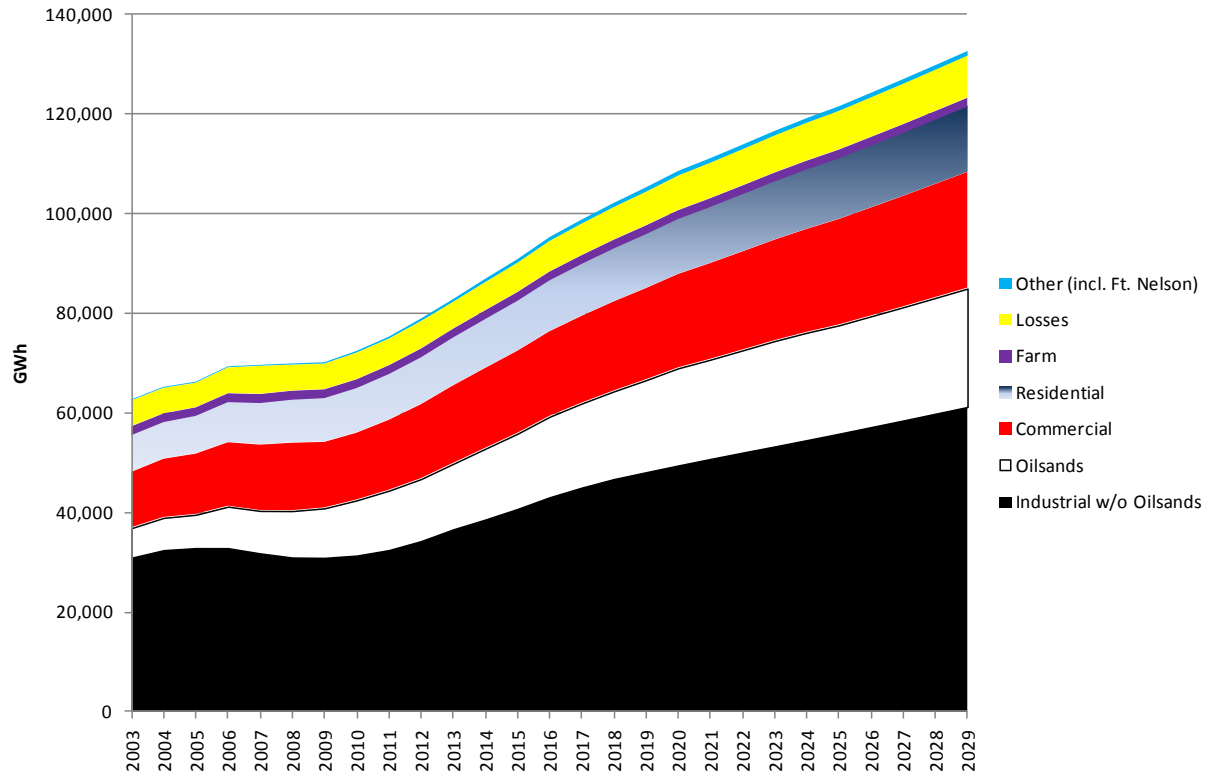
Introduction

In January 2009, the Pembina Institute published *Greening the Grid*, a report that identified and estimated the scale of alternative electricity options available to Alberta to meet its growing demand over the next 20 years. At the time of the report, the Alberta Electric System Operator (AESO), among other industry analysts, predicted that the electricity consumption in the province was expected to be almost twice current levels by 2029. While these forecasts have slowed somewhat as a result of global economic changes, Alberta' electricity growth remains poised to continue as shown in Figure 1:

Figure 1: Alberta Internal Load (post-2008 data is forecast).



Source: AESO (2009)

The analysis in *Greening the Grid* found that Alberta has sufficient natural resources at its disposal that can be harnessed using technology that is already available today. Based on rates of deployment in numerous other jurisdictions in North America and globally, Alberta could significantly lower the impact of its electricity system while meeting future demands by using a combination of renewable energy (primarily wind), plus cleaner transitional technologies (such as natural gas cogeneration), along with significant energy efficiency efforts. The analysis does not address what policy tools could or should be used to efficiently and cost-effectively tap into the province's alternative energy resources. In order to better understand what policy levers could be useful, the Pembina Institute and Institute for Sustainable

Energy Environment and Economy (ISEEE) are hosting a Thought Leaders Forum focused on what practical next steps the province and major municipalities might take to advance the "greening" of Alberta's grid.

The event will focus on two of the most significant "wedges" identified in the aforementioned analysis - wind power and natural gas cogeneration. These two facets of greener electricity were chosen for a variety of reasons: they are currently in use in Alberta; they are technologies with a proven track record; they are the most efficient options given the Alberta landscape; they are among the cheapest electricity generating options[1] ; there is ample room for them to grow; they have been adopted by both the private and public sectors; and they are part of long term planning strategies that have been released by Alberta Energy, the Alberta Electric Systems Operator (AESO) and Alberta Environment, as part of the provincial Climate Change Strategy.

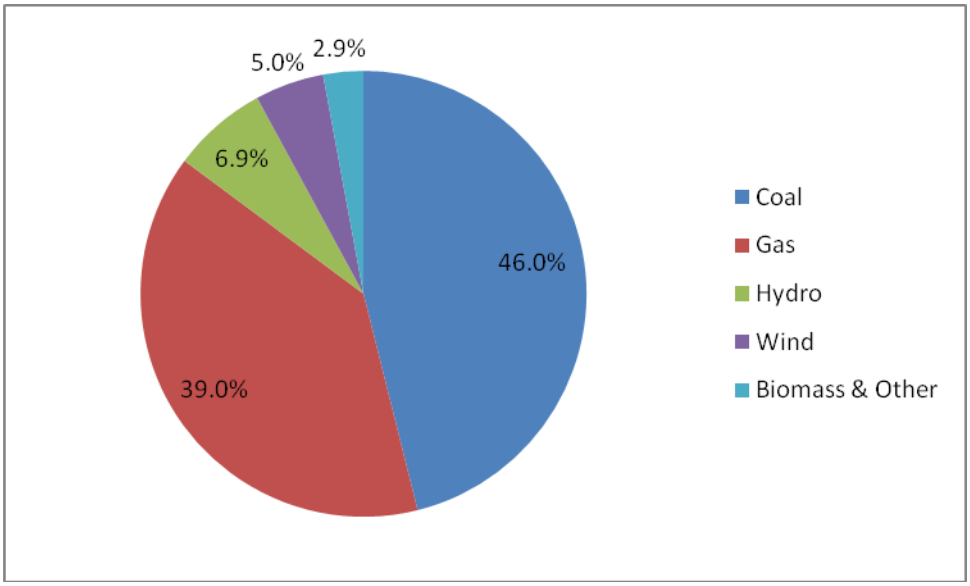
The purpose of this pre-forum paper is to provide an inventory of relevant policy examples for the adoption of wind energy and cogeneration that have been proposed or implemented in other jurisdictions. It should be noted that this report is not aiming to evaluate or write policy, nor does it suggest an overall strategy to address wind and cogeneration opportunities. Rather it is an overview of Alberta's current electricity situation along with a short list of policy options that Alberta can learn from and consider within our unique electricity system. The content of the report is meant to initiate discussion and explore and evaluate electricity policy options through an "Alberta lens."

