Peel Region Official Plan Review

Discussion Paper

Energy

Region of Peel
Working for you

PROPR ENERGY DISCUSSION PAPER (DRAFT)
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Energy systems and sustainable land use policies in the Region of Peel

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EXECUTIVE SUMMARY

The Region of Peel is currently reviewing and updating its Regional Official Plan (ROP) in order to conform to the Province of Ontario's *Planning Act* and to comply with new Provincial Conformity directives contained in the *Provincial Policy Statement 2005*, the *Greenbelt Plan, 2005* and the *Growth Plan for the Greater Golden Horseshoe 2006.*

Energy is one of the fifteen focus areas that forms part of the ROP review. The objective of this Energy Discussion Paper is to advance discussions about alternative energy systems, the energy aspects of transportation planning and improved air quality through land use and development patterns for the long-term sustainability of Peel. Alternative energy systems are sources of renewable energy (wind, solar, biofuels) or energy conversion processes (cogeneration, district energy, geothermal energy) that significantly reduce the amount of harmful emissions to the environment (air, earth and water) when compared to conventional, fossil-based energy systems Submissions made at the Regional Council public meeting held in February 2007, presentations at the Energy Workshop held in January 2008 and earlier stakeholder consultations have provided valuable input to the discussion and are highlighted in this paper.

The Peel Region Official Plan Review (PROPR) is an opportunity to engage area municipalities and specialized agencies, energy organizations and utility companies, university research and development departments, energy-related businesses and relevant stakeholders on how to address the energy challenges facing Peel now and into the future.

This paper is structured into four main sections. Section One states the purpose of this paper, examines energy and utilities in the provincial context, and describes the merits and demerits of the different renewable energy sources- wind, solar, small-scale hydro, bioenergy, cogeneration, district energy and geothermal energy, as well as the non-renewable energy systems in a broader context. The section then provides an analysis of energy supply and demand in Peel and highlights the achievements of the Corporate Energy Management Division given the legislative mandate by the Province to manage the Region's energy portfolio in a financially responsible manner and to promote the wise use of energy and maintain a healthy environment. The section ends with a look at the connections between this energy focus area and the other PROPR focus areas.

Section Two presents the Provincial policy directives, which are the key drivers of the PROPR process. The Provincial Policy Statement (PPS) is a significant part of the Provincial planning system as it sets policy direction on matters of provincial interest related to land use planning, growth management, environmental protection, and public health and safety. The Greenbelt Plan is designed to provide permanent protection to the agricultural land base and the ecological features and functions occurring on this landscape and identifies where urbanization should not occur. The Greenbelt includes 80% of Caledon and 1% of Brampton, which amounts to 45% of Peel Region. The Region of Peel, the City of Brampton and the Town of Caledon are required to implement the Greenbelt Plan through their official plans. The Places to Grow Plan provides a framework for implementing the Government of Ontario's vision for building stronger, prosperous communities by better managing growth to 2031, and The Places to Grow Act requires municipalities to bring official plans into conformity with the Growth Plan for the Greater Golden Horseshoe by June 16, 2009.

The rest of this section introduces energy indicators and targets for sustainable development that are seen as critical to effectively measure and monitor important changes and significant progress towards achieving energy conservation in the future.. Section Three outlines the energy governance structure for Ontario and describes the functions and responsibilities at the different levels of government in managing energy matters in the province. The final section presents the vision, objectives and principles that could guide the progress of the energy sector in the future in Peel, and concludes by underscoring the importance of energy in society and the policy imperatives to prepare forward looking policies that could adequately meet the demand for clean, green and affordable energy in the Region over the long-term.

Details of the major contributions made by participants during the PROPR energy consultation process; namely, the Regional Council public meeting in February 15, 2007, stakeholder consultation in June 19, 2007, the Energy Workshop held on January 28, 2008 and the Sustainability Workshop in June 6, 2008, that could help in shaping the energy policies in the Official Plan are provided in Appendix I. Approaches and methods pursued by other municipalities and specialized agencies in developing alternative and renewable energy policies that could be relevant for Peel are presented in Appendix II to V.

1.0 PURPOSE

The Region of Peel is currently reviewing and updating its Regional Official Plan (ROP) in order to conform to the Province of Ontario's *Planning Act* and to comply with new Provincial Conformity directives contained in the *Provincial Policy Statement 2005*, the *Greenbelt Plan, 2005* and the *Growth Plan for the Greater Golden Horseshoe 2006*[1]. The ROP provides Regional Council with a long-term regional strategic policy framework for guiding growth and development in Peel through to the year 2031 while having regard for protecting the environment, managing its renewable and non-renewable resources and outlining a regional structure that manages this growth in the most effective and efficient manner. The Region is required to review its Official Plan every five years to reflect changing needs and priorities as well as to conform to provincial plans, policies and legislation. The scope of this paper is therefore limited to achieving conformity and community planning and not about corporate energy, except to note that Peel has demonstrated its leadership in energy initiatives and projects as will be described later in this paper.

Fifteen different focus areas are being considered in this Peel Region Official Plan Review (PROPR) as shown in Diagram 1.

Diagram 1: Focus Areas of the Peel Region Official Plan Review (PROPR)

Source: Environmental, Transportation and Planning Services, Planning Policy and Research Division, 2008

[1] This discussion paper seeks to identify and analyze the various energy options and energy efficiency, energy supply and systems that could form the basis for formulating energy policies. This is with a view of ultimately incorporating the policy directives in Section 1.8: 'Energy and Air Quality' of the Provincial Policy Statement (PPS), and Section 4.2 'Policies for protecting what is valuable' in the Places to Grow Plan, into the Regional Official Plan.

The purpose of this energy review is twofold. First, is to address the lack of energy and energy-related policies in the Official Plan, and to develop policies with a view to achieving energy efficiency and improved air quality through land use and development patterns for the long-term economic prosperity and benefit of businesses and residents in Peel. Secondly, to incorporate policy directives in the Official Plan in conformity with Section 1.8: 'Energy and Air Quality' of the Provincial Policy Statement (PPS), 2005, and Section 4.2 'Policies for protecting what is valuable' in the Places to Grow Plan, 2006. The remainder of this paper provides an overview of the energy sector with particular reference to Peel, and what the Region is doing to address the broad range of issues respecting energy at present and into the future.

The growing demand for energy due to rapid population and job growth and economic development presents Peel with an opportunity to formulate comprehensive energy policies that can help shape the course of economic and social development in the Region. The aim of this discussion paper therefore, is to raise public awareness about the different types of renewable and non-renewable energy sources, their use and impacts on society at present and the future; and to engage interested stakeholders in the discussions about the energy opportunities and policy challenges facing Peel Region. In order to accomplish this task, we need your contribution.

2.0 ENERGY AND UTILITIES IN THE PROVINCIAL CONTEXT

The major sources of electricity generation in Ontario are nuclear, hydroelectric, fossil (coal) and natural gas. Ontario is committed to increasing the power supply from alternative sources such as wind energy to 10% (2700 MW) of total supply by 2010. Ontario's electric power industry is made up of provincial crown corporations, investor-owned utilities and municipal utilities[2].

2.1 Electricity

The electricity sector in Ontario has undergone significant restructuring in recent years as the government ended monopoly control and imposed a competitive market framework on the industry. Electricity prices are based on the costs of generation, long-distance transmission and local distribution. Consumer rates vary by customer class (i.e., residential, commercial, industrial). Large power users who use more than 250,000 kilowatt-hours of electricity per year are free to negotiate long-term contracts with a retailer for their supply of electricity[3].

Transmission is the backbone of Ontario's power system. It connects consumers and their utilities to existing generation all across the province. It provides access to electricity for new and growing communities, and it enables new generation facilities to be developed or retired[4].

Ontario requires significant upgrades to its transmission infrastructure to maintain a healthy economy and a high quality of life for Ontarians. The following section provides

[2] Ministry of Finance (2007). *Energy & Utilities.* Retrieved April 4, 2008, from Ontario Facts Web site: www.2ontario.com/facts/fact15.asp-41k-
[3] Ibid.
[4] Ontario Ministry of Energy and Infrastructure (2007). *Ontario's Electricity Transmission System.* Retrieved April 4, 2008, from Building Ontario's Energy Future Web site: www.energy.gov.on.ca/index.cfm?fuseaction=electricity.transmission-15k-

an introduction to Ontario's transmission system and some of the initiatives the government is undertaking to improve the system.

Transmission Strategies and Electricity Supply Mix

The government has given the Ontario Power Authority (OPA) the responsibility to plan for Ontario's future electricity needs by developing an Integrated Power System Plan (IPSP). The 20-year IPSP was filed with the Ontario Energy Board on August 29, 2007. The IPSP is designed to assist, through the effective management of electricity supply, transmission, capacity and demand, the achievement of the government of Ontario's goals identified in the Supply Mix Directive dated June 13, 2006[5]. The intention of this Plan is to ensure a "reliable, adequate and sustainable long-term electricity supply for the province[6]." The aim of the supply mix is that renewable energy; conservation and demand management would lead to reduction in peak demand by 6,300 megawatts by 2025.

Table 1 provides a breakdown of the province's current capacity mix and Table 2 shows the Target Capacity Mix in 2025, based on the June 2006 Supply Mix Directive. According to current projections, electricity supply from renewable sources will increase significantly by 87.2% from 8,388 MW in 2008 to 15,700 MW in 2025.

Table 1: Ontario's Electricity Mix, March 2008

Source	Ontario's Supply Mix March 2008
Nuclear	14,000
Hydro	7,795
Coal	6,434
Oil and Gas	5,103
Conservation	1,350
Wind	501
Other Renewables	92

Source: Ministry of Energy and Infrastructure, News Release - March 2008

Table 2: Target Capacity Mix in 2025

Source	MW
Nuclear	14,000
Renewables*	15,700
Gas & Cogen	9,400
Conservation	6,300
Gasification	250

* Renewables include hydro

Source: Ministry of Energy and Infrastructure, News Release - March 2008

[5] Ontario Power Authority (2007). *Scope and Overview.* Retrieved April 6, 2008, from The Integrated Power System Plan for the period 2008-2027 Web site: www.powerauthority.on.ca/Storage/24/1922_OPA_-_IPSP_Scope_and_Overview.pdf-

[6] Ministry of Energy and Infrastructure (2008). *Ontario Electricity Supply Mix.* Retrieved April 6, 2008 from Ontario Energy Future Web site: http://www.energy.gov.on.ca/index.cfm?fuseaction=english.news&back=yes&news_id=173&backgrounder_id=131; Ministry of Energy and Infrastructure (2008). *Ontario Electricity Supply Mix.* Retrieved April 6, 2008 from Ontario Energy Future Web site: http://www.energy.gov.on.ca/index.cfm?fuseaction=english.news&back=yes&news_id=134&backgrounder_id=105

Conservation measures are expected to increase over fourfold from 1,350 MW to 6,300 MW. Nuclear energy will be maintained at 14,000 MW while coal would be phased out by 2014. The OPA has been authorized to strengthen the transmission system to:

- Enable the achievement of the supply mix goals;
- Facilitate the development and use of renewable energy resources such as wind power, hydroelectric power and biomass in parts of the province where the most significant development opportunities exist;
- Promote system efficiency and congestion reduction; and,
- Facilitate the integration of new supply; all in a manner consistent with the need to cost effectively maintain system reliability.

Transmission upgrades will enhance Ontario's energy security, help clean up the environment and stimulate economic development across the province[7].

2.1.1 Hydroelectric Energy

Hydroelectric generation accounts for 22% of Ontario's power supply and continues to be a key component of the province's generating mix. Most of the waterpower installations are run-of-the river operations, as opposed to projects involving dams with extensive waterway diversions. There are currently about 180 hydroelectric stations in Ontario, the size and power of which vary considerably. The smallest stations produce less than one megawatt of power, while Ontario's largest, Niagara Falls' Sir Adam Beck 2 Generating Station, produces over 1,400 megawatts of electricity[8]. In 2005 the Ontario government announced plans to expand the province's renewable energy capacity by making 18 sites available for waterpower development and invited applications to develop wind power on Crown land. There are substantial opportunities to further utilize Ontario's waterpower resources and the Ministry of Natural Resources estimates that there is 2,000MW of additional waterpower potential in Ontario[9].

The major advantage of hydroelectric plants is that they do not produce greenhouse gas, as fuel is not required for their operation. Hydroelectric plants tend to have longer economic lives of over 50 years than fuel-fired generation. Operating labour cost is usually low since plants are automated and have few personnel on site during normal operation. Reservoirs created by hydroelectric schemes can improve transportation, serve as tourist attractions, and control floods, which would otherwise affect people living downstream of the project[10].

However, large hydroelectric dams can cause considerable adverse impacts on the environment. Some reservoirs created by such projects inundate areas of cultural and archaeological significance, environmentally sensitive areas, forests, farmland, wildlife habitats and scenic areas. Hydroelectric projects can also cause radical changes in river ecosystems and can be disruptive to surrounding aquatic ecosystems both upstream

[7]Ontario Ministry of Energy and Infrastructure (2007). *Ontario's Electricity Transmission System.* Retrieved June 22, 2008, from Building Ontario's Energy Future Web site: http://www.energy.gov.on.ca/index.cfm?fuseaction=electricity.transmission
[8]Ministry of Energy and Infrastructure (2008). *Hydroelectric Energy.* Retrieved July 20, 2008, from Building Ontario's Energy Future Web site: www.energy.gov.on.ca/index.cfm?fuseaction=english.electricity-19k-
[9]Ministry of Energy and Infrastructure (2007). *Hydro Electric Power.* Retrieved August 8, 2008, from Cleaner, Green Energy Web site: http://www.energy.gov.on.ca/index.cfm?fuseaction=renewable.hydro
[10]Wikipedia (2008). *Hydroelectricity.* Retrieved April 27, 2008, from Wikipedia Web site: http://en.wikipedia.org/wiki/Hydroelectricity-89k-

and downstream of the plant site. Some dams without fish ladders prevent salmon access to spawning grounds upstream, thereby resulting in reduced populations. Depending on the location, water exiting from turbines is usually much warmer than the pre-dam water, which can change aquatic faunal populations, including endangered species, and prevent natural freezing processes from occurring. Moreover, the generation of hydroelectric power changes the downstream river environment as water exiting a turbine usually contains very little suspended sediment, which can lead to scouring of riverbeds and loss of riverbanks[11].

2.1.2 Nuclear Energy

Nuclear power accounts for more than 52% of total electricity generation in Ontario. Nuclear energy is one part of the Ontario government's balanced plan to ensure that the electricity needs in the Province can be met in the future. The Ontario Hydro and Atomic Energy Canada Limited developed the CANDU (Canadian Deuterium Uranium) nuclear reactor to provide electricity, using natural uranium fuel and heavy water[12]. The two major benefits of this energy source are comparatively lower operating costs for power generation, with none of the emissions that lead to smog, acid rain or global warming[13].

Nuclear power generation has several major disadvantages. Radioactive wastes are extremely dangerous if not properly secured and pose high risks and major disposal, health and security problems. A small probability of reactor failure can have devastating consequences both for all living things as well as the environment. Therefore, nuclear wastes have to be carefully looked after for several thousand years. Also, failure in terms of reactor operations (i.e. cooling the 'core') can lead to disaster. Building more nuclear power plants to meet rising energy demand, and nuclear waste storage shelters increases the probability of a disastrous failure that could last for many decades, affecting present as well as future generations. Increased demand for uranium ore can result in the depletion of uranium supply. Radioactive waste can be used for the production of nuclear weapons and nuclear proliferation. Moreover, nuclear power plants take a very long time to build and commission and are very expensive to build with high initial capital cost because plants require containment safeguards[14].

2.2 Fossil Energy Generation

The major fossil energy sources coal, oil and natural gas are briefly described below.

2.2.1 Coal: Ontario currently has four coal-fired fuel stations: Lambton, Thunder Bay, Atikokan and Nanticoke. Together they account for 6,434 MW (16%) of Ontario's energy generating capacity. Lakeview generating plant, one of the Province's coal-fired fuel stations was closed in April 2005. The government plans the phased closure of these remaining coal plants by 2014. This is expected to reduce Ontario's greenhouse gas

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[11] ibid.

[12] Babylon English English Dictionary (2007). *Heavy Water.* Retrieved July 22, 2008, from Babylon Web site: http://www.babylon.com/definition/heavy_water/English 'heavy water' may be defined as "water with a higher average molecular weight than ordinary water, water used for cooling the core of an atomic reactor"

[13] Ontario Ministry of Energy and Infrastructure (2008). *Nuclear Energy.* Retrieved April 27, 2008, from Building Ontario's Energy Future Web site: www.energy.gov.on.ca/index.cfm?fuseaction=electricity.main There are three nuclear power plants in Ontario: Pickering Generating Station, Darlington Generating Station and Bruce Nuclear Power Generating Stations

[14] Peterson, A-K and J. Rohrer (2007). *Nuclear Energy.* Retrieved July 20, 2008, from Time for Change Web site: http://timeforchange.org/pros-and-cons-of-nuclear-power-and-sustainability

emissions by 44% and contribute towards tackling the problems of climate change and environmental causes of illness, as well as greening the economy and providing stronger protection for the natural environment[15]. The government has put in place plans to ensure the reliability of supply as demand increases, and has directed the Ontario Power Authority to plan for coal-fired generation in Ontario to be replaced by cleaner renewable energy sources in the earliest practical time frame that ensures adequate generating capacity[16].

2.2.2 Oil: Crude oil is refined in Ontario refineries and provides most of the energy used for transportation and the petrochemical industry. Fuel oil together with wind and solar energy currently account for one percent of the total electricity generation in Ontario. Refined petroleum products are the various products created from refining petroleum. The main ones used for electricity generation plants are heavy fuel oil, light fuel oil and diesel fuel. Each differs in the type of plant in which it is used: heavy fuel oil is used almost exclusively in steam plants, light fuel oil is only used in combustion turbine plants, and diesel fuel is used in nearly all of Canada's internal combustion generating stations, as well as in some large combustion turbine plants[17]. Crude oil prices are determined by global supply and demand conditions in international markets of which Canada is a price taker [that is, operating in a competitive economy where it is necessary to accept the prevailing market price in order to sell goods]. Gasoline prices are affected by the changes in crude oil prices, local market conditions, inventory levels, and government taxes[18].