Electricity in Alberta

Alberta has a total electricity capacity of over 13,000 megawatts (MW) and generated almost 70,000 gigawatt hours (GWh) of electricity in 2009 (including "behind the fence" generation).[2] Currently, fossil fuels (gas and coal) account for the majority of the installed generating capacity in Alberta. Coal represents the largest segment of existing generation capacity at 5,972MW (or 46 per cent) followed closely by gas at 5,142 MW (or 39 per cent), although much of the gas is part of the "behind the fence" systems found for the most part in the oil sands. Compared to other Canadian provinces and territories, Alberta is the most reliant on coal-fired power generation. For example, while Ontario may have more installed coal capacity (with 6,329 MW) coal-fired generation represents only 19 per cent of its total generation.

[1] Pembina Institute: Greening the Grid: Powering Alberta's Future with Renewable Energy (January 2009)
[2] The "Alberta Interconnected Electric System" load was approximately 58,000 GWh, which does not include behind the fence or Medicine Hat.

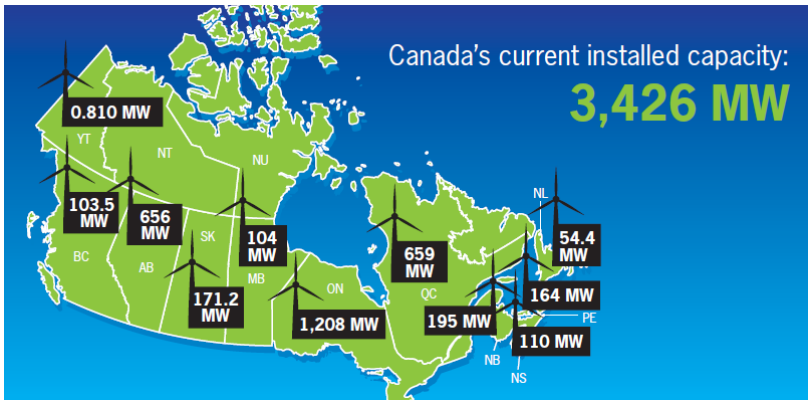
Figure 2: Electricity Generation Capacity in Alberta, 2009



Source: Alberta Energy

At present, Alberta has 657 MW of existing wind generation capacity (roughly 5 per cent of overall generation and 2 per cent of annual supply), and nearly 7,400 MW of wind power has been applied for and sits in the interconnection queue for potential future development. [3] It should be noted that until recently, Alberta led all Canadian provinces in wind electricity, but now is second to Ontario in terms of wind generation capacity. A rough estimate of Alberta's total wind energy potential is about 64,000 MW.[4]

Figure 3: Canada's Wind Capacity, March 2010

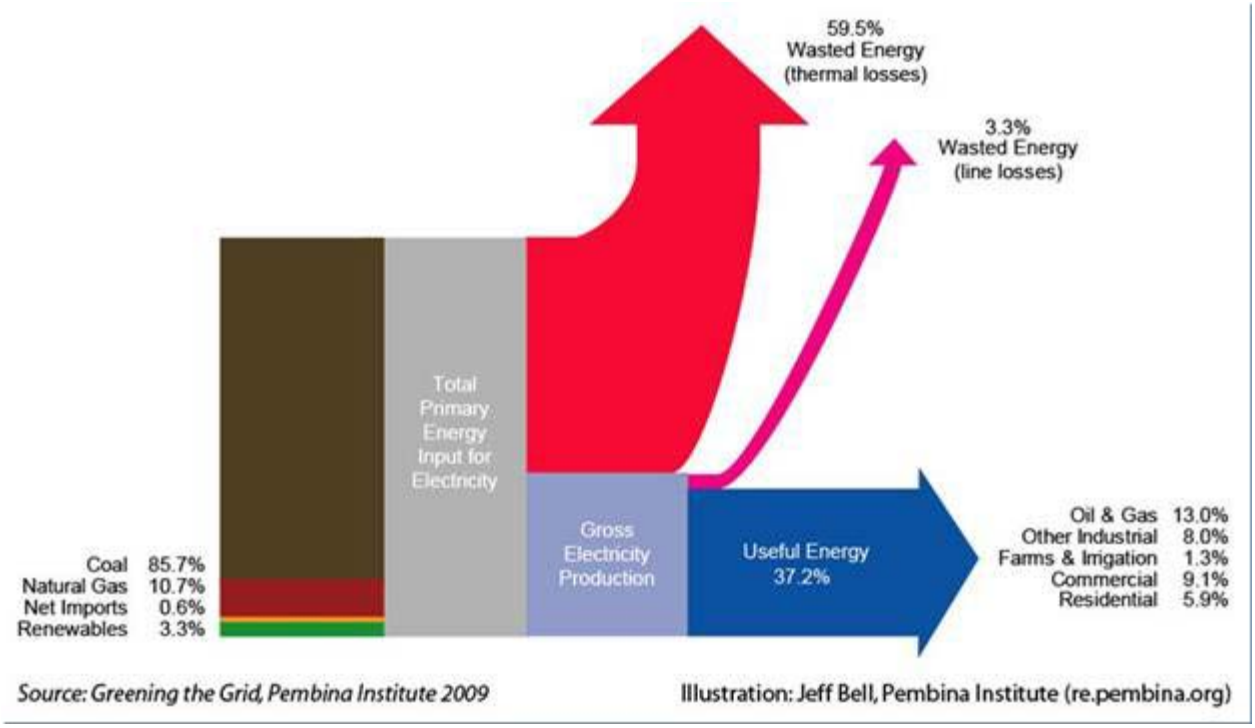


Source: CanWEA

[3] AESO Current Connections Queue: http://www.aeso.ca/11601.html
[4] Pembina Institute: Greening the Grid: Powering Alberta's Future with Renewable Energy (January 2009)

Cogeneration, which captures the heat produced during electricity generation, currently represents 12 per cent of electricity capacity in Alberta. While not necessarily renewable (unless the fuel is biomass/biogas) it can be considered a form of energy efficiency as it extracts more useful energy from the primary fuel and offers considerable potential for reducing emissions. Cogeneration of electricity and heat from a single fuel can play an increasingly important role in supplying both industrial process heat and residential/commercial heating, including district heating.