2.2.3 Natural Gas: Natural gas accounts for approximately 8% of Ontario's power generating capacity. There are currently about 102 natural gas electricity generation stations of varying sizes and outputs across the province, of which 19 are connected to the grid. Natural gas is the major fuel for all sectors of the economy except transportation, and is the primary fuel used in residential, commercial and industrial heating in Ontario. The sale of natural gas was deregulated in Ontario in October 1985. The "commodity" prices of natural gas are unregulated and negotiated between buyers and sellers, while the local distribution rates are regulated at the provincial level. Gas can be purchased from either a local distribution company or any Ontario Energy Board (OEB) licensed gas marketer or broker[19]. Natural gas has advantages over other fossil fuels such as coal and petroleum products in that gas burns cleanly, thus producing no acid pollutants. This advantage has made natural gas an attractive option for future electrical generating capacity[20].

2.2.4 Advantages of fossil fuels: Fossil fuels – coal, oil and natural gas, have certain relative advantages when compared to renewable energy sources. For example, fossil fuel systems have the ability to respond to changes in demand (or load) in response to changes in customer demand as different electricity loads can be turned on or off as

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[15]Ministry of Energy and Infrastructure (2008). *Moving forward on coal replacement.* Retrieved April 8, 2008, from Ontario's Energy Future Web site: http://www.energy.gov.on.ca/index.cfm?fuseaction=english.news&body=yes&news_id=176

[16]Ministry of Energy and Infrastructure (2008). *Fossil Energy Generation- Coal.* Retrieved April 8, 2008, from Building Ontario's Energy Future Web site: www.energy.gov.on.ca/index.cfm?fuseaction=english.electricity-18k -

[17] Natural Resources Canada (2004). *All stations, 1997: By Fuel.* Retrieved August 18, 2008, from The Atlas of Canada Web site: http://atlas.nrcan.gc.ca/site/english/maps/economic/generatingstations/allbyfuel/1

[18]Ministry of Finance (2007). *Energy & Utilities.* Retrieved April 4, 2008, from Ontario Facts Web site: www.2ontario.com/facts/fact15.asp-41k-

[19]Ibid. Ministry of Energy and Infrastructure (2008). *Natural Gas.* Retrieved April 4, 2008, from Fuelling Ontario Web site: http://www.energy.gov.on.ca/index.cfm?fuseaction=oilandgas.naturalgas

[20] Natural Resources Canada (2004). *All stations, 1997: By Fuel.* Retrieved August 18, 2008, from The Atlas of Canada Web site: http://atlas.nrcan.gc.ca/site/english/maps/economic/generatingstations/allbyfuel/1

required. Natural gas-fired electricity generation (if running at low outputs as a "spinning reserve") or storage-based hydro power, are able to respond to load changes very quickly, and are therefore able to deliver peaking power on demand. Coal-based power plants can also adapt their output to load cycling and to known daily on/off cycles[21]. In addition, large amounts of electricity can be produced in one place using coal, and transporting oil and gas to power stations is easy. Gas-fired power stations are very efficient, and a fossil-fuelled power station can be built almost anywhere, so long as there are large accessible quantities of fuel available to it. The combustion process is straightforward and comparatively inexpensive[22].

2.2.5 Disadvantages of fossil fuels: There are many disadvantages associated with the use of fossil fuels. Principally, fossil fuels are not renewable and known reserves are being rapidly depleted due to growing energy demand. The exploitation of fossil fuel reserves is not sustainable in the long-term[23]. It is estimated that within the next 100 years the cost of finding and extracting new deposits of fossil fuels with known technologies will render them too expensive for everyday use[24]. Some projections indicate that the world will reach a "peak oil" condition around 2010, when the world's annual oil demand reaches world's annual production capacity. At post "peak oil", the world's oil production will steadily drop, while demand continues to grow. It has been estimated that by 2025, the world shortfall in oil supply will be around 35%. In general, small shortfalls could give rise to big price increases, which could have serious implications for the transportation sector and ultimately, the economy[25].

Interruptions in fossil fuel supply due to geopolitical tensions, global economic uncertainties, political instability and regional conflicts can disrupt regular crude oil deliveries, lead to shortages and price volatility and could raise issues of national security. Moreover, coal extraction also has a very damaging effect on the landscape, which requires costly rehabilitation[26].

2.2.5.1 Air quality: Major environmental and health problems have been attributed to the combustion of petroleum and petroleum products. Key air pollutants in Ontario resulting from the burning of fossil fuels are nitrogen oxides (NOx), sulphur dioxide (SO_2), carbon dioxide (CO_2) and mercury (Hg) that contribute to GHG emissions, global warming and smog. Smog is a combination of airborne pollutants that affect our health and our natural environment. Most harmful are ground-level ozone and fine particulate matter that can enter our lungs. These contaminants come from vehicles and other gasoline or diesel-powered machinery, factories, chemical sprays, oil-based paints, airborne dust and other sources[27]. Coal-burning power plants and natural gas processing release 20% of Canada's NOx. Carbon dioxide is a key greenhouse gas,

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[21]Canadian Electricity Association (2006). *Fundamentals of Electricity Generation.* Retrieved June 18, 2008, from Power Generation in Canada Web site: www.canelect.ca/en/Pdfs/HandBook.pdf
[22]Carbon Neutral Newcastle (2006). *Fossil Fuels.* Retrieved April 6, 2008, from Energy Advantages and Disadvantages Web site: www.discoveringfossils.co.uk/fossilfuels.htm-63k-
[23]Discovering Fuels (2007). *Fossil Fuels.* Retrieved May 5, 2008, from Energy Resources Web site: http://home.clara.net/darvill/altenerg/fossil.htm
[24]Carbon Neutral Newcastle (2006). *Fossil Fuels.* Retrieved May 5, 2008, from Energy Advantages and Disadvantages Web site: http://discoveringfossils.co.uk/fossilfuels.htm-63k
[25]Hirsch, R., R. Bezdek and R. Wendling (2005). *Global Oil Supply.* Retrieved April 25, 2008, from World Oil Web site: www.scag.ca.gov/rcp/pdf/summit/WorldOil-May05Bezdek.pdf
[26]Minerals and Waste Planning Division (2004). *Sustainable Development of Minerals.* Retrieved August 8, 2008, from Mineral Matters-Eight Web site: http://www.mineralsuk.com/britmin/mm8.pdf
[27] Ministry of the Environment (2008). *Green Tips.* Retrieved August 26, 2008, from Ministry of Energy Web site: http://www.ene.gov.on.ca/cons/3764e.htm

contributing to the threat of climate change, and mercury is a potent nerve-toxin that builds up in the food chain. Nitrogen oxides and SO_2 can irritate the lungs and lower resistance to respiratory infection, particularly in Ontario's most vulnerable populations: the very young, the old, or people already suffering from respiratory ailments. Both gases can also aggravate cardiovascular disease[28].

In southern Ontario, particularly in and around the urban areas, periods of smog occurring most often during the summer can cause air quality to fall well below acceptable standards. The total number of smog days in Ontario ranged from 17 days in 2006 to 53 days in 2005. There were 39 smog days in 2007 and 14 smog days so far in 2008[29]. Both NOx and SO_2 cause acid rain, which has harmful effects on the environment and on structures[30]. Acid rain damages lakes and marine life, forests, crops and physical structures, while smog lowers visibility and can lead to respiratory and cardiovascular problems[31]. The Ministry of the Environment has developed a special program to notify Ontario residents when poor air quality is expected. If forecasts indicate that the Air Quality Index (AQI) may exceed a reading of 50, over a wide geographic area, the ministry will declare either a 'smog watch' or a 'smog advisory'. A smog watch is issued when there is a 50 per cent chance that poor air quality will occur within the next three days. A smog advisory is issued when there is a high probability that poor air quality will occur within next 24 hours or if smog conditions happened without warning. Programs such as Drive Clean and the Ontario Anti-Smog Action Plan initiated by the Ontario government are aimed at improving the province's air quality and in reducing smog levels over the next few years[32].

All levels of government are working collectively, pooling experience and information to better understand how to deal with the effects of smog, to protect the most vulnerable members of the communities, and to minimize the contributions to the air quality problem in Ontario. Municipalities play an important role in combating smog, since it is within communities that actions can be taken to reduce local emissions, to inform and advise citizens about smog, and to facilitate efforts to reduce the release of air pollutants, especially during smog alerts. A number of Ontario municipalities including Peel Region have taken the initiative to implement smog response action plans. The smog alert response plans identify processes the municipality can take to notify the community in the event a smog advisory is issued by the Ministry of the Environment. It also often includes outreach initiatives to increase public awareness about smog, and actions the municipality can implement to reduce smog emissions from municipal operations, such as reducing energy consumption, minimizing the use of solvents and oil-based paints, and re-scheduling the use of small engines for grounds maintenance and landscaping[33].

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[28] City of Hamilton (2007). *Fact Sheet #4 Where Does it Come From.* Retrieved August 25, 2008, from the Clean Air Hamilton Web site: http://www.cleanair.hamilton.ca/reports/factsheet4.asp

[29] Ministry of the Environment (2008). *Smog Advisory Statistics.* Retrieved August 26, 2008, from Ministry of Environment Web site: http://www.airqualityontario.com/press/smog_advisories.cfm

[30] BC Citizens for Public Power (2007). *Issues-Coal.* Retrieved April 18, 2008, from Fossil Fuels Web site: www.citizensforpublicpower.ca/issues/fossil_fuels-14k; www.hc-sc.gc.ca/ewh-semt/pubs/air/champions_air/air-pollution-atmospherique-eng.php-23k

[31] Ministry of Energy (2001). *Coal-fired electricity generation in Ontario.* Retrieved August 25, 2008, from Ministry of Energy Web site: www.ene.gov.on.ca/envision/techdocs/4016e.pdf-

[32] Ministry of the Environment (2008). *Spare the Air Actions.* Retrieved August 26, 2008, from Ministry of Environment Web site: http://www.airqualityontario.com/science/partners.cfm

[33] Ministry of the Environment (2005). *Smog Alert Response A Municipal Guide to Action.* Retrieved August 26, 2008, from the Ministry of Energy Web site: www.ene.gov.on.ca/envision/gp/3760e.pdf-

Education and communication is at the core of an effective response to a smog alert. Municipalities, as the contact point for the local communities they serve, perform an important role in getting the word out to vulnerable people, hospitals and health workers, seniors' homes, schools, area businesses and local industries. Ensuring that staff especially those dealing with public health issues are trained, aware of their roles and responsibilities and are informed promptly when an alert is issued is vital to an effective smog alert response[34].

The relationship between transportation and the environment is multi-faceted. It concerns the direct and indirect environmental effects of transportation activity - the actual movement of goods and people - and the transportation system. The major current sources of air pollution from transportation are carbon monoxide (CO), CO_2, NOx and volatile organic compounds (VOCs): the causes of urban smog and climate change. Transportation contributes over 65% of Ontario's NOx emissions. The small number of heavy-duty diesel vehicles produce about the same amount of NOx as all of the automobiles on the road. A wide range of regulations are in place governing fuel quality, combustion, and operating practices. Increasing efforts are being made to change the design of transportation systems, to influence transportation behaviour, and to reduce transportation fuel demand[35].

According to Statistics Canada,

> Energy production and consumption accounted for 81% of total Canadian greenhouse gas emissions in 2003 and 91% of the growth in emissions from 1990 to 2003. Road transportation, thermal-electric power generation and fossil fuel production were the principal sources of the increase in emissions.
>
> Road transportation accounted for 19% of total emissions in 2003 and 23% of the growth in emissions from 1990. In part, this reflects a shift in the types of vehicles used for personal transportation from automobiles to vans, sport utility vehicles and light-duty trucks. These heavier vehicles emit on average 40% more greenhouse gases per kilometre than do automobiles.
>
> The emissions from thermal-electric power generation accounted for 18% of total emissions in 2003 and 27% of the growth from 1990. This growth was driven by the rising demand for electricity and the relative increase in the use of fossil fuels, particularly coal, for electricity generation.
>
> Fossil fuel production accounted for 10% of total greenhouse gas emissions in 2003 and 13% of the growth since 1990. Between 1990 and 2003, exports of crude oil increased nearly six-fold, while exports of natural gas more than doubled. These increases explain about one-half of the total emissions increase for this category[36].

2.3 ALTERNATIVE AND RENEWABLE ENERGY SOURCES

The major alternative and renewable energy sources are briefly described below.

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[34] Ibid.

[35] Transport Canada (2005). *Transportation and the Environment.* Retrieved August 26, 2008, from Transport Canada Web site: http://www.tc.gc.ca/pol/en/report/anre2005/5_e.htm; see also, http://www.cleanair.hamilton.ca/reports/factsheet4.asp

[36] Statistics Canada (2005). *Canadian Environmental Sustainability Indicators.* Retrieved August 8, 2008, from Statistics Canada Web site: http://www.statcan.ca/daily/English/051214/d51214c.htm

2.3.1 Wind energy: Wind energy has major environmental and health benefits, as a non-polluting source of energy and modern wind technologies provide reliable, cost-effective, energy for individual, community and national applications. Wind turbines can be installed in a variety of ways and at a variety of scales, and generating costs are generally, nearly competitive with conventional energy sources.

The quality of a wind turbine site depends on wind speed at the centre of the turbine on top of the turbine's shaft, accessibility to allow for wind turbine installation and maintenance and proximity near power lines that can handle its power. Previously in off-grid applications, turbines had to be sited near the place where the electricity was used. However, with improved technologies, the transmission of power through direct current technology now makes it possible to install wind turbines off the Atlantic coast. Other factors that play a role includes; ownership and financing structures, local permitting and zoning requirements, visual and noise impacts, as well as impacts on birds, bats, and other species[37].

A wind turbine's location has a major effect on the amount of electricity it produces and, thus, on its cost-effectiveness. A wind turbine that is installed in a consistently windy area generates less expensive electricity than the same unit installed in an inconsistent or less windy area. Modern wind turbine generators cost between $1500 and $2000 per kilowatt for wind farms that use multiple-unit arrays of large machines. Smaller individual units cost up to $3000 per kilowatt. In consistently windy areas, the costs of generating electricity range between 5 and 10 cents per kilowatt-hour. That cost is somewhat higher than the costs associated with an electrical facility such as a coal-fired or nuclear power plant, but wind energy costs are decreasing every year, whereas most conventional generation costs continue to increase[38]. In addition, the financial costs do not consider the intangible environmental benefits of wind energy over conventional methods. Backup electricity from a utility company or from an energy storage system is necessary when the wind dies down[39].

There is some public opposition to wind energy generation due largely to concerns about the visual impact and noise of wind turbines, and their impacts on the open countryside and settled areas in particular. Residents close to proposed wind energy turbines have been critical about the distance or setback between wind turbines and residential properties over health and safety concerns. Concerns have also been expressed about both audible and inaudible sound, noise not heard but felt, the visual impact of blinking lights on top of wind towers and the effect on birds, especially endangered species due to electrocution or collisions with spinning rotors[40].

2.3.2 Offshore wind turbines: Offshore wind farms could also play a key role in renewable energy generation, and the installation of many and large turbines can generate substantial amounts of energy. There are limits to the growth of onshore wind power in areas that are densely populated and lack the space for large arrays of wind

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[37]Ontario Sustainable Energy Association (2005). *Siting Issues and Considerations.* Retrieved April 18, 2008, from Ontario's Landowner's Guide to Wind Energy Web site: www.ontario-sea.org/pdf/LandownersGuideToWindEnergy.pdf

[38] Natural Resources Canada (2007). *About Wind Energy.* Retrieved April 18, 2008, from Technologies and Applications Web site: http://www.canren.gc.ca/tech_appl/index.asp?CaId=6

[39]Royal BC Museum (2002). *Renewable Energy Resources- Wind Power.* Retrieved April 18, 2008, from Living Landscapes Web site: www.livinglandscapes.bc.ca/thomp-ok/env-changes/energy/ch3.html

[40] Canadian Wind Energy Association (2007). *Concerns around wind.* Retrieved August 8, 2008, from Canadian Wind Energy Web site: www.canwea.ca/images/uploads/File/CanWEA-_Addressing_concerns_about_wind_energy.ppt

turbines. Environmentally sensitive areas are not suitable places to put wind power plants, for ecological or aesthetic reasons. In contrast, there is potentially plenty of space and a favourable wind regime on oceans and lakes that are stronger and more predictable than those on land, because there are no hills or buildings to disrupt the wind. Moreover, properly sited offshore turbines would create no significant problems for recreational users, aircraft or commercial shipping. Offshore sites are ideal for large wind power plants with generating capacities of 100MW and above, due to lower incremental transmission costs, and such power plants can be controlled like conventional power plants and incorporated into the electricity transmission networks. Large wind power plants have the added advantage in that they perform even better than conventional power stations in terms of rapid response and flexible operation under changing load conditions[41].

Offshore wind turbines are more expensive to build and maintain than those sited on land because offshore foundations may be more expensive to build and saltwater environments can also raise maintenance costs by corroding the towers. Offshore wind turbines have to be coated with extensive corrosion protection measures, which may not be required in fresh water locations. However, stronger offshore winds and the ability to use larger turbines tend to make up for this extra cost over the lifetime of the plant, and wind energy is getting cheaper as technologies develop. Importantly, placing wind turbines offshore increases the environmental gains in such a project, as the turbines can produce an energy output, which is up to 25% higher than for comparable turbines on shore.

In the United Kingdom, the Kentish Flats wind farm comprises 30 wind turbines capable of producing up to 3 MW of electricity each, giving an annual output of 280,000,000 kilowatt-hours, which corresponds to the consumption of more than 100,000 British households. The Kentish Flats project will displace an estimated 4.4 million tonnes of carbon dioxide over its 20-year lifetime, compared to conventional fossil fuel generation[42].

In January 2008 the Ontario government lifted a 14-month moratorium on offshore development after studying the potential environmental impacts on wildlife, aquatic species and bird migration routes, thereby opening up possibilities for companies to build offshore wind farms. The Ontario Energy Board has determined that there are 64 feasible offshore wind development sites on the Ontario side of the Great Lakes that could generate 34,500 MW of power using 5-MW turbines. It is estimated that this could provide over 60 years of renewable energy development and green-collar manufacturing employment for thousands of Ontario workers. Feasibility studies are ongoing by certain companies including one for a proposed 750-MW TPW1 offshore project in Lake Ontario, approximately 20 kilometers southeast of Prince Edward County. There are no shipping lanes in the area and the wind farm will create a “reef effect” for aquatic life. Also, bird flight patterns on the Great Lakes are generally along the shore and rarely reach out into the middle of the lake. The project will be able to power up to 300,000 Ontario homes and reduce carbon emissions by 3 million tonnes a year[43].

[41]Vestas (2005). *Project Business.* Retrieved April 8, 2008, from Annual Report Web site: http://www.vestas.com
[42] Elsam (2005). *Offshore Wind.* Retrieved June 2, 2008, from Kentish Flats Offshore Wind Farms Web site: http://www.kentishflats.co.uk/page.dsp?page=2624
[43] Group CNW (2008). *Tai Wind Consortium launches green-collar manufacturing initiative.* Retrieved June 2, 2008, from News From CNW Group Web site: http://www.newswire.ca/fr/releases/archive/June2008/19/c5801.html

2.3.3 Solar energy: Energy from the sun is virtually unlimited and largely free once the initial cost of the installation has been recovered. Solar energy systems have the advantage of not generating air pollution or greenhouse gases during operation. The primary environmental, health, and safety concerns about solar energy systems are focused on how they are manufactured, installed, and ultimately disposed of[44]. At any particular time, the available solar energy is primarily dependent upon how high the sun is in the sky and current cloud conditions and upon the location. Furthermore, useable solar energy depends upon available solar energy, other weather conditions, the technology used, and the application[45]. The major drawbacks of these systems include that of harnessing this energy so that it is available at the appropriate time and in the appropriate form[46]. Technologies have been developed to concentrate energy into useful quantities that can be stored or used as a supplemental energy source for nighttime and cloudy days, but until recently most of them have been too expensive and solar energy cannot at the present time compete with conventional power plants on an economic basis[47]. However, global production of solar photovoltaic cells or PV panels has risen six fold since 2000 and costs of solar panels are expected to decrease by 40% by 2010 with advances in technology[48].

There are many ways to transform sunlight into energy. The main types are photovoltaic panels that convert sunlight directly to electricity, and solar thermal panels that absorb heat from the sun and transfer it as space heating or water heating. Solar photovoltaic energy systems can be stand-alone or connected to a power grid. Backup electricity from a utility company or from an energy storage system is necessary when there is little or no sunshine[49].

2.3.4 Small-scale hydro: Small-scale hydro installations produce renewable energy and have many environmental benefits. They do not emit greenhouse gases and the process to generate electricity does not produce waste. Small-scale hydro developments do not require river diversions and contribute to a more distributed electricity system by generating power where it is needed rather than transporting it great distances. Small-scale hydro can be a competitive source of clean, reliable energy and an alternative to traditional high-cost diesel generation. Such installations also provide economic benefits for nearby communities and for communities living in remote locations[50]. They have a relatively low environmental impact compared to large hydro, take up little space and do not require the construction of dams, since the turbines are generally placed directly in the flowing stream. These smaller projects are often classified as small (1–30 megawatts), mini (100 kilowatts – 1 megawatt) and micro (100 kilowatts or less)[51].

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[44] EcoWorld (2007). *India's Solar Power.* Retrieved April 18, 2008, from Greening India's future energy demand Web site: http://www.ecoworld.com/home/articles2.cfm?tid=418

[45] Natural Resources Canada (2005). *About Solar Energy.* Retrieved April 18, 2008, from Technologies and Applications Web site: http://www.canren.gc.ca/tech_appl/index.asp?CaId=5&PgId=121

[46] The Columbia Encyclopaedia (2008). *Solar Energy.* Retrieved April 18, 2008, from Bartleby Web site: http://www.bartleby.com/65/en/energy-s.html

[47] The Canadian Encyclopaedia (2008). *Solar Energy.* Retrieved April 18, 2008, from The Canadian Encyclopaedia Web site: http://www.thecanadianencyclopedia.com/index.cfm?PgNm=TCE&Params=A1ARTA0007549

[48] Renewable Energy World (2008). *Solar Power.* Retrieved August 8, 2008, from Renewable Energy Web site: www.renewableenergyworld.com/rea/news/story?id=48624-66k-

[49] Natural Resources Canada (2005). *About Solar Energy.* Retrieved April 18, 2008, from Technologies and Applications Web site: www.canren.gc.ca/tech_appl/index.asp?CaID=4&PgID=27-36k-

[50] Ontario Sustainable Energy Association (2008). *Benefits of Small Hydropower.* Retrieved August 8, 2008 from Renewable Energy- Small Hydro Web site: http://www.ontario-sea.org/RE_smallhydro.php

[51] Natural Resources Canada (2007). *Small-scale hydro.* Retrieved July 20, 2008 from Renewable Energy Technologies Web site: www.nrcan.gc.ca/media/newcom/2007/200702b-eng.php

2.3.5 Bioenergy: Bioenergy is produced by the release of chemical energy contained in fuels made from biomass. Biomass includes forest and mill residues, agricultural crops and wastes, wood and wood wastes, animal wastes, livestock operation residues, aquatic plants, fast-growing trees and plants, and municipal and industrial wastes that can be converted into fuel. Biomass can supply heat, electricity and vehicle fuels such as ethanol and biodiesel, and results in substantially fewer harmful emissions when compared to traditional sources of power generation. Biomass materials can be obtained from landfill sites, agricultural and livestock operations, food processing and the forest industry. Ontario Regulation 232/98 under the Environmental Protection Act requires the collection of landfill gas for new or expanding landfill sites larger than three million cubic meters or 2.5 million tonnes. The production of energy from methane derived from animal manure wastes can serve to mitigate other disposal and surface or groundwater contamination concerns. Developments in fuel/energy technologies could also have positive environmental and economic benefits[52].

The only 'Energy From Waste' (EFW) facility located within the Region of Peel was opened in 1992 and is owned and operated by Algonquin Power Systems Inc. in Brampton. The EFW facility is designed to incinerate non-recyclable, non-hazardous solid waste materials, including municipal solid waste to produce steam. Steam is used to drive a turbine generator to produce electricity. The facility processes 174,000 tonnes of solid waste each year, out of which, approximately 160,000 tonnes is residential waste from the Region of Peel, and produces a maximum of 15 MW of electrical energy. The remainder of the waste processed at the facility is international airport waste and industrial, commercial and institutional (IC&I) waste. The electrical energy produced at the facility is sold to the Provincial utility, under a long term Power Purchase Agreement[53]. This facility does not process all of the municipal solid waste generated by the Region of Peel, and the remaining residual waste is currently transported to landfill sites in Michigan.

Algonquin Power continuously monitors stack emissions and the results are submitted to the Ministry of Environment (MOE) on a monthly basis and are also discussed at Public Liaison Committee meetings held by the Region approximately every two months. This Committee also acts as a public forum, where public concerns are addressed[54].

2.3.6 Cogeneration: Cogeneration, also called combined heat and power (CHP) systems, offers an efficient solution for the simultaneous production of electricity and thermal energy from the same fuel source in the same facility. Cogeneration represents only six per cent of electricity production and three per cent of industrial thermal energy in Canada. Generally, 60 per cent of all energy produced from traditional power generation such as coal, oil and natural gas is lost as heat. Using cogeneration technology, the heat energy produced in the process of generating power is recovered and used for industrial processes, as well as for heating and cooling applications. Cogeneration eliminates the need to burn fuels for the sole purpose of heating, reduces air pollution and contributes to reductions in greenhouse gas emissions. Cogeneration provides electric power and heat using 10 to 30 per cent less fuel than would be required

[52] Carbon Neutral Newcastle (2006). *Fossil Fuels.* Retrieved May 5, 2008, from Energy Advantages and Disadvantages Web site: http://www.discoveringfossils.co.uk/fossilfuels.htm
[53] Algonquin Power Systems Inc. (2008). *Energy From Waste.* Retrieved May 11, 2008, from Algonquin Power Energy From Waste Facility Web site: http://www.algonquinpower.com/business/facility/alternative_peel.asp
[54] Region of Peel (2008). *Algonquin Power Energy From Waste Facility.* Retrieved May 11, 2008, from Region of Peel Web site: http://www.peelregion.ca/pw/waste/facilities/algonquin-power.htm#whatis

to produce the same amount of electricity and heat separately. Other benefits of local cogeneration include energy diversity and reliability, power transmission avoidance and reduced costs of producing electricity and heat. Cogeneration can also be applied to district heating and cooling. In a district energy system, thermal energy in the form of hot water, steam or chilled water, is distributed by underground pipelines from the source of local energy production to several buildings and facilities such as hospitals, universities, industrial complexes, etc[55].

2.3.7 District Energy System (DES): A district energy system, or community energy system, [also known as district heating and cooling (DHC), or "combined heat and power" (CHP)] supplies heating, cooling and power to multiple buildings from a centralized plant or from several interconnected but distributed plants. The system is comprised of pipes, heating equipment, cooling equipment, heat exchangers, as well as the social infrastructure for management and settlement. DES is cheaper and more efficient to use, operate and maintain, and greater efficiencies are achieved when heat and power are simultaneously produced through a cogeneration system. District energy systems are increasingly incorporating renewable and alternative energy sources. These include biomass, landfill gas, industrial waste heat, sewer water, ground-source heat pumps, and solar thermal collection and storage. Apart from achieving energy efficiency and fuel cost reduction for a community, an integrated supply and energy management system can supply excess energy to the network while consumers in need of energy are drawn from the network. The result is an increased synergy and efficiency of energy use throughout the community that maximizes local resources[56].

CANMET Energy Technology Centre (CETC) supports municipalities in the development of community energy systems and offers assistance from the planning phase to post-development performance measurement activities as part of a municipality's overall sustainable community strategy. Investment in community energy systems is increasing in Canada and several municipalities have installed systems that provide heat and can connect to the electrical grid, enabling combined heat and power (CHP) for efficient generation of electrical power while meeting the thermal demands for hot water supply. Natural Resources Canada estimates that between 2006 and 2009, over $90 million will be invested in new and existing plant expansions. Examples of district energy systems operating in Ontario include Hamilton which uses CHP to provide heating to its downtown core and electricity to its City Hall. Markham and Ajax utilize local resources as wood or clean wood waste and municipal waste to heat buildings and provide electricity, thereby turning the "disposal problem" of solid waste into biomass combustion for energy. "The Markham District Energy Corporation is recognized as an economic development tool, successfully attracting business and development to the area with the prospect of stabilized heating and cooling costs[57]." Sudbury's natural gas fired cogeneration and supplemental chillers supply heating and cooling to several buildings in the city's downtown core[58]. Cornwall's power plant generates electricity at a

[55] Environment Canada (2004). *Efficient Technology Generates Heat and Power.* Retrieved August 27, 2008, from EnviroZine Web site:http://www.ec.gc.ca/EnviroZine/english/issues/41/feature1_e.cfm
[56] CANMET Energy Technology Centre (2003). *Integrated Energy Solutions for Communities- Community Energy Systems.* Retrieved August 26, 2008, from Natural Resources Canada Web site: www.nrcan-rncan.gc.ca/es/etb/cetc/cetc01/htmldocs/pdfs/community_energy_systems_e.pdf
[57] Ibid. and Town of Ajax (2006). A*jax Energy From Waste Project.* Retrieved August 27, 2008, from Ministry of Energy Web site: www.ene.gov.on.ca/envision/env_reg/er/documents/2006/Ajax%20Overview.pdf-
[58] Centre for Analysis and Dissemination of Demonstrated Energy Technologies (2008). *Sudbury Cogeneration and district Energy Systems.* Retrieved August 27, 2008, from CADDET Web site: http://www.caddet.org/infostore/display.php?id=21056

competitive rate, adds stability to the system and minimizes negative environmental impacts. The system generates about 4% of the city's electrical energy[59]. Several universities and hospitals in Ontario and Alberta have installed small gas turbines or reciprocal engine CHP systems. Since 1993, Ottawa, Cornwall, Sudbury, London, Markham and Windsor have established gas CHP systems that produce about 3-5 megawatts of electricity (MWe) each[60].

DES technologies provide a basis for responsible environmental conservation and present the economic and ecological opportunity to address the challenge of sustainable development. The benefits of this type of system over current building-based systems include increased efficiencies due to economies of scale, reduced energy, operating capital and maintenance costs and increased reliability. They reduce ozone-depleting greenhouse gas emissions from CFC chillers, conserve natural resources, and use a broader choice of fuels including renewable energy and low grade heat [a surplus of low-temperature heat produced by heat engine commonly referred to as "waste heat" or "secondary heat"]. District energy systems are energy efficient, environmentally sound and easy to operate and maintain. Local generation systems have benefits in security of energy supply, reduced transmission losses and competitive life-cycle costs. DES provide essential backup source of energy in the event of an emergency and help in reducing congestion on the electric grid by removing or reducing load. Moreover, they allow for greater building flexibility, and are comfortable and convenient as indoor environments can be better managed and controlled[61].

Peel Region and other Canadian municipalities face significant environmental challenges such as climate change and improving air quality, solid waste management, drinking water quality and waste water treatment. District energy systems have significant potential in helping to solve some of the problems of energy and the environment. Currently, district energy systems produce about one percent of the energy used in Canada in contrast to countries like Finland, Denmark and the Scandinavian countries where the figure is closer to 50 percent.

The quality of urban life is a priority of the Government of Canada and in 2005 the government launched 'The New Deal for Cities and Communities' and put in place significant and innovative measures to promote energy efficiency and renewable energy. Entrepreneurs will be able to more quickly recoup their investments in energy efficiency and renewable energy. By its amendments to the Income Tax Act, the Government of Canada made available $295 million in tax incentives. The capital cost allowance on high-efficiency co-generation equipment and the range of renewable energy production materials was increased to 50% and deductions were extended to energy distribution equipment such as pipelines, pumps and meters. Other major elements of this policy include the transfer 5 billion dollars from the gas tax to municipalities to encourage ecologically-sustainable infrastructure projects, such as mass transit, drinking water and waste water treatment, solid waste treatment, and district or centralized energy systems. In addition, $350 million dollars was injected into Green Municipal Funds (GMF) administered by the Federation of Canadian Municipalities. GMF provides loans and grants, builds capacity, and shares knowledge to support municipal governments and

[59] CANMET Energy Technology Centre (2003). *Cornwall, Ontario District Heating System.* Retrieved August 27, 2008, from Natural Resources Web site: www.nrcan.gc.ca/es/etb/cetc/pdfs/cornwall_district_heating_system_e.pdf-

[60] Environment Canada (2004). *Efficient Technology Generates Heat and power.* Retrieved August 27, 2008, from EnviroZine Web site: http://www.ec.gc.ca/EnviroZine/english/issues/41/feature1_e.cfm

[61] See footnotes # 56 and # 58

their partners in developing communities that are more environmentally, socially and economically sustainable[62].

Problems related to cogeneration and district energy systems include large initial investments with returns spread over time, site requirements, environmental standards and other municipal regulations that could limit district energy and municipal cogeneration development near urban centres. However, these problems can be solved by providing full financial quantification of benefits and improving corporate taxation incentives. The Federal government is working to make CHP a more affordable option, by providing municipalities with air emissions guidelines which promote energy efficiency and long-term planning concepts that will enhance sustainable community living. It is estimated that cogeneration could supply more than 20 per cent of Canada's electricity and thermal needs in the future, due in part to increasing energy costs and energy security concerns[63].

2.3.7 Geothermal Energy: Geothermal systems use the relatively constant temperature of the ground between 10 and 15.5 degrees Centigrade (50 and 60 degrees Fahrenheit) in the upper 3.048 meters (10 feet) of the Earth's surface to regulate the temperature of a home or building at very high effective efficiency. Geothermal technology is also referred to as earth energy systems, ground-source heat pumps, geothermal heat pump systems, and GeoExchange™ technology or water source heat pumps. Heat pumps are highly energy efficient devices for moving heat from one location to another. They are electrically powered and therefore produce no air emissions. The system moves heat from the ground to the home/building for heating — and in the opposite direction for cooling and does not create heat through combustion of fuel and can thus reduce greenhouse gas emissions. Geothermal energy is sustainable as the hot water used in the geothermal process can be re-injected into the ground to produce more steam. Geothermal power plants are not affected by changing weather conditions and can work continually, day and night, making them base load power plants[64].

Peel's new headquarters will be the first Regional building to use geothermal heat pumps for heating and cooling, supplying 15 percent of the building's total heating and cooling load. Projects are also underway to retrofit the heating and cooling systems of three other Regional buildings to geothermal heat pumps during 2008. In addition, two new community recycling centres and a new central administration building for Lakeview Water Treatment Facility are being designed to have a number of green energy features including geothermal heating and cooling, domestic hot water systems, passive heating and cooling and ventilation measures, high levels of insulation, extensive use of natural

[62] Environment Canada (2005). *Speech delivered by the Hon. Stéphane Dion P.C., M.P., Minister of the Environment.* Retrieved August 28, 2008, from Environment Canada Web site: http://www.ec.gc.ca/media_archive/minister/speeches/2005/050518_s_e.htm

[63] Ibid.

[64] Natural Resources Canada (2006). *About Earth and Geothermal Energy.* Retrieved April 29, 2008, from NRCan Web site: http://www.canren.gc.ca/tech_appl/index.asp?CaID=3; Ministry of Revenue (2008). *Wind, Micro Hydro-Electric and Geothermal Energy Systems Rebate.* Retrieved April 29, 2008, from Ministry of Revenue Web site: http://www.rev.gov.on.ca/english/refund/windgeo/; Ministry of Energy (2007). *Geothermal Energy.* Retrieved April 29, 2008, from Ministry of Energy Web site: http://www.energy.gov.on.ca/index.cfm?fuseaction=renewable.geothermal; Wikipedia (2008). *Geothermal Power.* Retrieved, April 29, 2008, from Wikipedia Web site: http://www.en.wikipedia.org/wiki/Geothermal_power-89k-

daylight and intelligent lighting that automatically dims the artificial lighting when sufficient natural light is present, as well as green roofs and renewable energy systems[65]

The cost of installing a geothermal system is determined by site-specific variables such as site conditions (soil/rock type, water quality, etc.), the loop type and size, overall size/capacity of the system, and local regulations. The estimated costs to install a complete system, including the ground loop and indoor heat pump, range from $15,000 to $30,000 for a typical home. Geothermal systems are more expensive to install than conventional systems, but long-term energy savings can be significant. The payback period for each system varies depending on the cost of the system and the existing energy expenses. The Ontario provincial government and Canadian federal government offer grants or subsidies to residential customers who have a certified installation to help offset the cost of home energy efficiency renovations. Under the provincial 'Home Energy Retrofit Program' and the federal 'EcoEnergy' initiative, homeowners may be eligible for a total grant of up to $7,000 toward the cost of a geothermal system. Provincial Sales Tax (PST) rebates are also available through the Ontario Ministry of Revenue for homeowners who purchase and install qualifying alternative energy systems by January 1, 2010. In addition, the Canada Mortgage and Housing Corporation (CMHC) provides a 10% mortgage loan insurance premium refund, and local financial institutions and local utilities offer low interest lines of credit and home improvement loans to eligible homeowners who undertake energy-saving renovations[66].