Figure 4: Total Alberta fuel energy used for electricity generation and energy delivered to customers by end use in 2007



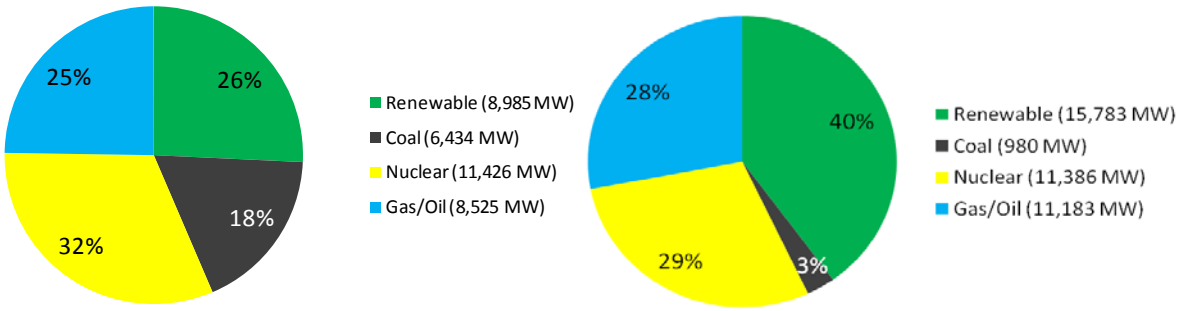
For the purpose of this report, the single fuel would be natural gas, of which Alberta has ample supply - 80 per cent of the natural gas produced in Canada is found in Alberta.[5] In addition to heating homes and businesses, over 60 per cent of the natural gas consumed in Alberta is used by the industrial sector. Natural gas is an important raw material for the province's oil sands and electric power generation industries, which have seen tremendous expansion over the past decade. Industrial users have been at the forefront of the adoption of cogeneration technologies – between 1998 and 2006, about 3,000 MW of cogeneration capacity came online in the Fort McMurray area, home to large industrial oil sands projects, proving that there is precedent for capacity growth of this technology.[6]

[5] Calgary Economic Development: Energy Sector Profile (August 2009)
[6] Pembina Institute: Greening the Grid: Powering Alberta's Future with Renewable Energy (January 2009)

Policy Examples from Various Jurisdictions

As mentioned, Alberta already has significant wind and natural gas resources, giving it a strong base upon which it can build a greener electricity system. Ontario, in fact, is using a combination of wind (and other renewables to a lesser extent) and natural gas to replace its entire coal fleet in the next four years as shown below:

Figure 5: Ontario electricity system 2009 (left) and 2014 forecast (right)[7]



Source: Ontario Power Authority

Other jurisdictions have made significant strides in growing alternative sources of electricity, and as such they can provide good examples of potential policies to be implemented here. Recognizing that policies implemented elsewhere might not be readily applicable in Alberta due to some unique characteristics within the policy and technical framework in the province (as explained later in the document), it is still worth examining what other jurisdictions have done. Most of the policies are part of broader climate change legislation or renewable energy acts, so include goals that go beyond just the adaptation of more wind and cogeneration options. That said, they all include targets for their respective electricity systems. Additionally the examples are meant to be helpful and illustrative, not necessarily comprehensive. It should also be noted that Alberta and its cities do in fact have some policies in place that have allowed for the development of renewable forms of electricity and they are included later in this paper.

Finally, the examples provided represent a mix of municipal, provincial, regional, state and national policies. While the Alberta government has primary responsibility for regulatory or incentive legislation that could lead to more adaptation of lower impact electricity, municipalities have a major role to play as well, and are doing so in Europe and many American states. Cities are high energy consumption systems, and home to the majority of the population in both Alberta and Canada, and ultimately they

[7] Source data taken from: Jason Chee-Aloy, Director, Generation Procurement, Ontario Power Authority, *Integrating Renewable Energy Supply Resulting from Uptake of the FIT and microFIT Programs*, Nov 18, 2009

are the end-users of electricity. In addition to the purchase of power by those within the cities or for the municipal operations themselves, cities can also enable and/or encourage their citizens to generate power locally. Additionally, in Alberta as in many states and provinces across North America, several cities are also owners (either directly or indirectly) of utility companies.

Province of Ontario

As previously mentioned, Ontario's electricity system is much less reliant on coal. The Provincial Government has committed to shutting down all of its coal plants by 2014. In addition, Ontario's *Green Energy and Green Economy Act, 2009* was passed into law on May 14, 2009. The final regulations were delivered in September 2009, and it represents North America's first comprehensive set of "Feed-in Tariffs (FIT)." The Act is made up of the following components:

- A Feed-in-Tariff program, which allows individuals and companies to sell renewable energy – like solar, wind, water, biomass, biogas and landfill gas – into the grid at set rates. Examples include, on-farm biogas (18.5-19.5 c/kWh), on-shore wind-power (13.5 c/kWh), and landfill gas (10.3-11.1 c/kWh).[8]
- Domestic content requirements, which would ensure at least 25 per cent of wind projects and 50 per cent of solar projects be produced in Ontario – requirements for solar will increase by January 1, 2011 and wind will increase by January 1, 2012.
- A streamlined approvals process and a service guarantee to bring developers greater certainty.
- Regulations for setting wind turbines certain distances from houses, roadways and property lines.
- A new Ontario Renewable Energy Facilitation Office – a one stop shop to help renewable energy projects get off the ground faster.
- The introduction of mandatory conservation measures and a demand management plan designed to cut electricity use by 20 per cent (building code changes, energy efficiency standards for households, micro-generating capabilities, etc).

Province of Nova Scotia

Like Alberta, Nova Scotia is largely reliant on coal-fired electricity – in fact 88 per cent of Nova Scotia's electricity comes from fossil fuels.[9] The Province is exploring ways to move away from this type of traditional electricity generation. In June 2007 the government passed Bill 146 known as *The Environmental Goals and Sustainable Prosperity Act*. The Act sets out 21 far-reaching goals for the province, ranging from reduced air emissions and waste, to new energy standards for buildings and increased protection of the province's land and water. The Act is based on the principle that a long-term approach to planning and decision making is necessary to harmonize the Province's goals of

[8] Ontario Power Authority: http://fit.powerauthority.on.ca/

[9] Government of Nova Scotia: Department of the Environment. Toward a Greener Future: Nova Scotia Climate Change Action Plan. (January 2009): http://www.climatechange.gov.ns.ca/

economic prosperity and environmental sustainability.[10] Some highlights as far as long-term environmental and economic objectives for the Province are to ensure:

- International recognition for having one of the cleanest and most sustainable environments in the world by the year 2020;
- Greenhouse gas emissions will be at least 10 per cent below the levels that were emitted in the year 1990 by the year 2020; and,
- 18.5 per cent of the total electricity needs of the province will be obtained from renewable energy sources by the year 2013.

The Act represents Canada's first "Renewable Portfolio Standard" (RPS), a policy lever described in further detail later in his paper. The Act was followed up by the release of the *Energy Strategy and Climate Change Action Plan* in January 2009. While the regulations have yet to be determined, the Provincial government plans to reduce greenhouse gas emissions of 5-7.5 megatons by 2020 through various measures including energy efficiency, conservation, renewable energy, air quality, and hard caps on Nova Scotia Power.[11] The details surrounding the hard caps are unclear, but the targets will be adjusted every 5 years through to 2020, becoming increasingly stringent each time. The Province also announced that it would accelerate the deployment of renewable power to ensure a minimum of 25 per cent of the province's power was generated from renewable sources by 2015.[12] To accomplish this goal, the Province initiated a four-month public consultation period run by the University of Dalhousie. The results of this consultation recommended a community-based Feed-in Tariff as well as either a broad Feed-in Tariff for large-scale renewable energy procurement or a set of competitive Request for Proposals (RFP). [13]

Province of New Brunswick

In February of 2010, New Brunswick unveiled its community energy program.[14] The first phase will consist of 75 MW, 50 MW of which will be available to community-owned projects and 25 MW to First Nations projects. All projects must not be larger than 15 MW in capacity. Projects will receive 10 cents/kWh for electricity produced beginning in 2010 and will be indexed to the consumer price index in New Brunswick after five years. Eleven workshops were announced between March 8 and 24 to educate interested communities and partners about the policy. This represents Canada's first Feed-in Tariff exclusively for not-for-profit organizations, as for profit companies can only be minority partners in any project.