Geothermal energy offers a number of advantages over traditional fossil fuel based sources, primarily that the heat source requires no purchase of fuel. Geothermal power is a clean and renewable source of energy that reduces dependency on fossil fuels. Geothermal power plants release less than 1% of the carbon dioxide emissions of a fossil fuel plant and emit 97 percent less acid rain - causing sulfur compounds than are emitted by fossil fuel plants. Geothermal power plants deliver power with over 95% reliability. Geothermal energy is extremely price competitive in some areas and reduces reliance on fossil fuels and their inherent price unpredictability. It also offers a degree of scalability: a large geothermal plant can power entire cities while smaller power plants can supply more remote sites such as rural villages. Geothermal systems do not require an additional fuel delivery system to the home in addition to electricity, or venting of combustion products from a furnace[67].

The minimal noise produced by underground components is undetectable to the homeowner. According to Natural Resources Canada and the Environmental Protection Agency (USA) geothermal systems currently have the least environmental impact of any space conditioning technology and geothermal heat pumps are the most energy-efficient, environmentally clean, and cost-effective systems for temperature control. When installed correctly, geothermal systems generally require very little repair for 20-25 years[68].

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[65] Region of Peel (2008). *Doing our part to conserve energy.* Retrieved September 8, 2008, Pathways@Peel Web site: http://pathways.peelregion.ca/news/2008/may/052908-news.shtm

[66] Ministry of Energy and Infrastructure (2007). *Geothermal Technology.* Retrieved August 27, 2008, from Cleaner, Greener Energy Web site: http://www.energy.gov.on.ca/index.cfm?fuseaction=renewable.geothermal

[67] Canadian Geothermal Energy Association (2007), *What is geothermal?* Retrieved April 29, 2008, from CanGEA Web site: http://www.cangea.ca/what-is-geothermal/

[68] Ministry of Energy (2007). *Geothermal Energy.* Retrieved April 29, 2008, from Ministry of Energy Web site: http://www.energy.gov.on.ca/index.cfm?fuseaction=renewable.geothermal

The economics of geothermal heating and cooling of buildings is very site-specific and a good application must possess the following characteristics:

- Geothermal district heating and cooling is best installed at the time new buildings are constructed - either in a greenfield development or a major redevelopment project. In a greenfield development, even low-density suburbs can sometimes be served cost-effectively.
- Several large buildings or building complexes (such as hospitals, hotels or colleges);
- A mix of uses (such as a city, town or village centre);
- Moderate residential densities (such as multi-family units or apartments);
- Relatively small spacing between buildings and a grid-street layout;
- A source of relatively cheap energy (such as waste heat from an existing boiler or sewage treatment facility);
- Existing buildings that are not served by electric resistance heating (these cannot be easily retrofitted)[69].

2.3.8 Conclusion: Renewable energy sources have several social, environmental, and economic benefits and are playing an increasingly substantial role in meeting the current and future needs of society and reducing the pollution associated with the use of conventional fossil fuels. According to the Pembina Institute, a sustainable energy source must meet the following criteria:

- "have minimal or no negative environmental or social impact;
- not deplete natural resources;
- meet the needs of people today and in the future in an accessible, equitable and efficient manner;
- protect air, land and water;
- have little or no net carbon or other greenhouse gas emissions; and,
- be safe today and not burden future generations with unnecessary risk[70]."

According to some accounts, renewable energy sources are considered to be the future of energy production. Renewable energy sources can provide comparable energy production and heating. At present, some technologies are very expensive, but the rate of technological development will make them more affordable with time. Electricity generation from wind, solar and tidal sources have been increasing across the nation, but combined generation from these sources in 2006 represented less than 0.5% of total generation. The capacity of wind generation projects more than doubled from 2005 to 2006, rising from 680 megawatts to 1,460 megawatts, with Ontario showing the largest capacity increase of 400 megawatts[71].

To conclude this section, continued reliance on fossil fuel energy sources could give rise to a number of environmental, social, and political problems and make us dependent on limited resources controlled by a few countries and corporations. Unlike conventional

[69] The Pembina Institute (2007). Energy Source. Retrieved April 11, 2008, from The Pembina Institute Web site: http://pembina.org/sources/geothermal

[70] The Pembina Institute (2007). *Benefits of Renewable Energy.* Retrieved April 11, 2008, from Supporting Renewable Energy in Canada Web site: http://re.pembina.org/benefits

[71] Statistics Canada (2008). *Analysis.* Retrieved May 11, 2008, from Report on Energy Supply-demand in Canada 2006 Web site: www.statcan.ca/english/freepub/57-003-XIE/2006000/part1.htm-21k

fossil fuel energy sources, renewable energy sources could offer increased local control of energy production, help in ensuring stable prices and increase the security of our energy supply. In meeting the PROPR objectives, renewable energy could also provide environmental benefits such as helping to improve local air quality and reducing our impact on the land, water and climate system. Increased use of renewable energy could also help boost local economies through job creation[72].

2.4 ENERGY SUPPLY AND DEMAND IN PEEL REGION

For the purpose of this paper, energy supply and demand in Peel will be considered within the energy systems network in Ontario as the infrastructure and services are closely interlinked at the provincial level. It is important to note that the thrust of this paper is about electricity generation based largely on fossil fuels and its impact on the environment, the drive towards green renewable energy systems and, in satisfying the requirements for energy self-reliance and energy security. It has been observed that "[B]y 2020, approximately 15 per cent of Canada's current electrical generation capacity will be more than 40 years old. Incremental generation requirements by 2020 for both plant replacement and demand growth are expected to be 42,000 MW or 40 percent of the current stock of approximately 105,000 MW[73].

According to Natural Resources Canada, Office of Energy Efficiency, the total secondary energy use in Ontario in 2005 was 2,778.5 petajoules (PJ). Secondary or end-use energy demand is the energy used by the final consumer in Canada and is separated into four sectors: residential, commercial, industrial and transportation. The two largest energy end-users in Ontario were the industrial and transportation sectors, which accounted for 863.8 PJ (31.09%) and 853.8 PJ (30.73%) respectively. Total energy use by the residential sector was 558.8 PJ (20.11%), commercial/institutional 454 PJ (16.34%) and agriculture 48.1 PJ (1.73%)[74].

In the regional context, Peel has undergone a major transition during the past few decades. Rapid population growth and commercial and industrial development have transformed what was primarily a rural area of farms and villages into a dynamic blend of urban, industrial and residential areas[75]. The Region has one of the fastest population growth rates in Ontario. As can be seen in Table 3, between 2001 and 2006, the population increased by 170,457 (17.24%) from 988,948 to 1,159,405. Within Peel's municipalities, Brampton experienced the largest percentage increase during this period of almost (33.3%) from 325,428 to 433,806; followed by Caledon (12.8%) 50,595 to

[72] The Pembina Institute (2007). *Benefits of Renewable Energy.* Retrieved April 11, 2008, from Supporting Renewable Energy in Canada Web site: http://re.pembina.org/benefits

[73] Global Change Strategies International, "Energy and Climate Change—Review and Assessment of National Plan," Prepared for the National Round Table on the Environment and the Economy, March 31, (2004), p. 24; quoted in the National Round Table on the Environment and the Economy (NRTEE), Economic Instruments for the Long-term Reductions in Energy-based carbon Emissions, (2005), p 15

[74] Office of Energy Efficiency (2007). *Secondary Energy Use by End-Use.* Retrieved August 8, 2008, from Comprehensive Energy Use Database Web site: http://www.oee.nrcan.gc.ca/corporate/statistics/neud/dpa/comprenhensive_tables/index.cfm; & National Energy Board (2008). *Energy Overview.* Retrieved August 8, 2008, from Canadian Energy Board Web site: www.neb.gc.ca/clf-nsi/rnrgynfmtn/nrgyrprt/nrgyvrvw/cndnnrgyvrvw2007/cndnnrgyvrvw2007-eng.html-182k-

[75] The Region of Peel (2008). *Corporate Overview.* Retrieved May 11, 2008, from Region of Peel Web site:http://www.region.peel.on.ca/overview.htm

57,050; and Mississauga (9.1%) 612,925 to 668,549[76]. The Region's population is projected to increase between 2006 and 2031, by (25.86%) 337,000 to 1,571,000[77].

Table 3: Population Forecasts 2001-2031

Year	Mississauga	Brampton	Caledon	Unallocated portion	Peel
2001	(61.98%) 612,925	(32.9%) 325,428	(5.12%) 50,595		988,948
2006	(57.66%) 668,549	(37.42%) 433,806	(4.92%) 57,050		1,159,405
2031	(46.55%) 730,000	(44.32%) 695,000	(5.35%) 84,000	(3.76%) 59,000	1,571,000*

Note: Totals from Mississauga, Brampton and Caledon for 2031 do not add up to Peel's total due to rounding.
* This figure includes the 'Unallocated' portion of the forecasts of 59,000 (3.76%), which represents growth that is expected to happen in Peel between 2020 and 2031.
Source: Region of Peel, Peel Data Centre Population Forecasts 1971 to 2006 and 2001 to 2031

Employment showed a corresponding growth in Peel between 2001 and 2006, increasing by 103,000 (19.3%) from 534,000 to 637,000 as shown in Table 4. In 2001, Mississauga's share of employment was 382,000, (71.5%), Brampton 134,000 (25.1%) and Caledon 18,000 (3.4%). By 2006, Mississauga's employment increased by (14.2%) to 436,000, while both Brampton and Caledon registered strong growths of (32.1%) 177,000 and (33.3%) 24,000 respectively. Peel's employment is projected to increase between 2006 and 2031, by (36.4%) from 637,000 to 869,000[78]. Over the same period employment in Mississauga is projected to decrease by 14.2% in contrast to Brampton's increase of over 10%, and a slight increase of 0.9% in Caledon.

Table 4: Employment Forecasts 2001-2031

Year	Mississauga	Brampton	Caledon	Peel
2001	(71.5%) 382,000	(25.1%)134,000	(3.4%) 18,000	534,000
2006	(68.4%) 436,000	(27.8%) 177,000	(3.8%) 24,000	637,000
2031	(57.3%) 500,000	(35.7%) 310,000	(4.3%) 37,000	869,000*

Note: Totals from Mississauga, Brampton and Caledon may not add up to Peel's total due to rounding
*This figure includes the 'Unallocated' portion of the forecasts of 14,000 (2.7%), which represents growth that is expected to happen in Peel between 2021 and 2031.
Source: Peel Data Centre - Region of Peel: Employment Forecasts 2001 to 2031

As growth has been occurring, so is the demand for energy – electricity and natural gas for residential, commercial and industrial heating and lighting, and fuel for transportation and the petro-chemical industry. The three main electricity Local Distribution Companies (LDCs) in Peel are (Enersource) in Mississauga, and (Hydro One Brampton Networks Inc.) in Brampton and Hydro One in Caledon. They are responsible to provide safe, reliable, efficient delivery of electricity within their LDC's service area while being accountable to their shareholders.

[76] The Region of Peel, Peel Data Centre, Population, *Land Area and Density* (2001) and (2006) Censuses; and, MMAH (2006) *Growth Plan for the Greater Golden Horseshoe*, Schedule 3: Distribution of Population & Employment for the Greater Golden Horseshoe 2001-2031, p 47
[77] The Region of Peel (2008). *Population 1971to 2006 & Population Forecasts 2001to 2031.* Retrieved June 22, 2008, from Peel Data Centre Web site: http://www.region.peel.on.ca/planning/pdc/data/census/population-1971-2001.htm; and http://www.region.peel.on.ca/planning/pdc/data/forecasts/population-2001-2031-htm
[78] The Region of Peel (2007). *Employment Forecasts 2001-2031.* Retrieved April 5, 2008, from Peel Data Centre Web site: http://www.peelregion.ca/planning/pdc/data/forecasts/employment-2001-2031.htm

Table 5: Ontario Energy Board 2006 Yearbook of Electricity Distributors in Peel

Electricity Distributors As at December 31, 2006	Enersource Hydro Mississauga Inc.	Hydro One Brampton Networks Inc.	Hydro One Caledon
General statistics			
Population served	700,000	433,806	57,050
Total customers	182,596	120,364	17,765*
Residential customers	161,749	111,597	na
General Service <50kW Customers	16,452	7,234	na
General Service >50kW Customers	4,386	1,529	na
Large User (>5000kW) Customers	9	4	na

*Figure obtained from StatsCan, 2006 Census
Source: Ontario Energy Board, 2006 Yearbook of Electricity Distributors, August 31, 2007

The number of electricity distribution customers in Mississauga increased by over 62.0% (68,940) from 112,702 in 1988 to 182,596 in 2006[79]. There were a total of 120,364 electricity distribution customers in Brampton in 2006[80], and 17,765 in Caledon. Table 5 provides a breakdown of electricity distribution customers in Peel in 2006.

In 2006, the total electricity generated in Canada from fossil fuels was 38,389 GigaWatt hours[81]. Total energy demand in Canada in 2006 was 7,643 petajoules. Total energy demand for the same period in Ontario was 2,604 petajoules, accounting for just over 34% of Canada's entire energy demand[82]. Growth in peak electricity demand in the province has outstripped increases in supply, to the extent that the province is experiencing situations when peak demand threatens to exceed the available supply of reliable, reasonably priced capacity. Exacerbating this problem is the need to replace or refurbish a significant portion of the province's aging generating facilities over the next 5-15 years. The issue of addressing new supply is urgent, and actions that reduce base and peak demands, in an economic manner without adversely affecting the provincial economy, have been initiated[83].

At the provincial scale, Hydro One Networks Inc. is developing transmission solutions to meet Ontario's growing electricity needs and has divided the province into four zones: Northern, Eastern, Western and Central. The Central zone consists of Toronto and Regions[84]. The Central zone accounts for "more than 10,000 MW of load, or 40 per cent of the province's total load. In order to supply this much electricity, the electrical system in the GTA includes three major connection points between the 500 and 230 kV systems, with another currently under construction[85].

[79] Enersource Corporation, Mississauga (2006) Annual Review, *'Committed to Delivering'*, p 9; see also, Ontario Energy Board (OEB) (2007) 2006 Yearbook of Electricity Distributors, p 64
[80] OEB (2007) 2006 Yearbook of Electricity Distributors, p 66
[81] Statistics Canada (2006). *Report on Energy Supply-demand in Canada, Table 8-1: Electricity generated from fossil fuels.* Retrieved April 5, 2008, from Statistics Canada Web site: www.statcan.ca/english/freepub/57-003-XIE/2006000/t131_en.htm-16k-
[82] *Energy supply and demand.* Retrieved April 5, 2008, from Statistics Canada Web site: www.statcan.ca/Daily/English/071220/d071220a.htm-30k-;
[83] Ontario Energy Board (2003). *Electricity demand in Ontario.* Retrieved April 5, 2008, from Ontario Energy Board Web site: www.oeb.gov.on.ca/documents/directive_dsm_HydroOne211103.pdf
[84] For transmission planning purposes, the GTA includes the City of Toronto plus a ring of suburban communities, including Oakville, Mississauga, Brampton/Caledon, Richmond Hill, Vaughan, Markham, Aurora, Newmarket, Pickering, Ajax, Whitby and Oshawa.
[85] Hydro One Networks (2003). *10 Year 2005 combined.* Retrieved April 5, 2008, from Hydro One Networks Web site: hydroonenetwork.com/en/about/10-Year_Plan_Section02.pdf, pp 22-34

Electricity demand in Ontario is projected to grow at an average rate of about 1% per year over the next 10 years and the Central zone is expected to have a higher growth of about 5% annually for some municipalities in the western GTA area such as Brampton. This high rate of electrical load growth can be attributed to the strong economic growth in this area, residential growth in many communities and the continued strong performance of petrochemical, automotive and other manufacturers. As can be seen in Diagram 2, a 500 kV transmission corridor that connects Nanticoke Generating Station (GS) and Bruce GS to the 500 kV transmission stations at Milton Transformer Station (TS), Trafalgar TS and Claireville TS supplies the area. There is also a 230 kV corridor that runs from Burlington TS to Richview TS, just southeast of Pearson International Airport between Mississauga and Toronto.

In line with its policy to shut down five coal-fired plants in the Province for health and environmental reasons, the government retired the 1,200 MW Lakeview Generating Station coal-fired facility located in southern Mississauga in April 30, 2005. Lakeview GS was the first fossil-fuel station to be shut down as the result of an environmental mandate by the provincial government. It is estimated that around $5 billion in new generating capacity will be needed and that "[A]ggressive conservation measures and a growth in independent generation, including from renewable sources" would play a vital role in meeting future demand[86]

Diagram 2: Hurontario Station and Line Extensions

Source: IESO and OPA, Ontario's Integrated Power System Plan, Discussion Paper 5: Transmission, Nov. 2006

[86] National Round Table on the Environment and the Economy (NRTEE), Economic Instruments for the Long-term Reductions in Energy-based carbon Emissions, 2005, p 16

There are also several smaller private generators in the area including the Peel Waste Recovery GS- Algonquin Power (10 MW) and the cogeneration TransAlta McDonnell Douglas GS (110 MW) at Toronto's Pearson International Airport designed for very low stack gas exit temperatures[87].

There are a number of natural gas suppliers and independent natural gas marketers in Peel with Enbridge Gas Distribution as the main supplier. Enbridge supplies natural gas to about 1.8 million residential, commercial, and industrial customers across Ontario. Natural gas produces fewer greenhouse gases and less smog-forming pollutants than other fossil fuels, and Natural Resources Canada estimates that there are known natural gas reserves in North America, to meet demand for at least, the next 70 years at current consumption rates and under current policies[88].

2.4.1 Gasoline and petroleum products

The demand for gasoline and petroleum products has increased steadily over the past 20 years as vehicle ownership continues to increase rapidly. However, Ontario produces less than one per cent of its oil requirements and is dependent for its supplies either from Western Canada or other sources. The price of gasoline is dependent on the cost of crude oil in the global market, and on the balance between supply and demand over the long term. Since Canadian oil prices were deregulated in 1985, oil prices in Canada have been determined by international market conditions[89]. It is important to note that gasoline prices at any given time reflect not only the price of crude oil, but also other factors such as local market conditions, inventory levels and government taxes. The large oil and gas companies developing energy resources and providing petroleum products and services in Peel include Petro-Canada, Shell, Imperial Oil and Sunoco.

2.5 PEEL'S CORPORATE ENERGY MANAGEMENT (CEM) DIVISION

The Region of Peel is mandated to manage the Region's energy portfolio and Corporate Energy Management (CEM) Division has responsibility to implement the energy plan in a financially responsible and sustainable manner, while promoting the wise use of energy to maintain a healthy environment[90]. In this regard, CEM has been playing a pivotal role in managing the Region's modern energy needs and has responsibility for fostering a healthy, clean environment centred on the development of a culture of conservation. In order to meet this challenge, CEM's approach is based on the principles of sound financial planning, maximizing Regional partnerships and helping to develop sustainable communities. CEM serves as the champion in accomplishing the Region's need for reliable and cost effective energy supply and management while positioning the Region of Peel as a leader in energy efficiency.