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[10] Government of Nova Scotia: Environmental Goals and Sustainable Prosperity Act. (April 2007): http://www.gov.ns.ca/legislature/legc/bills/60th_1st/1st_read/b146.htm

[11] Ecology Action Centre: EAC Response to Nova Scotia Climate Change Action Plan and Energy Strategy. (January 2009)

[12] Government of Nova Scotia: http://www.gov.ns.ca/news/details.asp?id=20090728002 (July 2009)

[13] Government of Nova Scotia: Department of Energy Renewable Plan: http://www.gov.ns.ca/energy/renewableplan/

[14] Government of New Brunswick: http://www.gnb.ca/cnb/news/ene/2010e0178en.htm (February 2010)

Province of British Columbia

BC Hydro issued the Clean Power Call Request for Proposals (RFP) on June 11, 2008 to help ensure that the province has sufficient clean electricity to meet its electricity needs. The Clean Power Call RFP aligns with the Province's *Energy Plan: A Vision for Clean Energy Leadership*, released February 27, 2007, which indicates that at least 90 per cent of all electricity generated in the province must continue to come from clean or renewable sources and to achieve electricity self-sufficiency by 2016. All new electricity generation projects must have zero net greenhouse gas emissions. This represents Canada's first zero emissions portfolio standard for new build projects. The plan also states that by 2016, existing thermal generating power plants will need to achieve zero net greenhouse gas emissions through either carbon capture and storage or the purchase of emission offsets.

British Columbia has also implemented the following policies with respect to electricity generation:

- All new electricity generation projects will have zero net greenhouse gas emissions.
- Zero greenhouse gas emissions from coal fired electricity generation.
- Zero net greenhouse gas emissions from existing thermal generation power plants by 2016.
- Ensure clean or renewable electricity generation continues to account for at least 90 per cent of total generation.
- No nuclear power.

Finally, BC also has a "standing offer program" to purchase energy from small projects with a nameplate capacity greater than 0.05 megawatts but not more than 10 megawatts at fixed rates above the retail rate.

State of Texas

When talking about energy, Alberta and Texas are often mentioned in the same breath as they both have economies that are largely reliant on oil and gas. In the same vein, both these jurisdictions have massive wind energy resources and are also largely electrically isolated grids (i.e. are poorly interconnected to their neighbours). The government of Texas has positioned itself as the United States' leader in wind energy development. In 1999, the state of Texas implemented a Renewable Portfolio Standard (RPS) which created a market-based system designed to build up to 2,000 MW of renewable energy capacity by 2009. Within the RPS was the use of Renewable Energy Credits (RECs) to validate compliance in meeting the renewable energy goal – RECs are issued when a renewable energy facility (i.e. a wind farm) generates electricity. Each REC represents the positive environmental attributes of one megawatt-hour of renewable generation, including the emission-reduction benefits of displacing conventional fuels, such as coal, nuclear or natural gas.[15]

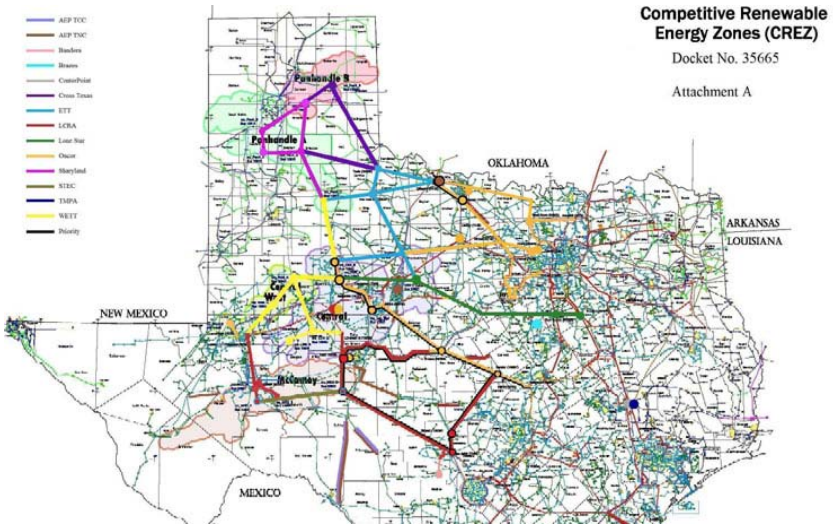
The initial program was so successful that an increased RPS was passed in 2005, which Texas has surpassed several years ahead of schedule. As a result of the RPS policy, Texas leads the United States in

[15] The Wind Coalition: Renewable Portfolio Standard: a Texas Success Story

the amount of wind capacity added to the electric grid. Nearly $3 billion worth of wind-powered electric generators were installed in Texas during 2007, growing the state's total wind capacity by 59 per cent over the previous year. In the same year, over 1,600 MW of new wind power was installed, which is more than twice the capacity added in any other state.[16] Texas now has over 9,400 MW of wind power installed (system capacity 36,268 MW), and in February 2010, 19 per cent of the state's entire power was generated from wind alone.[17]

Texas has also established "Competitive Renewable Energy Zones" (CREZ) that identify the "best" renewable resource zones. CREZs are designated where both the renewable resources are optimal and land areas are sufficient to generate power from renewable energy. The Public Utility Commission of Texas (PUC) then developed a plan to construct the transmission infrastructure required to deliver the power from these CREZs to electricity customers across the state of Texas. The PUC assigned $4.93 billion of CREZ transmission projects to be constructed by seven transmission and distribution utilities. The project will eventually transmit 18,456 MW of wind power from West Texas and the Panhandle to highly populated metropolitan areas of the state.

Figure 6: Competitive Renewable Energy Zones, Texas



Source: Public Utility Commission of Texas

In designating the CREZs, the PUC was required to consider the level of financial commitment by generators for each zone to determine whether to designate an area as a CREZ and grant a certificate of convenience and necessity (CCN) to a transmission service provider (TSP) for the construction of transmission lines. If the PUC issued a CCN, or ordered a utility to construct or expand transmission facilities, the construction and expansion could be included in the utility's rate base. It is important to

[16] The Wind Coalition: Renewable Portfolio Standard: a Texas Success Story
[17] Electric Reliability Council of Texas (ERCOT): http://mospublic.ercot.com/ercot/jsp/frequency_control.jsp

note however, that the CREZ process is not intended to exclude other areas of the state from wind energy development.

Municipality of Austin, Texas

In February 1999, the Austin City Council adopted a resolution, which set a goal for Austin Energy to achieve 5 per cent of the energy in its portfolio mix from renewable resources by December 31, 2004. Funding to achieve the 5 per cent increase in renewable energy resources was authorized to be provided by Austin Energy's green pricing program -- GreenChoice -- initiated in 2000. Residential and business customers can opt to have the standard (fossil) fuel charge on their electric bill replaced entirely by the GreenChoice power charge, which will remain fixed for 10 years.

In February 2007, the Austin City Council approved another resolution to increase Austin's renewable portfolio goal to 30 per cent by 2020, with 100 MW required to come from solar.[18] The resolution also sets a green power procurement goal for City facilities of 100 per cent by 2012. According to the *Austin Climate Protection Annual Report* for 2009, the utility now contracts for 439 MW of wind energy.[19] Austin Energy estimates that it will need to secure a total of 835 MW of renewable energy generation by 2020 in order to meet the 30 per cent target.