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[87] Hydro One Networks (2005). *Transmission Needs and Solutions.* Retrieved April 25, 2008, from Hydro One Networks Web site: www.hydroonenetworks.com/en/about/10-Year_Plan_Section02.pdf-

[88] Ministry of Finance (2007). *Energy & Utilities.* Retrieved April 4, 2008, from Ontario Facts Web site: www.2ontario.com/facts/fact15.asp-41k-

[89] Ministry of Energy and Infrastructure (2008). *Oil and Gas.* Retrieved April 4, 2008 from Fuelling Ontario Web site: (www.energy.gov.on.ca/index.cfm?fuseaction=oilandgas.faqs&subtopic=gaspricing-31k-) International agreements such as the North American Free Trade Agreement (NAFTA) prevent governments from requiring that domestic suppliers favour domestic customers. Consequently, Canadian producers must offer their crude oil to our trading partners on the same terms they offer to Canadian refiners.

[90] The Region of Peel (2008). *Corporate Energy Management Plan.* Retrieved June 22, 2008, from Corporate Energy Web site: www.region.peel.on.ca/finance/corp-energy/environment/-23k-

CEM is collaborating with other departments at Peel and the area municipalities to set energy efficiency standards and procedures and to ensure that the Region remains up-to-date with the latest in energy efficient technology. CEM continues to conduct extensive research and have prepared and released the Council endorsed *Energy Management Plan* in early 2008. This Plan focuses on the theme of sustainability and stresses not only the need for reducing energy consumption, but also consuming energy differently. "This includes improving energy efficiency, minimizing waste, adopting a lifecycle perspective on our actions, reducing emissions and integrating these principles into every aspect of our performance[91]. Other ongoing research and development efforts being conducted by the division include investigations into renewable energy sources such as solar power, wind energy and bio-mass systems, with the aim of reducing greenhouse gas emissions and contributing to a cleaner, healthier environment for Peel.
Corporate Energy has been involved in a variety of activities which include energy efficiency audits, building retrofits, exploring opportunities for renewable energy, bio-fuel generation, demand reduction programs and providing general advisory services to all internal departments. The Region's first solar photovoltaic system (11 Kilowatts) went into operation at Clarkson Waste Water Treatment Plant in March 2008. The Solar Flairs™ require very little maintenance and will last approximately 35 years[92].
CEM obtains contracts with utility suppliers and purchases energy for the Region through a mechanism that reduces financial risk, saves money and ensures stable energy costs for future years. In the past four years, the Region of Peel has reduced $14.6 million from its energy costs through conservation measures, reviewing all energy costs and bills, and exercising cost avoidance measures in how it purchases its energy commodities[93]. CEM also uses an innovative "real time" energy tracking technology to measure the energy consumption of various Regional facilities. This data tracker is critical in that the information:

- Helps monitor energy use for opportunities to reduce consumption through efficiency and retrofit projects.
- Helps build consumption profiles for different Regional facilities so that any unexpected or adverse changes in energy use can be investigated.

Reducing expenses through "Real Time" Energy Tracking is achieved by the use of Smart Meter Technology that provides accurate, measurable information, which can be used to enhance the Region's energy management and ensures the best in operating practices and cost savings.

Smart Meters similarly provide electricity consumers the choice to save by letting residents and business owners actually see when electricity demand is low and prices are lower. Consumers who choose to shift their energy use to "off peak" hours when both demand and prices are lower, can save money and help the environment. The Provincial government intends to install 800,000 smart electricity meters by December 31, 2007 and have all Ontario electrical consumers including new developments, outfitted with smart meters by December 31, 2010. As this initiative rolls out, the pricing system of electricity will also change, with the price of electricity shifting throughout the day based on demand.

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[91] ibid.
[92] The Mississauga News (2008). *Sustainable Energy Blooms in Clarkson.* Retrieved, August 29, 2008, from The Mississauga News Web site: http://www.mississauga.com/article/16570

[93] Enersource Hydro Mississauga (2008). *Sustainable Energy Blooms in The Region of Peel.* Retrieved August 29, 2008, from Enersource Web site: http://www.enersource.com/HM/PressReleases.aspx?id=882

The utility bill validation and payment for Regional facilities is part of the division's energy efficiency audits. CEM maintains a complete database of Regional energy accounts that contain all historical and current energy bills. The bill validation and bill verification services ensure that Regional facilities are charged correctly for their energy consumption.

The division also fulfils a principal role of providing advisory services to other Regional departments with up-to-date information about energy efficiency practices, renewable energy technology and energy and environmental standards that can be applied to new building designs or to existing buildings through upgrades. Another major responsibility of CEM is speaking at various conferences and workshops on energy initiatives currently being undertaken by the Region of Peel. In terms of engagement with the community, CEM continues to work closely with a number of energy oriented organizations and hosts meetings for staff from other municipalities and the commercial/industrial sector to share ideas and best practices in energy management and reduction. CEM has organized a series of annual Energy Summit Conferences that have attracted energy experts from within Canada and abroad to address a variety of emerging public sector energy issues and challenges and to advance solutions in resolving them. In April 2008, CEM organized the Energy Matters Summit on the theme of *"Leadership in the Public Sector: Shifting Mindsets Toward Sustainability".* This conference focused on the cultural challenges of shifting mindsets and speakers from municipalities across Canada, the U.S. and Europe shared their experiences on best practices towards sustainability and strategies to build green communities and build upon environmental stewardship[94].

In 2007, the Region launched the *'Conservation Peel Web site'.* This initiative underscores the strong connections between earth, air, energy and water, and is geared towards managing Peel Region's energy use, enhancing energy and cost savings, and improving the environment. To accomplish this, CEM monitor's the Region's energy use, helps set energy efficiency standards, uses renewable technologies and works with our community and staff to promote conservation[95].

Corporate Energy, through the Conservation Peel Website enables residents of Peel Region to have the tools necessary to conserve energy at home, at work and on the road. The division offers practical and convenient energy reduction tips that could promote a healthier, cleaner environment.

In concluding this section, reference is made to the work of the National Round Table on the Environment and the Economy (NRTEE). Interest in renewable energy systems and energy conservation has grown markedly in recent years due to steadily rising energy costs, dwindling fossil fuel resources and increased concern for environmental protection. Efforts underway in the province and the other levels of government, indicate a significant policy shift to reflect these emerging realities, provide strategic leadership and promote proactive responses in a responsible and concerted manner to mitigate adverse health, social, economic and environmental impacts.

The National Round Table on the Environment and the Economy (NRTEE), an energy research and development group in Canada, has noted that,

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[94]The Region of Peel (2008). *Energy Matters.* Retrieved June 22, 2008, from Energy Matters Summit Web site: www.region.peel.on.ca/news/archiveitem.asp?year=2008&month=2&day=28&file=2008228b.xml-23k-

[95]The Region of Peel (2008). *Energy.* Retrieved June 22, 2008, from Conservation Peel Web site: http://www.peelregion.ca/conservation/programs/energy.htm

> "Drivers for past shifts to new energy sources have been affordable energy, quality of energy, ease of use, reliability, regional security of supply, desire for decentralized generation and other non-ecological factors. Climate change considerations have not been a main driver for energy technology change and will not be—unless consideration of long-term carbon emission reductions is given greater priority in energy policy than it has up to this point[96]."

Energy generation, supply, distribution and demand are increasingly no longer business as usual, and energy policies and mandates are being formulated to meet the various challenges and opportunities presented by this major paradigm shift. The following section will consider various policy approaches to dealing with emerging energy issues in other jurisdictions. This is with the view of gaining knowledge of possible processes and solutions that could be employed in the PROPR.

3.0 CONNECTIONS BETWEEN ENERGY AND THE OTHER PROPR FOCUS AREAS

There are important connections between energy and some of the other fourteen focus areas being considered in this PROPR. Progress achieved in one area can have important, positive outcomes in one or more areas, and conversely, setbacks can have adverse impacts in other areas. For example, there are important linkages between energy and growth management, housing, transportation and agriculture. Also, the connection between urban design standards, subdivision design, building orientation, housing and energy use and conservation is being strongly emphasized at present. Compact, pedestrian-oriented and transit supported neighbourhoods, could contribute to reducing fossil fuel use and greenhouse gas emissions, through shorter travel trips and more efficient means of transport, thereby resulting in improvements to air quality. The Leadership in Energy and Environmental Design-Neighborhood Development (LEED-ND), and the Green Building Rating System aim to create neighbourhoods and buildings that will improve occupant well being, environmental performance and economic returns for the community using innovative technology, standards and technologies. Achieving LEED standards in one of the four levels namely, Certified, Silver, Gold and Platinum, could contribute to reducing energy use and improving the environment.

The combustion of fossil fuels in road transportation accounts for major GHG emissions. Reducing the need for transportation, especially single occupant vehicles, and using energy efficient transit systems can lower emissions. More compact people-oriented living and working places would assist in containing the majority of development within a number of interlinked, diverse and more complete communities. This would enable people to live, work and play in relative proximity without having to travel great distance. This in turn could increase transportation choices, create complete communities, and reduce sprawl.

There is a growing interest in installing wind turbines to generate energy in agricultural areas. Wind turbines can be installed on farms after completion of required feasibility studies, environmental assessment and zoning provisions, which will ensure minimal negative impacts on farming operations and nearby communities. Solar panels can be mounted in south facing unshaded locations and biomass energy can be produced from

[96] The National Round Table on the Environment and the Economy (NRTEE) (2005). *Economic Instruments for Long-term Reductions in Energy-based Carbon Emissions,* p 15

plants and organic wastes. The net benefits from these renewable energy sources include; reducing GHG emissions and demand on the provincial electricity grid, as well as providing new sources of income for farmers and strengthening or revitalizing local economies.

In the next section, the provincial policy directives will be presented against the background discussed in the preceding sections. The NRTEE has observed, "no one policy tool is optimal in its performance against the criteria of environmental effectiveness, economic efficiency, administrative feasibility and political acceptability. Therefore,

> "a portfolio of policy instruments can enable a government to combine the strengths, while compensating for the weaknesses, of individual policy instruments. Such a policy package should focus on measures that would be politically acceptable today while nonetheless influencing technological innovation[97]."

4.0 THE PROVINCIAL POLICY DIRECTIVES AND PEEL REGION OFFICIAL PLAN

The Provincial policy documents issued by the Province provide policy direction for implementing the Government's vision for building stronger, more prosperous communities in the Greater Golden Horseshoe. Municipalities including Peel Region must bring their official plans into conformity with the PPS, the Growth Plan and the Greenbelt Plan by June 2009.

The goal of the policy statements include the reduction of greenhouse gas emissions by reducing our dependency on fossil fuels and diversifying our energy generating capacity so as to ensure reliable, clean and secure energy supply, transmission and distribution to meet the growing demand. The Growth Plan for the Greater Golden Horseshoe articulates the significance of developing 'A Culture of Conservation'. It states, "As the Greater Golden Horseshoe (GGH) grows, so will the overall demand for water, energy, air, and land. The ongoing availability of these natural resources is essential for the sustainability of all communities". This Plan recognizes and supports the role of municipal policy in providing leadership and innovation in developing a culture of conservation[98]. Municipalities thus have the mandate to manage land-use patterns and urban design standards that encourage and support energy-efficient buildings and opportunities for developing renewable energy systems and alternative energy systems. Additionally, they have the responsibility to protect and conserve water, energy, air and cultural heritage, as well as to undertake integrated approaches to waste management.
The Region of Peel like most other jurisdictions, is currently, largely dependent on fossil energy sources – coal, petroleum and natural gas for home heating and electricity and fuel for automobiles and mass transportation, as well as industry. The policy directives on energy contained in the Provincial Policy Statement and Places to Grow Plan call for significant policy shifts in energy generation, supply and efficient use, as well as the conservation of energy. The directives are presented below.

[97] ibid. p 90
[98] MMAH (2006). The Growth Plan for the Greater Golden Horseshoe, p 30

#1 The Provincial Policy Statement under section 1.8.1 directs that **"Planning authorities shall support energy efficiency and improved air quality through land use and development patterns"** by promoting a number of functions and actions, which call for fundamental changes to certain existing procedures and practice.

- Promote compact form and a structure of nodes and corridors;
- Promote the use of public transit and other alternative transportation modes in and between residential, employment (including commercial, industrial and institutional uses) and other areas where these exist or are to be developed;
- Focus major employment, commercial and other travel-intensive land uses on sites which are well served by public transit where this exists or is to be developed, or designing these to facilitate the establishment of public transit in the future;
- Improve the mix of employment and housing uses to shorten commute journeys and decrease transportation congestion; and
- Promote design and orientation which maximize the use of alternative or renewable energy, such as solar and wind energy, and the mitigating effects of vegetation.

- Given that the energy industry is extremely complex and dynamic, what are the main considerations that should guide the process of analyzing choices in formulating Official Plan energy policies and what are the implications?
- How could the Regional Official Plan support energy efficiency and improved air quality through land use and development patterns?
- How could the Regional Official Plan create an efficient and diversified energy sector that achieves sustainable economic development, in balance with high social and environmental standards?
- How could the Region build upon its existing planning policies to accomplish the objectives listed above?

#2 The Provincial Policy Statement under section 1.8.2 directs that **"Increased energy supply should be promoted by providing opportunities for energy generation facilities to accommodate current and projected needs and the use of renewable energy systems and alternative energy systems, where feasible".**

Forms of renewable energy systems include solar and wind energy generation, geothermal, district heating, micro hydro, biomass and biofuels for transportation.

- Recognizing that renewable energy systems currently account for a very small percentage of energy supply, how could the Regional Official Plan contribute in optimizing the use of the largely untapped renewable energy sources and what are the policy implications?
- How could the Regional Official Plan promote and provide opportunities for energy generation facilities to accommodate current and projected needs, and encourage the use of renewable energy systems and alternative energy systems, where feasible?
- How could the Region deal with the need for conventional energy generation capacity and protection of rights-of-way for transmission lines?

#3 The Provincial Policy Statement under section 1.8.3 directs that **"Alternative energy systems and renewable energy systems shall be permitted in settlement areas, rural areas and prime agricultural areas in accordance with provincial and federal requirements. In rural areas and prime agricultural areas, these systems should be designed and constructed to minimize impacts on agricultural operations".**

- How could the Regional Official Plan make certain that alternative energy systems and renewable energy systems are permitted in settlement areas, rural areas and prime agricultural areas and what are the policy implications?
- How could the Regional Official Plan ensure that the alternative energy systems and renewable energy systems to be designed and constructed in the rural and prime agricultural areas would minimize impacts?

4 **With regard to 1.1.3 Settlement Areas, the Provincial Policy Statement under section 1.1.3.1 directs that "Settlement areas shall be the focus of growth and their vitality and regeneration shall be promoted".**

1.1.3.2 Land use patterns within settlement areas shall be based on:
a) densities and a mix of land uses which:
1. efficiently use land resources;
2. are appropriate for, and efficiently use, the infrastructure and public service facilities which are planned or available, and avoid the need for their unjustified and/or uneconomical expansion; and
3. minimize negative impacts to air quality and climate change, and promote energy efficiency in accordance with policy 1.8 [Energy and Air Quality]; and
b) a range of uses and opportunities for intensification and redevelopment in accordance with the criteria in policy 1.1.3.3.

- How could the Regional Official Plan provide opportunities for increased energy generation, supply and conservation, including alternative energy systems and renewable energy systems?
- How could the Regional Official Plan promote the growth, vitality and regeneration in settlement areas?
- How could the Region's Official Plan build upon existing planning policies to accomplish the policy objectives listed above?
- What are the policy implications?

#5 The Provincial Policy Statement in 1.6.5.1 directs that **Transportation systems should be provided which are safe, energy efficient, facilitate the movement of people and goods, and are appropriate to address projected needs.**

- How could the Regional Official Plan ensure that transportation systems to be provided would be safe, energy efficient and appropriate to facilitate the movement of people and goods at the present time and in the future?
- What are the policy implications?

#6 The Provincial Policy Statement in 1.7.1 directs that **Long-term economic prosperity should be supported (among other things) by: Providing opportunities for increased energy generation, supply and conservation, including alternative energy systems and renewable energy systems.**

- How could the Regional Official Plan provide opportunities for increased energy generation, supply and conservation, including alternative energy systems and renewable energy systems?
- As a leader in energy efficiency, how could the Region's Official Plan promote the conservation of the Region's environment and enhance the quality of life of its citizens?
- How could the Regional Official Plan provide policy guidelines that would ensure that the Region has long-term reliable energy sources at competitive prices to support sustainable economic development, community requirements and industrial usage?
- What incentives can be created to improve efficiency and promote conservation in the production and consumption of electricity, heating fuels, and transportation fuels?

The following section provides a brief description of energy indicators and targets in determining progress towards achieving energy conservation at present and in the future.

4.1 Energy indicators and targets for sustainable development

Energy indicators and targets for sustainable development are important as they provide specific and consistent sets of quantifiable parameters that can be used to effectively measure and monitor important changes and significant progress towards achieving energy conservation at present and in the future. As a first step, it is necessary to identify and define the set of indicators for sustainable energy development and secondly, to demonstrate the practical relevance and value of the parameters as a policy tool for analytical purposes.

It is generally recognized that the provision of adequate and affordable energy services, in a secure and environmentally benign manner, and in conformity with social and economic developmental needs, is an essential element of sustainable development. However, much of the world's energy is currently produced and consumed in ways that could not be sustained if technology were to remain constant and if overall quantities were to increase substantially[99].

Social and environmental indicators signify measures of progress concerning air pollutant emissions from energy systems and distinguish between desirable and undesirable energy consumption trends. Indicators could guide policy decisions on investments in energy, pollution control and industry. The use of indicators could also address issues of external costs, which are often difficult to quantify. Energy markets internalize certain 'external costs'. However, some externalities such as, ill health, environmental damage and decline in property values caused by oil refineries, power

[99] See, Corporate Energy Management, (2007). The Ninth Session of the UN Commission on Sustainable Development (CSD), (2001); World Summit on Sustainable Development (WSSD), (2002); Energy Indicators for Sustainable Development: Guidelines and Methodologies, 2005; The United States Energy Information Administration Interoffice Issues Group (IIG) - Key Energy Indicators Subgroup (KEIS), (2007).

lines and other energy facilities are difficult to internalize and unavoidably, have to be borne by society. "By quantifying energy intensity [i.e. the ratio of energy consumption to demand for energy services], accidents per unit of energy and environmental consequences per unit of energy, indicators can permit comparative assessment of alternatives and strategies, and help policymakers to decide on appropriate measures, including penalties or subsidies, to promote efficient and sustainable energy development[100]".

There are several measures Peel Region can consider when setting energy indicators and targets for sustainable development and in determining the direction it intends to follow to ensure that the objectives are successfully met. Firstly, the Region could take the initiative and demonstrate through leadership, by setting conservation and sustainability targets that are measurable, with results and progress posted publically on its website.

Secondly, the Region's Official Plan could set practical and verifiable energy consumption and pollution emission targets and indicators that reduce consumption of fossil fuels, increase energy efficiency and the use of renewable green energy, and improve overall environmental quality, energy conservation and peoples' quality of life.

Thirdly, the Region could explore opportunities to register with the International Organization for Standardization ISO 14001 standard. "ISO 14001 is an internationally recognized standard of excellence for environmental management systems. Organizations which achieve registration status know how to improve environmental performance, minimize harmful effects on the environment, comply with environmental regulations and legislation and continuously improve upon their practices." The ISO 14001 standard can provide the Region with the framework for how to manage the environmental aspects of its business activities more efficiently and effectively[101].

The Town of Richmond Hill is the first municipality in Ontario to have its entire Engineering & Public Works Department registered to the International Organization for Standardization ISO 14001 standard. Certification to the ISO 14001 Environmental Management System offers benefits which include, increased health for citizens and the natural environment, environmentally sustainable businesses and overall economic development[102].

Fourthly, the Region could explore opportunities to incorporate and use the environmental management system 'ecoBUDGET' to steer and follow up the environmental targets and environmental work in the municipality. The concept of environmental budgeting emerged from the definition of sustainable development and is designed with the principal aim to manage natural resources with the same efficiency as the financial resources. The system replicates the financial budget system. The traditional accounting system is complemented with an ecological accounting system, in which physical environmental quantities are measured instead of money. The system includes environmental objectives both within the municipal organization and the

[100] International Atomic Energy Agency (2005). *Energy Indicators for Sustainable Development.* Retrieved June 22, 2008, from IAEA Web site: http://www-pub.iaea.org/MTCD/publications/PDF/Pub1222_web.pdf-
[101] Government of Canada (2006). *ISO Environmental Management.* Retrieved August 29, 2008, from Canadian General Standards Board Web site: http://www.tpsgc-pwgsc.gc.ca/cgsb/pubs/broch/brochure_11225_ISO-e.html
[102] Town of Richmond Hill (2008). *International Organization for Standardization ISO 14001 Certification.* Retrieved August 29, 2008, from Town of Richmond Hill Web site: http://www.richmondhill.ca/subpage.asp?textonly=&pageid=epw_environment

municipality area. ecoBUDGET is a flexible system with few restrictions and follows the management cycle of "plan – do – check – act". ecoBUDGET allows environmental priorities within the principles of sustainable development to be determined, enables municipalities to implement the ecoBUDGET concept, monitor progress achieved against environmental plans, and to communicate the results to the general public. The ecoBUDGET year has three phases. The first is to establish and adopt the environmental budget. Next step is to implement the planned measures to achieve the budget. The final phase is to balance the environmental annual account[103].

A growing number of local governments for example, Nordhausen and Bielefeld (Germany), Bologna (Italy), Växjö (Sweden), Guntur (India) and Tubigon, Bohol, (Philippines) are integrating environmental budgeting as a strategic aid to setting targets in planning, and implementing ecoBUDGET as an instrument to good local resource management and governance[104].

The City Council of Växjö in Sweden adopted a new environmental program in 2006, based on the ecoBUDGET, which is the steering document for environmental issues. The program focuses on three profile areas which deal with consumption and waste issues, water and nature conservation issues, transport and energy issues. There are 16 environmental objectives in the program which the environmental management system ecoBUDGET steer and follow up. Every year the city council adopts an economic and ecologic budget. The 16 environmental objectives are budgeted in the municipality annual ecological budget[105].

5.0 THE PROPR ENERGY CONSULTATION PROCESS

5.1 Background

Public consultation forms part of the PROPR process as it allows for a range of concerns and concepts to be critically discussed before decisions are reached. Consultation also provides staff and our key stakeholders a better understanding of the challenges facing the energy sector and the opportunities available, and helps to advance the policy review process.

Stakeholders being consulted include Peel Corporate Energy Management Division, Area Municipalities, Ministry of Energy, Ministry of Municipal Affairs and Housing, Natural Resources Canada, Ontario Power Authority (OPA), Canadian Urban Institute (CUI), Sustainable Urban Development Association (SUDA), Canada Mortgage and Housing Corporation (CMHC), Canada Green Building Council (CaGBC), Social Housing Services Corporation (SHSC) Local Distribution Companies (LDCs) and Non Governmental Organizations (NGOs).

The Region has held the following meetings to date:

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[103] Växjö *kommun (2007). ecoBUDGET.* Retrieved August 29, 2008 from City of Växjö Web site: http://www.vaxjo.se/vaxjo_templates/Page.aspx?id=1665; see also, Destiny (2001). *Decision support system for local sustainable development based on eco-budget methodology.* Retrieved August 29, 2008, from istworld Web site: http://www.ist-world.org/ProjectDetails.aspx?ProjectId=4a8f04161b9245069394e13fc9ddbdcd

[104] International Council for Local Environmental Initiatives (2008). *Local Governments for Sustainability*. Retrieved from ICLEI Web site; http://cities21.com/index.php?id=7118; http://www.iclei.org/index.php?id=global-about-iclei

[105] Växjö *kommun (2007). ecoBUDGET*. Retrieved August 29, 2008 from City of Växjö Web site: http://www.vaxjo.se/vaxjo_templates/Page.aspx?id=1665.

- Regional Council PROPR public meeting, February 15, 2007
- Key Energy Stakeholders meeting, June 19, 2007
- PROPR Energy Workshop, January 28, 2008
- PROPR Public Open Houses, Mississauga, Brampton and Caledon, February-March, 2008

In addition to the above, the following are upcoming consultations:

- Focused consultation meeting, Fall 2008
- Workshop, Fall 2008

Details of the consultations held so far are provided in Appendix I.

6.0 THE ENERGY GOVERNANCE STRUCTURE IN ONTARIO

The Federal and Provincial governments have the main responsibilities to formulate energy policies and regulations in Canada. Organizations such as OPA, Hydro One Networks Inc., are mandated to undertake specialized functions - electricity supply, transmission and distribution in Ontario.

6.1 The Federal Government

Natural Resources Canada (NRCan) works to ensure the responsible development of Canada's natural resources, including energy, forests, minerals and metals. NRCan develops policies and programs that enhance the contribution of the natural resources sector to the economy and contributing to a healthier environment. NRCan's Office of Energy Efficiency (OEE) is charged with the responsibility to provide information for energy conservation, energy efficiency and alternative fuels, and with the assistance of the National Advisory Council on Energy Efficiency, identifies opportunities for new energy efficiency measures.

The OEE manages the Government of Canada's new ecoENERGY Efficiency Initiative to reduce energy use in buildings and houses, industry, retrofits, personal vehicles and fleets, as well as to promote other energy-efficient transportation choices. The OEE also provides practical energy conservation advice to various energy end users, and provides information about developments in technology that can conserve fossil fuels or support the transition to less carbon-intensive energy sources, including renewable energy[106].

NRCan also promotes regional residential energy efficiency initiatives that set up guidelines and building standards for homebuilders to meet, so that they can reach a minimum EnerGuide rating. These initiatives enable builders to create homes that are consistently more energy efficient. Homes built according to the initiative's specifications are awarded a certificate and/or home label that identifies the home as being built to the regional energy efficiency standard. Moreover, NRCan encourages energy conservation and the development of sustainable decentralized energy systems such as solar power, micro-hydro and wind power, by providing Green Energy technologies information for use in residential buildings and in the business sectors. NRCan provides Green Energy services and tools to architects, builders, current and future home owners, building

[106]The Office of Energy Efficiency (2008). *ecoEnergy Efficiency.* Retrieved April 25, 2008, from Natural Resources Canada Web site: www.oee.nrcan.gc.ca

managers, Green Energy suppliers and professionals, as well as public administrators who act in the areas of energy, buildings and climate change[107].

6.2 The Ontario Ministry of Energy

The Ontario government is committed to ensuring a reliable, sustainable and diverse supply of competitively priced power for the province, while promoting energy conservation. The government is also committed to increasing the province's renewable energy capacity. In 2004, the government set two renewable energy targets: to obtain an additional 5 per cent (1,350 megawatts) of our overall generating capacity from renewable sources by 2007 and 10 per cent (2,700 megawatts) by 2010. The government initiated a series of renewable energy Requests for Proposals (RFPs) and by the end of 2005, had contracted for over 1,300 megawatts of clean renewable energy from wind, water, landfill gas and biogas projects. To date, the Province has entered into agreements to purchase power from 19 new renewable energy projects, including 3 waterpower projects, 3 landfill gas and biogas projects and 13 wind farms for a total of 1,370 MW of clean, renewable electricity – enough to power 350,000 homes[108].

The government is working to remove renewable energy barriers and increase renewable opportunities through a number of initiatives. For example, the Ontario Wind Resource Atlas assists large and small wind developers to identify potential sites for future wind energy development. The Ministry of Energy and the Ministry of Natural Resources are working together to make Crown lands accessible to economic waterpower, and the government's RFP have been harmonized with the site release program of the Ministry of Natural Resources to maximize opportunities for waterpower. To encourage more solar installations, a Provincial Sales Tax Rebate is available on all solar equipment sold in Ontario[109].

The government has also initiated a number of programs and funding opportunities such as Local Authority Services (LAS), Municipal Eco Challenge Fund and Lightsavers Pilot Programs to work collaboratively with organizations and agencies including municipalities.

LAS provides a variety of services and products and its Energy Services Division focuses on helping municipalities save money, energy, and the natural environment through energy efficiency, conservation and demand management (CDM), and generation programs. LAS administers the Audit++ aimed at identifying operational best practices, opportunities for energy efficiency projects, and local capacity building, and the Energy Management Tool (EMT) allows municipalities to profile and compare facility performance, measure and verify savings from energy conservation projects, reduce operational costs and improve processes, and meet corporate environmental stewardship goals including greenhouse gas (GHG) reductions. Other programs conducted by LAS include initiatives to develop Effective and usable benchmarks to

[107] Government of Canada (2007). *Connect to companies, technologies and abundant opportunity.* Retrieved April 25, 2008, from Clean Energy Web site: http://www.cleanenergy.gc.ca/
[108] Ministry of Energy and Infrastructure (2008). *Electricity.* Retrieved April 25, 2008, from Building Ontario's Energy future Web site: http://www.energy.gov.on.ca/index.cfm?fuseaction=english.electricity,
[109] Ministry of Energy and Infrastructure (2007). *Targets and Progress.* Retrieved April 20, 2008, from Cleaner, Greener Energy Web site: http://www.energy.gov.on.ca/index.cfm?fuseaction=renewable.targets

enable municipalities to develop Energy Management Plans, Streetlight Retrofit Service: Research and Development and Wastewater Profile Modeling[110].

The Municipal Eco Challenge Fund (MECF) is a new $20-million grant program designed to help municipalities undertake infrastructure projects that will conserve energy and reduce greenhouse gas (GHG) emissions. The fund is split into two application streams: standard retrofit projects and showcase/demonstration retrofit projects. The Standard Audit and Retrofit Projects help municipalities "green" their building stock, through a grant program designed to cut both energy costs and environmental impacts through standard audit and retrofit measures. The Showcase/Demonstration Projects help municipalities cut their energy costs and reduce their environmental impact by exploring leading edge green building technologies. Showcase projects will help highlight new, innovative energy efficient technologies that are not “typical” and not commonly used – such as using light-emitting diode (LED) for general office ceiling lighting. Municipalities can apply for a grant to cover up to 25 per cent of retrofit costs, up to a maximum of $100,000 and up to 50 per cent of “showcase” retrofit costs, to a maximum of $500,000 in grants through Ontario's $20-million Municipal Eco Challenge Fund[111].

The purpose of the Advancing Low-Carbon Lighting LightSavers program is to stimulate market transformation for outdoor lighting, to increase efficiency and reduce emissions through the deployment of new technology, such as the use of (LED) lamps and intelligent lighting system controls. These technologies could reduce emissions associated with tasks such as street, park and parking area lighting by up to 70 percent. LightSavers will combine grants, green procurement, innovative financing, and market research to build market awareness and advance the use of LED lamps and intelligent lighting system controls across the GTA[112].

The Ministry of Energy (MOE) has responsibility to ensure that Ontario’s electricity system functions at the highest level of reliability and productivity. Electricity supports the economy, infrastructure and our way of life, and provides a sound basis for investment, employment and community development. The Ministry also encourages the development of new ideas and technologies in the energy sector and is committed to protecting the environment and in developing renewable sources of energy, cleaner forms of fuel, as well as fostering a conservation culture[113]. The MOE has oversight over a number of agencies and corporations, which will be considered later is this section.

6.3 PEEL REGION AND AREA MUNICIPALITIES

6.3.1 The Region of Peel

The Region’s Official Plan as well as those of the area municipalities’ supports the important contributions of renewable and non-renewable resources in land use development and economic growth, and direct that such resources are utilized in a

[110] Association of Municipalities of Ontario (2008). *Local Authority Services to offer Range of New CDM Programs.* Retrieved August 9, 2008, from LAS Backgrounder Web site: http://www.amo.on.ca/AM/Template.cfm?Section
[111] Ministry of Energy and infrastructure (2008). *Municipal Echo Challenge Fund (MECF).* Retrieved August 9, 2008, from Ontario’s Energy Future Web site: www.energy.gov.on.ca/index.cfm?fuseaction=conservation.mecf-19k-
[112] City of Toronto (2008). *Advancing Low Carbon Lighting.* Retrieved August 9, 2008, from Light Savers Program Web site: www.toronto.ca/taf/lightsavers.htm-24k-
[113] Ministry of Energy and infrastructure (2006). *Conservation.* Retrieved April 20, 2008, from Fuelling Ontario Web site: www.energy.gov.on.ca/

sustainable manner to ensure their viability for future generations. Section 1.1 (Purpose of the Plan) of the Peel Region Official Plan adopted in 1996, provides "Regional Council with the long-term regional strategic policy framework for guiding growth and development in Peel while having regard for protecting the environment, managing the renewable and non-renewable resources, and outlining a regional structure that manages this growth within Peel in the most effective and efficient manner[114]". The Plan in Section 3.1.1 (Resources – Purpose), envisions that "[n]on-renewable resources will continue to be consumed for urban and economic growth purposes, and require sound management to allow for their use and protect their availability. Renewable resources must be utilized in a sustainable manner to ensure their viability for future generations[115]. Though energy systems, and particularly, renewable energy systems are not mentioned explicitly in this Plan, the spirit and intent of the Plan provides latitude for developing such systems. Indeed, provision is made in Section 6.4.2.6 (Waste Management – Policies) to "Consider energy from waste facilities as an option for the disposal of post-recycled waste generated within Peel Region[116]." In this regard, the Algonquin Power 'Energy From Waste' (EFW) Facility in Brampton has been in operation since 1992. This facility incinerates non-hazardous solid waste to produce energy[117].

6.3.2 The City of Mississauga

A central element in the Mississauga Official Plan Section 2.7.2.10 (Objectives) is "To encourage energy conservation and reduce air pollution and greenhouse gas emissions through site and community design, which supports alternative forms of transportation such as, transit, cycling and walking. Under Sections 3.15.4.7 (Energy Conservation) and 3.18.4.3 (Urban Form), the Plan outlines the actions and initiatives necessary to promote the efficient use of energy. These include; compact, mixed land use and transit-oriented developments, infilling and incorporating appropriate energy conservation features in building design and construction. The Plan encourages wherever possible, that buildings be designed, constructed, oriented and landscaped to minimize interior heat loss and to capture and retain solar heat energy in winter and to minimize solar heat penetration in summer[118].

6.3.3 The City of Brampton

One of the primary objectives of the Brampton Official Plan is to promote the application of practical and progressive energy conservation standards and to conserve energy. The Plan emphasizes an integrated, pedestrian oriented urban structure with community services and shopping readily accessible in the Downtown and throughout the city. Under Section 3.1 (Sustainable Planning Framework), the Plan "Promote[s] sustainable management practices such as the principles of Leadership in Energy and Environmental Design (LEED), which supports a framework for environmentally sustainable development. The Plan also provides for "a safe, convenient, economical, efficient, sustainable and energy conserving Transportation System for the movement of people and goods which supports the Official Plan land use designations and encourages the appropriate development of the City Centre, the Central Commercial

[114] The Region of Peel (2005) Official Plan, Office Consolidation p 1
[115] Ibid. p 47
[116] Ibid. p 112
[117] The Region of Peel (2007). *Energy from Waste.* Retrieved June 24, 2008, from Algonquin Power Web site: www.region.peel.on.ca/pw/waste/facilities/algonquin-power.htm-27k-
[118] City of Mississauga Official Plan, (September 2007), pp. 7, 37-38 and 50

Corridor and other activity centres, while protecting established neighbourhoods, and promoting orderly growth." In Section 4.1.5.2 (Intensification), the “City shall consider intensification in appropriate locations and forms as a means to achieve compact development that will efficiently use land and resources, optimize the use of existing and new infrastructure and services, support transit and contribute to minimizing potential impacts on air quality and promoting energy efficiency”. Moreover, in Section 4.5.15.2 (Air Quality and Energy), the Plan recognizes the connection between air quality and energy use for travelling, and the primary role of land use planning and settlement patterns in reducing energy consumption and enhancing public health, as well as the long-term sustainability of the ecosystem. Towards this end, the Plan supports “Green urban and building design standards, and the use of alternative or renewable energy as one of its major policy objectives[119].”

6.3.4 Town of Caledon

Section 7.1.10.1 (Energy) of the Town of Caledon Official Plan states, “Energy conservation will be promoted through the site plan control process. Applicants will be encouraged to design estate residential developments which incorporate energy efficient design features such as building orientation, retention of trees to act as wind buffers, and energy conservation devices[120].”

Area municipalities are considering proposals under their emerging sustainability strategies to introduce rebates on development charges for LEED buildings as an incentive to encourage wider acceptance of green building development by developers. Caledon has initiated a green reduction of development charges program.

6.4 Agencies and corporations under the Ontario Ministry of Energy

As mentioned earlier, this section will briefly describe the role and responsibilities of the agencies and corporations under the MOE.

6.4.1 The Independent Electricity System Operator (IESO)

The Independent Electricity System Operator (IESO) manages the reliability of Ontario's power system and forecasts the demand and supply of electricity. The IESO also operates the wholesale electricity market, while ensuring fair competition through market surveillance.