Municipalities of Dallas and Houston

In September 2007, the City of Dallas finalized purchase contracts for more than 333 million kWh of green electricity for city facilities during 2008. The city has elected to continue its green power purchasing program through 2009 as well. The purchase amounts to roughly 40 per cent of total expected electricity consumption by municipal facilities for the year and will be supplied primarily with wind energy.

In 2007, the City of Houston negotiated a 5-year contract with Reliant Energy for up to 80 MW or 700 kWh annually of renewable energy credits (RECs). These RECs will be generated almost exclusively from wind power. The initially authorized purchase (beginning July 2008) was 30 MW, equivalent to roughly 263 million kWh annually or 20 per cent of the annual electricity consumption of the city's municipal facilities. Additional 10 MW increments of renewable energy are authorized to be stepped in over time up to the 80 MW specified in the contract. As of April 2009, the purchase had been increased to 40 MW, equivalent to roughly 350 million kWh annually or 27 per cent of annual electricity consumption in city facilities. This diversification of Houston's energy portfolio is in part intended to help insulate the city from price shocks such as those that occurred in the aftermath of Hurricanes Katrina and Rita.

Barcelona

Barcelona provides an interesting example, because thanks to its compact nature and its type of energy consumption (a mix of nuclear, natural gas and hydroelectric), among European cities of its size it has

[18] City of Austin: http://www.ci.austin.tx.us/council/downloads/mw_acpp_points.pdf
[19] City of Austin: Austin Climate Change Protection Annual Report: http://www.ci.austin.tx.us/acpp/downloads/ACPP_Annual_Report_5.20.09_FINAL.pdf

some of the lowest CO2 emissions per capita. But rather than rest on it laurels and continue with the status quo, Barcelona set ambitious goals in order to remain ahead of the curve. The city also recognized that starting out at such a good position meant that in order to comply with international commitments, relatively more effort would be needed to reduce the amount of emissions relative to other, more polluting cities. [20] As a result, in 2002 Barcelona introduced a *Plan for Energy Improvement (PMEB)* which aimed to apply various measures – a total of 55 projects – ranging from small modifications in energy use to large changes in energy production and distribution systems "to reach the horizon of 2010 with a more sustainable concept of energy."[21] The city set up the Barcelona Energy Agency to oversee the plan, which by 2010 has as a goal to:

- Reduce CO2 emissions by 20 per cent compared to 1999 levels;
- Maximize the use of the city's renewable energy sources (up to 188 million KWh/year of renewable energy or 1.1 per cent of the city's total energy consumption); and
- Emit less than 3.15 tonnes of equivalent CO2 per capita.

The 55 projects vary in nature, but some highlights include:

- The connection of micro-generation systems to any point in the electrical grid;
- The introduction of solar power in schools, in commercial and service premises over 3,500 square metres, in offices over 1,500 square metres; and,
- Combined heat power (CHP) generation in commercial buildings over 3,500 square metres, in large hotels and medical clinics, in office blocks of over 4,000 square metres.

The plan is also coupled with a Solar Thermal Ordinance which came into effect in 2000. The goal of the ordinance is to encourage and regulate the incorporation of low-temperature active solar collector systems to generate sanitary hot water in buildings and facilities across the city.[22] New buildings and buildings undergoing major refurbishment are required to use solar energy to supply 60 per cent of their hot water requirements. The city has as a goal to reach 100,000 square metres of solar collectors by 2010, diverting approximately 15,000 metric tonnes of CO2 every year.

Municipality of Sacramento

The Sacramento Municipal Utility District (SMUD) is the 6th largest publicly owned utility in the US in terms of customers served and has been widely recognized as a leader in innovative energy programs. It has two separate programs to grow renewable energy supplies: 1) a green pricing program called

[20] City of Barcelona: Barcelona Energy Improvement Plan (April 2003): http://www.barcelonaenergia.cat/eng/operations/pmeb.htm
[21] City of Barcelona: Barcelona Energy Improvement Plan (April 2003): http://www.barcelonaenergia.cat/eng/operations/pmeb.htm
[22] Barcelona Energy Agency: Towards A New Energy Culture

Greenenergy, and; 2) a Renewable Portfolio Standard (RPS) program. It should be noted that SMUD started its own RPS program in advance of a state-wide RPS program, and while state RPS statutes do not obligate local publicly owned electric utilities to have defined percentage goals and deadlines, SMUD has chosen to meet or exceed the state requirements. To meet its annual renewable goals, SMUD both contracts for renewable electricity from independent power producers and builds and owns renewable energy power plants. Its 2006 renewable energy supply goal was 12 per cent, which it surpassed (13.1 per cent) and it hopes to almost double this by 2011 (23 per cent).[23] SMUD maintains an almost equal distribution of renewable technologies in its renewable supply – wind stands at 21 per cent, biomass at 21 per cent, small hydro at 27 per cent and geothermal at 30 per cent. In 2008, SMUD met 19.5 per cent of its customer energy needs with renewable sources.

Municipality of Chicago

In 2008, the City of Chicago released its *Climate Change Action Plan*, which set an ambitious goal of achieving an 80 per cent reduction below its 1990 GHG emissions level by the year 2050. The Plan is based on the findings that if Chicago continues on its current path, its greenhouse gas emissions could increase 35 per cent by the year 2050. As a result, studies show that the city would face more extreme heat in summers, growing flood risks, stress on public health and threats to the city's economy. In order to achieve this goal, the Chicago Climate Task Force settled on 26 "mitigation" or emissions reduction actions, all within 5 broad categories: energy efficient buildings; clean & renewable energy sources; improved transportation options; reduced waste & industrial pollution; and adaptation. Within the Clean & Renewable Energy Sources actions, the Plan has as a goal to reduce GHG emissions from electricity use and natural gas by 34 per cent, by implementing the following mitigation strategies[24]:

- Upgrade Power Plants: Upgrade or repower 21 Illinois power plants = 2.5 MMTCO2e (million metric tons carbon dioxide equivalent) reduction
- Improve Power Plant Efficiency: Raise efficiency standards for new and existing power generators = 1.04 MMTCO2e reduction
- Build Renewable Electricity: Procure enough renewable energy generation for Chicagoans to reduce emissions by 20 per cent = 3.0 MMTCO2e reduction
- Increase Distributed Generation: Increase efficient power generated onsite using distributed generation and combined heat and power = 1.12 MMTCO2e reduction
- Promote Household Renewable Power: Double current household-scale renewable electricity generation = .28 MMTCO2e reduction

[23] Sacramento Municipal Utility District: 2007 Status Report on Renewable Energy at SMUD (May 2007)
[24] City of Chicago Climate Action Plan: Renewable Energy Sources (http://www.chicagoclimateaction.org/pages/renewable_energy_sources/13.php)

Country of Denmark

The Denmark story is one that is well known – it has effectively transitioned from being largely dependent on foreign energy sources such as oil and coal in the early 1970s to becoming a net exporter of natural gas, oil and electricity today. It is among the world's leaders in increasing its energy and CO2 efficiencies. Since 1980, the Danish economy has grown by 78 per cent, while energy consumption has remained more or less constant and CO2 emissions have been reduced. Today, renewable energy makes up more than 19 per cent of final energy consumption, up from just 6 per cent in 1990.[25] The Danes have reached this point through a variety of stringent measures and policies that have come into being over the last 30 years. These have included[26]:

- Energy taxes, passed in 1974 as a response to the energy crises, kept high and not lowered after fossil fuel prices dropped in the 1980s;
- A feed-in-tariff requiring utilities to buy all power produced from renewable energy technologies at a rate equal to 70-85 per cent the consumer retail price of electricity in a given distribution area;
- Environmentally friendly zoning that forced cogeneration units to replace district heating units and prohibited the use of oil, diesel, and coal for many generators;
- Long-term financing reduced the risk of building larger projects and encouraging local manufacturing;
- Open and guaranteed access to the grid;
- A general carbon tax on all forms of energy, adding around 1.3 euro cents per kWh of additional income for renewable energy generators; and
- Streamlined permitting through a central agency.