6.4.2 The Ontario Energy Board (OEB)

The Ontario Energy Board (OEB) is an agency of the Ontario Government that has regulatory oversight of both natural gas and electricity matters in the province. It serves as an independent adjudicative tribunal responsible for regulating Ontario's natural gas and electricity sectors. Part of the OEB's mandate is to protect the interests of consumers with respect to prices and the reliability and quality of electricity service.

In the electricity sector, the Board sets transmission and distribution rates, and approves the Independent Electricity System Operator (IESO)'s and Ontario Power Authority

[119] City of Brampton Official Plan, October (2006), pp. 16, 21, 31, 61, 114, 192 & 272
[120] Town of Caledon Official Plan, (2000) p 205

(OPA)'s budget and fees. The Board also sets the rate for the Standard Supply Service for distribution utilities that supply electricity (commodity) directly to consumers.

At the request of the Minister of Energy, the OEB developed an electricity price plan that provides stable and predictable electricity pricing, encourages conservation and ensures the price consumers pay for electricity better reflects the price paid to generators. Prices are reviewed and may change every six months based on an updated Board forecast, and any accumulated differences between the amount that consumers paid for electricity and the amount paid to generators in the previous period. As part of the Regulated Price Plan, the Board also sets time-of-use (or "smart meter") prices for eligible consumers of utilities that have opted to provide time-of-use pricing to its customers with smart meters. In addition, the Government of Ontario intends to replace all electricity meters in households across the Province, by 2010, with smart meters that will report hourly consumption and enable consumers to decide the best time of day to use electricity[121].

6.4.3 The Ontario Power Authority (OPA)

The Ontario Power Authority (OPA) contributes to the development of a reliable and sustainable electricity system in Ontario, and is responsible for:

- Assessing and ensuring the long-term adequacy of electricity resources;
- Forecasting future demand and the potential for conservation and renewable energy;
- Preparing an integrated system plan for conservation, generation, transmission;
- Procuring new supply, transmission and demand management either by competition or by contract, when necessary; and,
- Achieving the targets set by government for conservation and renewable energy.

Under the Electricity Act, 1998, the OPA is responsible for developing both an Integrated Power System Plan (IPSP) and adequate procurement processes for managing electricity supply, capacity and demand in accordance with the IPSP. The IPSP outlines the projects necessary to maintain a clean, reliable and affordable supply of electricity in the province over the next 20 years, and is reviewed every three years[122]. The OPA filed an application as required, for review and approval of the IPSP with the OEB on August 29, 2007. The OEB will examine the IPSP with regard to cost effectiveness and economic prudence[123].

6.4.4 Ontario Power Generation (OPG)

The Ontario Power Generation is a provincially owned business corporation that was created along with Hydro One, after the restructuring of Ontario Hydro[124]. The company operates and manages provincially owned electricity generation assets. It's

[121] IESO A smart meter tracks how much electricity you use and when you use it – key information to help you better manage your electricity use. In Ontario, all homes and businesses will be equipped with smart meters by the end of the decade. www.ieso.ca/imoweb/siteShared/smart_meters.asp?sid=ic-17k-

[122] The Ministry of Energy and Infrastructure (2006). *Electricity.* Retrieved April 6, 2008, from Ontario's Energy Future Web site: www.energy.gov.on.ca/index.cfm?fuseaction=english.news&news_id=88&body=yes-15k-

[123] Ontario Power Authority (2007). *Integrated Power System Plan.* Retrieved April 6, 2008, from Ontario Authority Power Web site: www.oeb.gov.on.ca/html/en/industryrelations/

[124] Ontario Hydro was a Crown Corporation owned by the Ontario government until it was privatized in 1999. It was the first provincially owned electric utility in Canada and was the largest public Electric Utility in North America www.thecanadianencyclopedia.com/index.cfm?PgNm=TCE&Params=A1ARTA0005941-14k–

hydroelectric, nuclear and fossil fuel stations generate approximately 70% of Ontario's electricity[125].

6.4.5 Hydro One Networks

Hydro One Networks operates the majority of Ontario's transmission lines and also serves as an electricity local distribution company in some areas of the province. The company owns and operates Ontario's 28,400 kilometer high-voltage transmission network that delivers electricity to large industrial customers and municipal utilities, and a 122,000 kilometer low-voltage distribution system that serves about 1.3 million end-use customers and smaller municipal utilities in the province[126].

Enersource Hydro and Hydro One are entrusted with the responsibility to provide safe and reliable distribution of electricity in Mississauga and Brampton/Caledon respectively, the promotion and delivery of electricity conservation programs and smart metering solutions to meet government objectives. The Ontario Power Authority in cooperation with Hydro One Brampton is assisting commercial, industrial, and institutional and agricultural customers to conserve energy through the Electricity Retrofit Incentive Program (ERIP). The program focuses on the areas of lighting, motors, heating and ventilation and air conditioning (HVAC), and the overall electricity systems[127]. Hydro One has embarked on a number of demonstrative projects and initiatives to promote energy conservation and encourage the use of alternative energy systems[128].

Against the background discussed above, staffs consider it important to set out the vision and broad objectives for developing renewable, alternative energy policies in the future. We have also developed principles as outlined in the next section, which could guide in energy and land use development policy formulation, and help to ensure their successful implementation.

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[125] Ontario Power Authority (2008). *Ontario's Energy Landscape.* Retrieved April 15, 2008, from OPA Web site: www.powerauthority.on.ca/Page.asp?PageID=376&ContentID=817&SiteNodeID=118-74k-

[126] Hydro One (2007). *Media Centre.* Retrieved April 15, 2008, from Archives Web site: www.hydroone.com/en/media_centre/news_releases/2007

[127] Enersource Mississauga (2007) *The ERIP Program.* Retrieved April 15,2008, from News Release Web site: www.enersource.com/powerwise/b-incentive.htm-11k-; & Hydro One Brampton (2007), from News Release Web site: www.hydroonebrampton.com/programs.html-19k-

[128] For example, the Hydro One Brampton 20.475kWp Solar Photovoltaic Array is a commercial PV system that demonstrates Grid Tie solar in a 3-Phase installation & uses a ballast mounted non-roof penetrating racking system. The system uses 105 Sanyo 195Wp Solar modules configured in 3 separate solar arrays each connected to 3 SMA SunnyBoy SB7000 Inverters rated at 7kW each.
The Hydro One Brampton residential solar demonstration system is a 1.56kWp solar PV grid tie system that uses the SunnyBoy SWR1800 inverter with 8 Sanyo 195W solar modules. This demonstration system shows the components used in a grid tie solar photovoltaic system & how the configuration would be connected and installed on a house. No batteries are required in this system.
The *'Peaksaver'* program aims to help consumers reduce the demand for electricity in their community and contribute towards improving the environment. Interested clients allow Hydro One Brampton to cycle down their air conditioning temporarily - (usually between 12 p.m. and 6 p.m. on weekdays; never on weekends or holidays). This helps to reduce the strain on the electricity system on summer days when electricity use is at its peak. Hydro One installs a programmable thermostat that allows a wireless signal to be cycled down to the air conditioner without affecting the comfort level or temperature of the home. Eligibility is open to homeowners of a single-family home with a central cooling system and Hydro One offers a $25 credit just for signing up.
Electricity reduction at peak times can help in reducing smog and air pollution and lessens the chance of voltage reductions or other disruptions in the power system. It can also contribute in cutting down on buying expensive energy from other places, thereby keeping electricity prices lower, and reducing the need for building costly new generating stations. Hydro One also assists its customers in disposing of inefficient appliances in an environmentally responsible manner. http://www.hydroonebrampton.com/

7.0 VISION, OBJECTIVES AND PRINCIPLES

Vision: To efficiently manage our energy resources and create smart energy solutions to sustain a healthy, prosperous, and secure quality of life for the people of Peel Region

Objectives: To incorporate energy policies in the Official Plan in support of energy efficiency and improved air quality through land use and development patterns for the long-term economic prosperity of Peel.

Principles: A number of principles will guide strategic and policy choices and help in ensuring that the energy industry develops to its full potential.

i. Diversity: Promoting use of renewable energy systems and providing a diversity of reliable energy sources.
ii. Conservation: Promoting energy efficiency and conservation.
iii. Efficiency: Promoting energy efficient urban design and facilitating alternative modes of transportation.

8.0 CONCLUSION

The foregoing discussion in this paper has attempted to show that the energy industry is complex and is undergoing major changes that could have wide-ranging consequences in society in the future. Energy is an essential commodity in various aspects of life, and a reliable supply of energy, particularly renewable alternative energy at a competitive price and produced in an environmentally responsible manner is seen as an important goal for Peel. The incorporation of energy policies into the Official Plan will require the Region to take a long-term view of the industry and its need for a predictable and positive environment. Policy objectives could address how the industry's main components; i.e., fossil fuel energy sources and non fossil fuel energy sources, would evolve within Peel in particular and the GTA in general. To do this, a number of issues have to be considered to guide the process of analyzing choices and formulating policies. These issues include; (a) how to create an efficient and diversified energy sector that achieves sustainable economic development, in balance with high social and environmental standards; (b) how to optimize the use of the largely untapped renewable wind, solar, bio-thermal energy resources in the Region; and (c) how to promote energy conservation and enhance the quality of life of the Region's residents. It is important that policy decisions reached are practicable and flexible as they will have important implications in the future. Organizations and businesses in the public and private sectors, as well as the general public, have an interest in the development and security of the energy sector. The Region working closely with all relevant stakeholders in the public and private sectors, could provide strategic leadership and direction in ensuring that the Regional Official Plan satisfies the provincial policy conformity requirements, and effectively addresses the present and the future needs for renewable energy systems in Peel.

The contributions by various stakeholders and participants during the ongoing consultation process have been very important in the writing of this paper. We look forward to benefiting from further inputs to this paper. We would appreciate your comments and suggestions as we advance the discussion towards the next consultative meeting later in the year, to prepare forward looking policies that could adequately meet the demand for clean, green energy over the long-term.

Please forward your comments and suggestions on this Discussion Paper to:
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Thank you for your cooperation.

GLOSSARY

Alternative energy systems: means sources of energy or energy conversion processes that significantly reduce the amount of harmful emissions to the environment (air, earth and water) when compared to conventional energy systems.

Petroleum resources: means oil, gas, and brine resources which have been identified through exploration and verified by preliminary drilling or other forms of investigation. This may include sites of former operations where resources are still present or former sites that may be converted to underground storage for natural gas or other hydrocarbons.

Planned corridors: means corridors identified through provincial plans or preferred alignment(s) determined through the Environmental Assessment Act process which are required to meet projected needs.

Provincial plan: means a plan approved by the Lieutenant Governor in Council or the Minister of Municipal Affairs and Housing, but does not include municipal official plans.

Renewable energy systems: means the production of electrical power from an energy source that is renewed by natural processes including, but not limited to, wind, water, a biomass resource or product, or solar and geothermal energy.

Transportation systems: means a system consisting of corridors and rights-of way for the movement of people and goods, and associated transportation facilities including transit stops and stations, cycle lanes, bus lanes, high occupancy vehicle lanes, rail facilities, park'n'ride lots, service centres, rest stops, vehicle inspection stations, intermodal terminals, harbours, and associated facilities such as storage and maintenance.

APPENDIX 1: WHAT WE HEARD AT PUBLIC CONSULTATION SESSIONS

WHAT WE HEARD AT REGIONAL COUNCIL PUBLIC MEETING ON FEBRUARY 15, 2007

Participants at the Regional Council meeting on February 15, 2007 made the following submissions:

- Recognize the effects of human activity on the environment, and the constrained future for energy production in the face of increasing energy consumption.
- Pursue land use planning policies that would promote compact urban form, transit use and trip reduction as a means of reducing energy consumption and improving air quality. Encourage the development of pedestrian-oriented subdivisions with an increased proportion of trips by bicycle and by foot, thereby encouraging healthy communities.
- Promote the building of affordable housing through innovative site planning, architecture, and energy conservation.
- Encourage development of a culture of conservation and promoting conservation demand management initiatives. There is increased focus on green power initiatives i.e. solar/wind power generation and infrastructure.
- Encourage the private sector to produce energy efficient buildings through innovative green building technologies and the LEED rating system.
- Promote a healthy natural environment through better city planning.
- Determine types of development in new growth areas to assist in loading forecasts and how much infrastructure will be required and when.
- Consider issues regarding road widening and extensions and where these will occur, as utility companies may need to relocate their electric plants, or use new road patterns to extend their existing circuits. This would also give an indication of how much design and crew time would be needed and when.
- Prepare a Regional Risk Management Strategy for dealing with high-energy prices.
- Encourage Research and Development into industry-driven research in alternative energy generation technologies, ‘green’ roof gardens and a geothermal heating and cooling system.
- The Ontario Power Authority (OPA) will work with Peel Region during the PROPR on areas of common interest, to ensure consistent planning and to avoid working separately for similar goals, such as the development of hydro corridors and major transportation infrastructure routes.
- The OPA will encourage improvement in building efficiency and realizing cost savings through the integration of energy efficient building techniques and the creation of district heating in city centres.
- Future concerns for the OPA in Peel Region include the requirement for increased power generation in South Peel, as well as the development of transmission corridors to accommodate increased growth in North West Brampton and Halton Region.

WHAT WE HEARD FROM THE AREA MUNICIPALITIES, ENERGY ORGANIZATIONS AND ENERGY UTILITIES AT A KEY STAKEHOLDERS MEETING ON JUNE 19, 2007

- The City of Brampton Growth Management Plan will ensure that development growth is linked to available services and infrastructure required to support that growth, so as to minimize public costs and optimize public benefits.
- The City of Brampton will endeavour to protect and enhance air quality and contribute to energy conservation through implementing a sustainable planning framework.
- Enersource is considering a pricing mechanism to drive energy conservation, and will be asking for a rate increase.
- Enersource has adopted the net metering program to allow consumers to reduce the amount of electricity they purchase from the provincial electricity grid.
- Enersource needs to know where roads will be built, as pole lines usually go beside the roads.
- There are concerns that some existing infrastructure has to be replaced. Major infrastructure will be required for more electricity power transmission and distribution. Additional wind generation cannot be connected to the grid without more transmission and distribution infrastructure.
- Pleasant Transmission Station is getting some expansion, but with the projected population growth, will soon reach full capacity.
- There is the need to reinforce the transmission system in the GTA West and to upgrade several transformer stations in order to satisfy the high load growth in the area.
- Municipalities need to show leadership through green development and Leadership in Energy & Environmental Design (LEED).
- City centre densification has not been mandated in certain jurisdictions that the first floor had to be retail, so people are still driving their cars to obtain low order goods and services.
- All new communities must be self-contained and have retail within the development area.
- Consider establishing the post of Chief Sustainability Officer in the Region, as well as establishing a Sustainability Committee.
- One wind turbine should be considered as an accessory use on farms. Two or more turbines constitute a wind farm, and subject to approved planning guidelines.

WHAT WE HEARD AT THE ENERGY STAKEHOLDERS CONSULTATION MEETING ON JANUARY 28, 2008

Eva Ligeti - Executive Director of Clean Air Partnership

Eva's presentation focused on energy consumption and its impact on climate change, and the need for a definitive energy policy, strategic leadership and direction at all levels of government. She argued that sprawling and fragmented communities contribute to high fossil fuel consumption, environmental pollution and poor health. She noted that though climate change and energy are global issues, action should be taken locally to help reduce carbon emissions and the impacts of climate change and global warming. To address this situation she made the following recommendations.

- Immediate action should be taken locally to make connections with other Regional and Municipal governments to enact strong energy policies and measures to combat global warming and environmental pollution;
- More research studies are needed to explore how environmental issues are impacting the health of residents in Peel and the rest of the GTA; and,
- Strong governments and strong policies are required to provide leadership and direction, as communities cannot be expected to make the changes necessary without government help.

John Jeza - Director Channel Development, Ontario Power Authority (OPA)
John's presentation provided an overview of the OPA's role and the interface between the OPA and Municipal energy planning. The OPA is currently involved in a large energy conservation program that will help reduce some of the energy needs of Ontarians. The Authority has responsibility to:

- Forecast the adequacy of electricity resources for the medium and long-term;
- Conduct independent planning for conservation, generation and transmission;
- Develop integrated power system plans for Ontario;
- Engage in activities to support adequate, reliable and secure electricity supply and resources in Ontario.

John made the following recommendations.

- Address energy supply and demand in terms of land use and built form;
- Assist people to conserve energy;
- Preserve corridors for energy infrastructure development; and
- Encourage communities to make more energy efficient choices by implementing standards such as LEED, so as to cut down on energy use.

Gary Wilde - Manager, Demand Response, Region of Peel

Gary's presentation elaborated on key issues such as climate change, peak oil, energy stress and economic stress that will affect energy and humanity in the next 25 years. He recommended that:

- Municipal plans should include energy management plans and emergency management plans for peak oil;
- Plan for life-cycle costing[129]; and
- Plan for fossil-fuel free communities to encourage renewable energy options.

John Stillich – Director, Sustainable Urban Development Association

John's presentation emphasized the need for sustainable community development to effectively tackle impending energy shortages of fossil fuels between 2010 and 2015. He argued that the consequences of declining crude oil reserves would be soaring costs of energy, high demand for alternative transportation and hardship for businesses and households. He noted that the adoption of *'good'* policy choices at present could mitigate the effects of declining fossil fuel supplies, and also help in reducing GHG emissions and

[129] A life cycle cost analysis calculates the cost of a system or product over its entire life span. A life cycle cost analysis is important for cost accounting purposes, as it helps show what costs need to be allocated to a product so that an organization can recover its costs. If all costs can not be recovered, it would not be wise to produce the product or service. http://en.wikipedia.org/wiki/Life_cycle_cost_analysis

the impact on climate change. The benefits of implementing a sustainable urban development policy include the following.

- Reduced exposure to energy supply and price volatility;
- Decrease in traffic congestion;
- Improvement in household and local finances;
- Cleaner and healthier air and water resources;
- Safer and vibrant communities;
- Stronger economy; and
- Improvement in food security.

He recommended that;

- Municipalities should enforce better land use planning and building design, and make better use of greenfield development through policies and legislation, so as to reduce our dependency on fossil fuel.