In an effort to continue on this path, in February 2008, the Danish government signed a broad-ranging energy agreement with all parliamentary parties except one. *The Energy Agreement*, as it is known, dictates that renewable energy in 2011 will account for 20 per cent of Denmark's energy consumption. In addition to raising the transfer price of power from the country's wind turbines, biomass and biogas,

[25] Danish Energy Agency: "The Danish example – the way to an energy efficient and energy friendly economy."
[26] Sovacool, Benjamin K., Hans Henrik Lindboe, and Ole Odgaard, "Is the Danish Wind Energy Model Replicable for Other Countries?" Electricity Journal 21(2) (March, 2008), pp. 27-38 (http://dx.doi.org/10.1016/j.tej.2007.12.009).

parties agreed to construct 400 MW of new offshore wind turbines by 2012.[27] Denmark's ultimate goal is to become completely independent from the use of fossil fuels.

In addition to work on the national level, Denmark's Climate and Energy Ministry works closely with local governments and municipalities to reduce energy use. One initiative that is worth noting is the designation of six "EcoCities" who have already made great strides in managing their climate and energy challenges and who have committed themselves to initiate a number of intelligent, future proof, and ambitious initiatives that will stand out on both a national and international scale.[28] One EcoCity is its capital, Copenhagen. Between 1990 and 2005, the City of Copenhagen succeeded in reducing CO2 emission by 20 per cent, due to the expansion of Copenhagen's district heating network and the conversion of power plants to natural gas. In order to reduce CO2 emissions by a further 20 per cent by 2015, the city is tackling energy friendly urban development.[29] Planned projects include building a CO2 neutral city suburb and another new, sustainable suburb that will utilize the most environmentally optimal energy supplies. The City of Copenhagen has also committed to making all new building energy efficient as well as modernizing old ones to become more eco-friendly. All new urban development areas are being designated low energy areas in order to ensure minimal energy consumption in new buildings.

Potential Policies

As exemplified by the programs in other jurisdictions, direct policy intervention is often needed to increase the presence of non-traditional forms of electricity. All three levels of government have a role to play in the advancement of cleaner forms of electricity generation and consumption. When it comes to innovative technologies like wind and cogeneration, it is often up to government to be the first mover. Governmental incentives or mandates, both direct and indirect, make it more viable and are currently necessary to leverage private capital and investments into new technologies. Most major changes in energy technologies have been supported by government policy – oil sands development is one example in Alberta. There are a variety of policy options that combine economic and environmental goals – offering opportunities to create new jobs and business opportunities, along with the reduction of greenhouse gas emissions, all the while providing a reliable supply of electricity to Albertans.

The potential policies listed here are applicable to both wind and cogeneration, although some are specific to one or the other. Some of them have been mentioned in the previous section, while others are new. Additionally, some are applicable to municipalities, while others would require provincial involvement. They are as follows:

[27] Danish Energy Agency: The Energy Agreement and other legislation (http://www.kemin.dk/en-US/climateandenergypolicy/dkpolicy/energyagreementsandlegislation/Sider/legislation.aspx)
[28] Danish Energy Agency: Co-operation with municipalities (http://www.kemin.dk/EN-US/CLIMATEANDENERGYPOLICY/DKPOLICY/MUNICIPALITY/Sider/municipalities.aspx)
[29] Danish Energy Agency: Eco Cities, Copenhagen (http://www.energibyer.dk/en-US/MoedDe6Energibyer/CityofCopenhagen/UrbanDevelopment/Sider/Forside.aspx)

- **Carbon pricing:** Putting a price on greenhouse gas emissions is a market based instrument that prices a pollution externality. It can be administered through a carbon tax (such as British Columbia's $15 / tonne economy wide tax – rising to $20 / tonne in July 2010) or through a cap-and-trade system. Alberta has a version of carbon pricing stipulating that regulated facilities must reduce their emission intensity by 12 per cent annually until the end of 2014, based on an average of the facility's 2003 to 2005 emissions intensity baseline. Emitters are required to pay $15 for every tonne above their reduction target. The revenue from carbon pricing mechanisms can be utilized for various purposes, including support for alternative technologies.

- **Subsidies/tax credits/ stimulus**: Governments have long used these three mechanisms to encourage investment in targeted sectors of the economy. In response to the recent financial crisis, the Obama administration introduced The American Recovery and Reinvestment Act of 2009 (ARRA). The act focused on two areas: 1) appropriations for government programs; and 2) tax based incentives. Of the $787 (USD) Billion package, more than $40 Billion in spending is appropriated for clean energy initiatives. New and modified tax incentives targeting clean energy are estimated at another $20 Billion.[30] As part of its Climate Change Action Plan, the City of Chicago utilized this stimulus package to develop the nation's largest urban solar power plant at a former industrial site in Pullman on Chicago's South Side. In 2009, the City of Chicago partnered with Exelon and SunPower Corporation for the development of a solar plant that will produce an average of 14,000 megawatt-hours (MWh) of power, enough to power 1,200 to 1,500 homes. The project was contingent upon Exelon receiving a federal loan guarantee for up to 80 per cent of the project cost from the US Department of Energy Loan Guarantee Program Office. The fact that the plant is being built on a brownfield site is another environmental bonus. In Sacramento, SMUD is using $5 million from ARRA to fund a solar highway, where unused land along state highways will be home to solar panels which will then be delivered via developing Smart Grid capabilities. In Canada, since 2002 there has been a 1 cent per kWh renewable energy producer incentive, this program stimulated growth in the wind energy sector, but as of 2010 this program is out of money for new projects and was not renewed in the 2010 Federal budget. In the US, the Production Tax Credit (PTC) an income tax credit of 2.1 cents/kilowatt-hour is allowed for the production of electricity from utility-scale wind turbines. The PTC was created under the Energy Policy Act of 1992. Through the ARRA, Congress acted to provide a three-year extension of the PTC through December 31, 2012. Additionally, wind project developers can choose to receive a 30 per cent investment tax credit (ITC) in place of the PTC for facilities placed in service in 2009 and 2010, and also for facilities placed in service before 2013 if construction begins before the end of 2010.

- **Feed-in tariffs**: Feed-in tariffs (FIT) are payments per kilowatt hour for electricity generated by a renewable resource. A FIT offers long-term price guarantees for renewable electricity generators by obligating utilities to pay pre-established above-market rates for renewable

[30] National Renewable Energy Laboratory: PTC, ITC or Cash Grant? An analysis of the choice facing renewable power projects in the United States. (March 2009): http://eetd.lbl.gov/ea/emp/reports/lbnl-1642e.pdf

power fed onto the grid. This has the effect of increasing investor confidence and makes it easier to finance projects. The way a FIT program is designed varies according to jurisdiction, but generally it has several key features: it allows all sizes of generators, from homeowners to large developers to participate; has prices that are intended to cover total project costs and provide a reasonable rate of return over a long term contract (i.e. 20 years); is open to various renewable energy technologies (biogas, biomass, landfill gas, solar photovoltaic (PV), wind and hydro power); and finally, provides a straightforward way to obtain a contract for renewable electricity generation. Feed-in tariffs eliminate two of the biggest obstacles inhibiting renewable energy development – the ability to connect to the grid and market uncertainty.

- **Emission standards**: This is not a particularly new policy, but it is one that can have very concrete results. When efficiency standards are raised for both new and existing power generators, the construction of plants that produce traditional forms of electricity become less feasible. This has been successful across numerous jurisdictions, and one such example is one of Denmark's aforementioned EcoCities. In the town of Herning, the municipality made a decision to establish small district heating plants in the surrounding villages. As a result, some 70 per cent of the municipality's heating supply is provided by district heating plants – despite the fact that the municipality has a relatively low population density. This has meant that the area has reduced annual CO2 emissions to only 4.9 tonnes per inhabitant, compared to 10 tonnes per inhabitant at a national level.[31] Closer to home, BC established a requirement that all coal power plants have carbon capture and storage (CCS) systems.

- **Government procurement**: Beyond their role as legislators, governments are also consumers, and large ones at that. Municipal and provincial governments can act as first movers by procuring renewable electricity to power their own operations. As show in the examples above, this is a policy that has been widely adapted, including here in Alberta. Seventy five percent of the City of Calgary's electricity will be supplied by renewable energy through 2011. Beginning in 2012, the amount of renewable electricity that the City will purchase will increase to 100 per cent. In 2003, the Government of Alberta announced its intention to purchase 90 per cent of its total electricity consumption from renewable sources as of January 1, 2005.[32] In 2005, the Government of Alberta purchased approximately 215,000 MWh of green power from wind and biomass sources through long-term contracts.

- **Green power pool**: In a deregulated retail electric market, consumers have the right to choose who will supply their power. By joining a power pool, consumers can work together as a larger customer to contract for a lower power price. In this case, the power pool would band together to demand renewable energy options, also at a more stable and lower price. Ultimately the

[31] Danish Energy Agency: Eco Cities, Herning Municipality (http://www.ecocities.dk/en-US/MoedDe6Energibyer/HerningMunicipality/Sider/Forside.aspx)
[32] Government of Alberta: Alberta leads country in purchase of green power, (http://www.gov.ab.ca/acn/200303/14035.html)

pool of end-users demands that environmental performance be considered as important a criterion as price.

- **Renewable Portfolio Standards** – A Renewable Portfolio Standard (RPS) mandates utilities and other power providers to supply a specified minimum percentage of their power output with renewable energy sources. The theory behind it is that an RPS provides a predictable, competitive market within which renewable generators will compete with each other to lower prices. Currently in the US, 25 states and the District of Columbia have an RPS. As described above, the introduction of an RPS in Texas has resulted in a booming wind energy industry. Coupled with "Renewable Energy Certificates" (RECs), an RPS becomes a market based instrument allowing utilities to trade renewable energy to meet the portfolio standard.

- **Green power marketing/green certificates**: Green power marketing refers to selling green power in the competitive marketplace, in which multiple suppliers and service offerings exist. Green certificates, also known as Renewable Energy Certificates (RECs) or tradable renewable certificates, represent the environmental attributes of the power produced from renewable energy projects and are sold separate from commodity electricity. Customers can buy green certificates whether or not they have access to green power through their local utility or a competitive electricity marketer. Plus they can purchase green certificates without having to switch electricity suppliers.

- **Phase out regulations**: An integral part of Ontario's green energy policy is the phasing out of its coal plants. Ontario has committed to stop burning coal to generate electricity by 2014 and has begun shutting down coal-fired plants. It is doing so to reduce air pollution and make room for greener, more renewable forms of energy on the grid. As part of its Climate Change Policy, Chicago is also looking at phasing out some of its coal-fired electrical power.

- **Technology standards:** Regardless of the electricity system in a given jurisdiction (i.e. power pool, crown corporation, etc), for the most part, governments still review proposals for power plants and regulate how and where transmission gets built. In their role as administrators for such massive capital investments, governments could also mandate that utilities must at least consider new technology standards such as smart grid technologies before they propose power plants or transmission lines. This could also be applicable to non-utility projects - governments could put in place mandates that all new upgraders, industrial projects, or large public buildings (i.e. hospitals, post secondary institutions) generate their own electricity by using high efficiency cogeneration.

- **Research & Development**: If mandating smart grids or efficiency standards is too interventionist, another tool would be to indirectly invest in such technology through a research and development fund. To date, approximately $122 million has been paid into the *Climate*

Change and Emissions Management Fund from large final emitters.[33] These funds could be earmarked for spending on the promotion of renewable energy and for research & development into technologies such as wind forecasting and storage.

For the most part, these policies do not exist in a vacuum – they compliment each other and the most successful examples are often as a result of a combination of multiple programs working together.

Policy Opportunities, Barriers and Evaluation

Although these policies have worked elsewhere, it is important to recognize that just because there was success in one location, this success might not be replicable in another. Policies have to be adapted to fit the local context, conditions and environment, and be filtered through a certain lens. This lens reflects some of the opportunities that could allow the success of wind and cogeneration policies, as well as some of the hurdles that would need to be overcome in order to allow for more wind and cogeneration capabilities. Some of the issues that need to be considered are:

- Alberta's economy is largely fossil fuel reliant;
- Alberta is home to a vast repository of innovative energy expertise;
- Alberta has a high degree of potential for wind power development based on its geography and environment;
- Alberta already offers a low corporate tax rate;
- Alberta has a preference for market-based instruments; and,
- Alberta has a power pool and utilities are not run by a crown corporation.

Other key factors that formulate an "Alberta Lens" on electricity will be explored during the Thought Leaders Forum.

In the end, the potential policies mentioned in this report need to be exhaustively evaluated against certain criteria to make sure that in their application within an Alberta context that they can be politically, economically, socially and environmentally successful. The policies as presented above undoubtedly have both their champions and critics. In order to evaluate which ones would work best and how they could be implemented, the following criteria, at a minimum, should be considered:

- **Cost effectiveness**: The costs of implementation as well as the potential savings that could be generated and economic opportunities that could result are important considerations. While a recent analysis of Ontario's Green Energy Act has found that the legislation could inject as much

[33] Government of Alberta: http://www.alberta.ca/acn/200904/25761CEE17478-A430-B24A-B65903CB1372560F.html (April 22, 2009)

as $4.5 Billion into the region's economy[34], the government is also facing criticism as commercial and residential electricity bills are starting to rise.

- **Policy stability and viability**: It is important to have political buy-in that will ensure proposed policies would first make it through the legislature and then be successful enough to survive a change in government. The long-term consistency of policies provides investors with certainty about the rules for renewable, making investment that much more attractive. This has proven to be the case in the United States with the extension of the PTC and the continued development of wind power. While Denmark has a long history of renewable energy policies, the current government took pains to involve all other political parties in its most recent legislative changes.

- **Simplicity**: As part of its Green Energy legislation, Ontario created a Renewable Energy Facilitation Office which is supposed to be a one-window access point to assist all renewable energy proponents (developers, communities and municipalities) obtain information about developing their projects. Chicago and Barcelona have similar models. In order to ensure the widest participation possible, rules and regulations should not be so complex as to be daunting for smaller, incremental projects, a complaint that has been lodged at some of the state RPS programs.

- **Market based:** The question "will this policy create a market for power from renewable facilities" needs to be asked. Public policies must refrain from interfering in the private marketplace to such an extent that distortions are created or the economic resources are used in an inefficient manner. If done properly, they can result in creating a whole new market base as well as a thriving industry. Denmark is a prime example – as a result of policies introduced over the last 30 years, exports of energy technology now account for 9 per cent of the country's exports, and it has become a leading player in wind-turbine production, covering about one-third of the global wind turbine market.[35]

- **Environmentally effective**: One of the main drivers for diversifying the electricity system is to include a greater amount of low emissions productions. When evaluating policy options consideration should be given to how effective they will be in reducing the life-cycle environmental impacts of producing and consuming the energy. As shown with the Copenhagen example, the city has seen the effects of changing its electricity supply and continues to push ahead with more innovative and environmentally effective urban planning.

An exhaustive evaluation according to these criteria is beyond the scope of this report, but suffice it to say that all of the policies noted above would need active commitment on the political level along with wide public participation.

[34] Hatch Management Consulting: Unlocking Value from the Feed-in Tariff in the Ontario Green Energy Act (November 2009): http://www.hatch.ca/Consulting/Articles/HMC_Oct2009_presentation.pdf
[35] Danish Energy Agency

Participants of the Thought Leaders Forum are encouraged to consider these criteria when discussing the various options Alberta has to advance cogeneration and wind power.

Conclusion

As previously mentioned, Alberta and its municipalities have already started down the path towards integrating lower impact energy into the electrical grid through the introduction of policies related to procurement and carbon pricing. Alberta has a proven capacity for both wind and cogeneration and much wider adoption is possible. The purpose of this paper has been to examine industry support mechanisms and policy levers that have enabled other jurisdictions to accelerate the integration of renewable energy resources into their respective electrical grids. The task of the Thought Leaders Forum is to further discuss and identify areas of consensus and divergence on policy solutions for the integration of wind and cogeneration into Alberta's electrical grid. As such, the questions for reflection prior to attending the Thought Leaders Forum are as follows:

- What policy options have you heard of or seen implemented that have not been identified by this paper, which might be worth exploring further for Alberta?
- For you, what should be considered when looking at the policy options through an "Alberta lens"?
- If it were your choice, what would be the top (one to three) priority policies you would recommend to advance wind power and cogeneration in Alberta at either or both the provincial and municipal levels?

Glossary of Terms

American Recovery and Reinvestment Act of 2009 (ARRA): Passed into law in February 2009, the ARRA is an economic stimulus packaged which had as a goal to create new jobs, spur economic activity and invest in long term growth. Valued at over $780 Billion, more than $40 Billion of spending was earmarked for clean energy initiatives.

Behind the fence (BTF) generation: This refers mostly to industrial projects that generate their own electricity and so are not connected to, nor do they take power from, the provincial grid.

Carbon tax: A carbon tax is a tax on the carbon dioxide emissions from burning fossil fuels. The theory behind it is that a tax would increase the price on gasoline, electricity and heating fuels to reflect the costs associated with climate change. As a rule, they are usually revenue-neutral, meaning that little if any of the tax revenues would be retained by the government – instead they are used for spending on public services and/or reducing other taxes such as income or corporate taxes.

Cap and trade: Also known as emissions trading, a cap and trade approach looks to control greenhouse gas emissions by placing a cap on emissions of carbon dioxide. A process is set whereby the government auctions off a dedicated number of pollution permits, which can then be traded on the open market, allowing large polluters to offset some of their emissions by trading or buying pollutions credits from other more efficient companies. In effect, the buyer is paying a charge for polluting, while the seller is being rewarded for having reduced emissions by more than was needed.

Cogeneration: Sometimes referred to as combined head and power (CHP), cogeneration captures the by-product heat from a power plant during electricity generation. Cogeneration of electricity and heat from a single fuel can play an increasingly important role in supplying both industrial process heat and residential/commercial heating, including district heating.

Competitive Renewable Energy Zones (CREZ): A Texas state policy which identifies zones where wind power can be profitably developed and mandates that high voltage transmission lines be built to facilitate the development of the wind power.

Distributed Generation: Small-scale power generation technologies, usually from renewable sources, that are located at or near to the point of use, reducing the amount of energy lost in transmitting electricity from traditional power plants located further away from end-users.

District Heating: Also called district energy, it is an energy solution that provides heating through a network of insulated pipes from a centralized location to both industrial and residential customers. It is seen to be more efficient than traditional heating systems which have separate boiler systems built into every building.

Feed in Tariffs (FITs): FITs encourage the development of renewable energy by obligating utilities to pay pre-established above-market rates for renewable power fed onto the grid. The tariffs, which usually

vary depending on the type of resource used, provide renewable generators with a set stream of income from their projects. Common in Europe, Ontario is the first jurisdiction in Canada to introduce FITs.

Production Tax Credit (PTC): A federal tax credit that has been in use in the United States, at various times since the 1990s, a PTC provides a 1.2 per kilowatt-hour (kWh) benefit for the first ten years of a renewable energy facility's operation. Combined with a growing number of states that have adopted renewable electricity standards, the PTC has been a major driver of wind power development over the past six years in the United States.

Renewable Energy Credit (REC): RECs are issued when a renewable energy facility (i.e. a wind farm) generates electricity. Each REC represents the positive environmental attributes of one megawatt-hour of renewable generation, including the emission-reduction benefits of displacing conventional fuels, such as coal, nuclear or natural gas. RECs are usually used in conjunction with a Renewable Portfolio Standard.

Renewable Portfolio Standard (RPS): An RPS requires electric utilities and other retail electric providers to provide a specific percentage or amount of customer electricity with eligible renewable resources.

Smart Grid: A smart grid integrates all of the elements connected to the electrical grid with an information technology infrastructure, offering benefits for both the providers and consumer of electricity. It gives the utility and the consumer the capacity to communicate with each other to better control electricity supply and demand, as well as the cost associated with it.

Smart Metering: As opposed to a traditional electrical meter which only measures the total amount of electricity used over an entire billing period, a smart meter records electricity consumption hour by hour, and sends that information over a wireless network to the utility making time-of-use pricing possible. The idea is that the utility can send price signals back to its customers, allowing them to adjust their consumption habits to be more responsive to electricity market prices.

Solar Thermal Ordinance (STO): An STO is a legal provision that obligates building owners to install a solar thermal system for new buildings or buildings that are undergoing renovations. Often part of a national or regional energy plan, an STO is implemented and enforced by a municipality through the enforcement of local building codes.

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For more info about the Thought Leaders Forum event that happened on March 30 in Calgary, see:

http://re.pembina.org/powerwedges