Glen Miller – Director, Education and Research, Canadian Urban Institute
Glenn's presentation highlighted the need for Integrated Energy Planning (IEP). He argued that three factors have changed in recent years that have altered formerly safe assumptions about energy availability and supply; namely,

- Dwindling reserves of fossil energy sources - oil, coal, natural gas;
- Affordability of various forms of energy - gas, electricity;
- Increased significance of alternative and renewable energy – major investment opportunity

He argued that the IEP enables municipalities to create their own vision, set achievable goals and targets, and engage key players in the community in the decision-making process. He outlined the important role of the District Energy System (DES) in providing heating, cooling and electricity from a central plant to end users in delineated land use districts. The benefits of the DES include, help in reducing peak demand and carbon emissions, and support urban form.
He recommended that;

- A municipal District Energy System is essential as it can help in creating employment, stimulate intensification and provide a catalyst for a comprehensive approach to integrated design and development.

John Sabiston – Transmission Planning Manager, Hydro One Networks

John's presentation dealt with infrastructure needs for municipalities, with an emphasis on reliable electrical supply to meet peak demand. He pointed out that to meet the energy needs for communities in the future, it is critical that land should be set aside for power transmission line corridors. He recommended that;

- Municipalities have a shared responsibility to reserve the corridors in their official plans for future energy transmission and distribution. Both an east-west corridor in northern Brampton/southern Caledon, and a north-south corridor in western Brampton are required to ensure reliable and cost effective supply to the future growth areas in Peel.

APPENDIX II: THE CITY OF GREATER SUDBURY OFFICIAL PLAN 2008

The City of Greater Sudbury Official Plan underscores a strong link between economic development and healthy community.

- The City's Official Plan emphasizes the significance of developing the 'quality of place' in sustaining community excellence. "Quality of place has been identified as a main factor in attracting and retaining community talent. The Official Plan plays an important role in influencing and improving the natural, cultural and lifestyle amenities of Greater Sudbury. Among other matters, this Plan establishes land use policies that will protect and enhance the City's natural environmental assets, as well as urban design guidelines that are intended to improve the quality of our built environment[130].

- The Plan sets out the energy policies as follows:
    1. Utility lines and plants will be installed in an efficient and economical manner with minimal disruption to existing development and the natural environment.
    2. Where economically feasible, utility and transmission lines are to be installed underground in living, employment and recreational areas so as to minimize their adverse visual impact on the environment.
    3. The City will actively participate with the responsible authorities in planning for the future expansion and location of power supply services and communication systems servicing the City. The proponents of such expansions will satisfy the City that there will be no major impacts from the development as related to environmental, economic, social, transportation and other concerns as determined by the City.
    4. Alternative energy systems and renewable energy systems shall be permitted in settlement areas, rural areas and prime agricultural areas in accordance with municipal, provincial and federal requirements.* (2007 MMAH Mod # 28)[131].

- The Plan promotes energy efficiency programs such as energy efficient subdivisions, street and building designs and access to green energy sources and transportation.
- The Plan focuses on eco-industry and renewable energy as one of the city's five engines for growth.
- Energy conservation is facilitated through alternative modes of transportation, encouraging energy efficient urban design, and anticipating renewable energy projects. (See Appendix I for a full text)
- Water and energy conservation and water and energy use efficiency is promoted across all sectors.
- *The EarthCare Sudbury Local Action Plan*[132] identifies wind farms and individual wind power systems as being suitable for residences, farms or businesses.
- Wind energy generating systems and the policies to guide their development are identified in the *EarthCare Sudbury Local Action Plan.*

[130] The City of Greater Sudbury Official Plan, Office Consolidation, (2008) Part V: Developing Quality Of Place, April 2008, p 147
[131] Ibid. p 141
[132] www.city.greatersudbury.on.ca/CMS/index.cfm?app=div_earthcare&lang=en&currID=883&parID=0-21k-

Wind Energy Conversion Systems
Wind power is an emerging energy source and land use. *The EarthCare Sudbury Local Action Plan* identifies wind farms and individual wind power systems suitable for residences, farms or businesses as a major component of the *Community Energy Plan*. This Plan establishes policies aimed at facilitating this economic development initiative and our move towards energy sustainability.

Wind Energy Conversion Systems consist of mechanical devices designed to convert wind energy into electricity. Land use policies to ensure the proper development of wind energy conversion systems at small and large scales are provided below.

Individual Generating Systems
Individual generating systems are wind turbines used to generate electricity that are small-scale in size and generally used to produce energy for the property owner. They are permitted in all designations and will be subject to regulations found in the Zoning By-law.

Policies
1. Individual generating systems are permitted as an accessory structure in all designations without amendment to the Zoning By-law.
2. The Zoning By-law will provide regulations for individual generating systems regarding setbacks from road allowances, lot lines, and structures (on-site and off-site) and maximum height provisions.

Wind Farms
Wind farms are comprised of more than one wind turbine of commercial scale. Wind farms generally produce energy for the provincial transmission grid.

Policies
1. Wind farms are permitted in the Agricultural Reserve, Rural Areas and the Mining/Mineral Reserve by an amendment to the Zoning By-Law.
2. The City will evaluate the suitability of the location and land use compatibility of the proposed wind farm and require the following:

    a. A site plan illustrating the location of the proposed turbines, as well as the location and height of all existing buildings and structures on the subject property, and the location and height of all existing buildings and structures within 500 metres of the subject property;
    b. Approval of the base and tower design of the turbines by a professional engineer; and,
    c. A noise study to determine the off-site noise impacts.

3. Setbacks from road allowances, lot lines, and structures (on-site and off-site), distance separation from Living Areas, and maximum height provisions will be established in the Zoning By-Law.
4. Commercial generating systems constructed within 10 km of the Greater Sudbury Airport will require the written approval of Transport Canada.

Energy Efficiency Programs

Policies and programs that incorporate and promote energy efficiency are necessary to achieve goals established by the *EarthCare Sudbury Local Action Plan*. Reducing energy use, providing consumers with access to green energy sources and transportation, and developing energy efficient subdivision, street and building designs are encouraged by this Plan. Attracting new businesses in the energy and environmental services sector to locate in Greater Sudbury is another strategy to make the City a municipal leader in energy efficiency.

The City of Greater Sudbury has initiated a program of municipal energy retrofits utilizing solar wall construction and geothermal heat pumps in City-owned facilities. Additional improvements in energy conserving design will be implemented as part of the *Strategic Energy Plan*. Alternative methods of heating, cooling and constructing buildings need to be promoted as the City works towards reducing greenhouse gas emissions and meeting Kyoto targets.

Programs

1. This Plan supports the continued development of programs to conserve energy and improve energy efficiency across all sectors, including the objectives outlined as part of the *Strategic Energy Plan* and the *Community Energy Plan*.
2. The City of Greater Sudbury will encourage the development of wind farms in order to produce clean energy for the City. Small-scale wind power systems suitable for residences, farms and businesses are also allowed by this Plan subject to policies contained in Section 12.4.1.
3. The City will implement a Landfill Gas Utilization Project to collect and use the energy from landfill gas as an effective means of converting waste to energy where economically feasible.
4. Small-scale hydroelectric projects with a combined capacity of 10 MW will be promoted to enhance the local provision of energy.
5. This Plan supports district energy plants as an efficient method of supplying heating, cooling and electricity to buildings. The environmental benefits of cogeneration plants are recognized for their contribution to cleaner energy sources and reduced greenhouse gas emissions.
6. Geothermal projects based on the small district energy system model will be facilitated by this Plan to meet the heating and cooling needs of new clusters of environmental businesses.
7. The introduction of hybrid and alternative fuel vehicles is encouraged in support of the bio-diesel project and other energy efficiency programs.
8. This Plan encourages building and landscape design practices that conserve energy and reduce waste including:

    a. Utilizing techniques and materials that increase energy efficiency;
    b. Siting buildings so as to best exploit the area's passive solar energy potential, and utilizing existing natural shade canopies to reduce summer energy use;
    c. Encouraging compact, mixed use and infill developments that concentrate complementary land uses as a means of conserving energy; and,
    d. Designing buildings that meet LEED (Leadership in Energy and Environmental Design) or equivalent standards.

APPENDIX III: POLICY APPROACHES TO DEVELOPING ALTERNATIVE ENERGY SYSTEMS AND RENEWABLE ENERGY SYSTEMS IN OTHER MUNICIPALITIES

East Gwillimbury Seeking Innovative Energy Solutions

There is an identified need for alternative energy solutions within East Gwillimbury and the Region of York for existing residents, the growing population and employment. The *Request for Expression of Interest (RFI)* for Energy Initiatives required that all submissions comply with the following criteria established by East Gwillimbury Council: East Gwillimbury Council supports an innovative Public Process to pursue safe and environmentally friendly energy solutions[133].

- Recognize environment and public health/safety standards as a priority;
- Provide cost effective, secure energy supply for existing residents & businesses;
- Identify innovative and reliable energy supply options for the planned employment corridors;
- Contribute energy supply to support the Town's anticipated growth & the needs of other York Region municipalities;
- Provide business partnership and/or economic opportunities for the Town;
- All submissions must adhere to all regulatory approval requirements of: Ontario Power Authority, Ontario Energy Board, and other key energy approval agencies

Purpose: It is anticipated that successful proposals will assist with the critical power supply needs for both East Gwillimbury and York Region.

1. East Gwillimbury Council will lead a proactive process to ensure that all power supply proposals meet specific environmental, public safety, future supply options and business partnership opportunities.
2. East Gwillimbury Council has developed a progressive Strategic Plan which provides the municipality with the opportunity to seek out utility partners to ensure that growth is accommodated with innovative and environmentally sustainable 'leading practices. This plan is predicated on the council's commitment to the environment, society and culture; infrastructure and the economy.
3. East Gwillimbury Council announced the adoption of a Municipal policy directing developers of residential developments of ten or more units to construct them to ENERGY STAR standard.

Outcome: With typical ENERGY STAR qualified homes containing high efficiency heating, hot water and air conditioning systems, insulation upgrades, higher performance windows, and better draft proofing, they consume 30 to 40% less energy and reduce greenhouse gas emissions by 2 to 3 tonnes per year, compared to homes built to the minimum Ontario Building Code requirements. By adopting the ENERGY STAR standards, East Gwillimbury is positioned as a leader in innovative environmental policy. Energy efficient housing helps to ensure that East Gwillimbury's residents are insulated against rising energy costs and won't have to make costly energy efficiency upgrade retrofits in the future. ENERGY STAR qualified homes cost less to operate and are much more comfortable to live in. ENERGY STAR® for New Homes is a label given to homes that meet balanced, whole-house, energy-efficiency standards, guaranteeing

[133] http://www.eastgwillimbury.ca/Environment/Energy/Energy_RFI.htm

their owners significant energy savings. The ENERGY STAR® mark is administered and promoted in Canada by Natural Resources Canada.

East Gwillimbury is also considering the adoption of Leadership in Energy & Environmental Design (LEED) standards for all new industrial, commercial, and institutional developments in the Town[134].

Nova Scotia: "Powering Nova Scotia's Economy: A Public Discussion Paper on the Province's Energy Strategy"

The approach taken by Nova Scotia provides a valuable policy framework that Peel could consider as part of the PROPR. The framework sets out the Values and Principles Guiding the Review[135], and identifies a range of values and principles that would form the basis on which the energy sector could grow and prosper. These values could also affect the broader economic and social growth in the Region. The following are the possible values and principles that Peel could consider in determining its strategic and policy choices.

- Responsible regulatory practices, public consultation, transparency, and accountability.
- The supply, demand and price of energy products and services in Peel should be guided by policies that encourage consumer choice and competition.
- Private sector partnership is essential in the management and growth of Peel's energy industry, and accounts for most of the innovation and capital investment required to develop and expand the region's energy sector.
- Residents of Peel should benefit from the technological advances, RFP and opportunities offered by the province.
- Potential environmental impacts should be fully evaluated in all energy policy-making decisions.
- The energy needs across Peel would be adequately met by providing a diversity of reliable energy sources and pursuing efficiency and conservation initiatives.

Examples from other municipalities:

- The **City of Charlottetown,** PEI, approved an application for a domestic waste collection and sorting facility to install a 50 kW wind turbine in one of the city's industrial parks in 2005. The city only chose to enforce two requirements above the PEI Provincial Planning Act setback rules for all sizes of wind turbines.

  - An ambient sound assessment at the property line was conducted to ensure that the wind turbine would not exceed existing levels for the area.
  - A variance to the existing by-law was required to allow a tower of over 10 m (35 ft) in height.

[134] www.hydroonenetworks.ca/en/community/projects/municipal_programs/downloads/AMO_Booklet_Top10Tips.pdf-
[135] http://www.gov.ns.ca/energy/AbsPage.aspx?id=1249&siteid=1&lang=1

It is important to note, "Where small wind turbines are a specifically permitted use, the most common types of restrictions concern maximum height, setback requirements, sound levels, and blade clearance above grade." Setback requirements mitigating potential safety as well as potential sound and visual impacts range from none to 4 times the height of the tower from the property line or other building structure on the same property. Wind-specific height restrictions range from 24.3 m to 121 m (79.7 to 397 ft), with the latter limit geared to commercial-scale turbines. At least one community has set a sound limit of 30 dBA (not much louder than a human whisper, which would be difficult to enforce) at the property line; others set the limit as high as 60 dBA.

- The Town of **Malahide**, Ontario, adopted regulations in March 2005 that limit small wind turbines as ***an accessory structure in agricultural zones.*** Small turbines fall under site plan review as part of the building permit approval process. Required setback from the property line or any other building structure is 1.2 times the height of the tower…. The only threshold requirements that the Town of Malahide imposed for the installation were setbacks and a structural engineering analysis of the tower.
- The municipality of **Meaford** (on the southern shore of Georgian Bay; popn. 11,000) has among the most permissive regulations on height restrictions, allowing towers to go as high as 60 m (200 ft).
- In contrast, the **Town of Blue Mountains** imposes a height restriction of 11 m (32 ft), a long-standing regulation originally devised for old-fashioned water pumping windmills.
- Similarly, **Tiny Township in Simcoe County** limits turbines to 10 m (34 ft), requires a setback of 1.5 times the tower height, and allows only one turbine per property.

The **Corporation of the County of Prince Edward** Comprehensive Zoning Bylaw tabulates requirements where a windmill is expressly listed as a permitted use[136]. Section 4.33 (Windmills) states, "Windmills shall only be permitted in zones where a windmill is expressly listed as a permitted use and shall meet the following requirements".

Table 6: Windmills - County of Prince Edward Comprehensive Zoning By-law

Zone	# of windmills permitted per lot (max)	Total kilowatts permitted per lot (max)	Front yard (min)	Interior side yard (min)	Exterior side yard (min)	Rear yard (min)	Distance from nearest neighbour's dwelling (min)
RR1	1	15 KW	1.25X height of windmill	Height of windmill (i)	1.25X height of windmill	39.4' (12 m) (i)	150' (45.7m)
RR2	1	15 KW	1.25X height of windmill	Height of windmill (i)	1.25X height of windmill	39.4' (12m) (i)	150' (45.7 m)

[136] Windmill: Shall mean a structure including a tower, nacelle, blades and related appurtenances, designed, erected, and maintained under appropriate qualified supervision, and used for driving a machine such as a pump or mill, or for conversion of wind energy into electricity. Windmill Facility (Wind Farm): Shall mean three or more windmills.

RU1 <25 ACRES	2	150 KW	200' (61 m)	175' (53.3 m) (i)	200' (61 m)	250' (76 m) (i)	350' (106.7 m)
RU1 >25 <50 ACRES	2	300 KW	300' (91 m)	200' (61 m) (i)	300' (91 m)	250' (76 m) (i)	400' (122 m)
RU2 & RU3 >50 ACRES	2	600KW	400' (122 m)	200' (61 m) (i)	400' (122 m)	250' (76 m) (i)	600' (182.9 m)

i. Notwithstanding the above, any accessory tower anchorage shall be no closer than 10 feet (3.05 m) from the interior side or rear lot line.
ii. In the Rural RU2 or RU3 Zone each windmill shall be a maximum of 300 KW.

Source: The Corporation of the County of Prince Edward Comprehensive Zoning Bylaw, 2006, p 60

Provincial Renewable Energy initiatives

- The Canadian Wind Energy Association (CanWEA) provides information and decision-making tools about small wind energy systems (i.e. turbines with rated capacities under 300 kilowatts). A model zoning bylaw covers the full range of issues related to zoning plans and siting requirements for small wind turbines: wind resource assessment, height restrictions, setbacks, sound, safety, fire risk, neighbouring property value impacts, visual considerations, and insurance requirements[137]. (See Appendix II)
- The Canadian Wind Energy R&D (WERD) Program promotes the development of commercially viable technologies and fosters the wise use of energy and the increased use of renewable energy and alternative fuels[138].
- The Ministry of Municipal Affairs and Housing (MMAH) issued an Information Sheet in 2003 titled *'How Can Municipalities Encourage Wind Energy Development?'* This document advocates that preparing for wind energy requires building community support and developing clear land use policies[139].

It was noted that, "None of the Canadian local zoning ordinances [by-laws] reviewed … include policies regarding removal of non-operating machines. Many counties in the U.S. require owners of small wind turbines no longer working to take them down after a prescribed length of time, usually within at least two years[140].

It will be necessary for the Region to evaluate its own specific geographical and environmental conditions, as well as legal and aesthetic considerations with regard to the siting of small wind turbines. To promote small wind turbine installations, it might be necessary to establish a default-zoning ordinance that would require area municipalities to approve small wind turbine applications as of right, if specified planning and engineering requirements are met. "Distributed small wind energy systems…enhance the reliability and power quality of the power grid, reduce peak power demands, increase

[137] www.smallwindenergy.ca/en/Resources/IncentivesSupport.html-12k-
[138] www.nrcan.gc.ca/es/etb/cetc/cetc01/htmldocs/pdfs/wind_energy_r_and_d_program_e.pdf-
[139] www.energy.gov.on.ca/english/pdf/conservation/2131027_windturbines.pdf-
[140] Small wind siting and zoning study, 2006, 10

in-state electricity generation, diversify the state's energy supply portfolio, and make the electricity supply market more competitive by promoting consumer choice[141]."

The above studies all underline the need for a clear planning policy framework that focuses on alternative energy policy and site specific and technical criteria for permitting and locating wind turbines. They also outline incentives to promote and maintain wind turbine development. The regulations and approval process details the environmental and planning requirements and procedures necessary for obtaining development approval for wind power facilities.

Wind Power Production Incentive: Environmental Impact Statement Guidelines for Screenings of Inland Wind Farms under the Canadian Environmental Assessment Act

- The CEAA provides a comprehensive basis and methodology for assessing the EIS and would be valuable when dealing with matters such as environmental impacts, mitigation requirements and residual effects for wind turbine applications[142]

The section above describes some policy approaches to developing alternative energy systems and renewable energy systems by the province and in other municipalities. The salient aspects evidenced in these plans can be summarized as follows.

- Official Plans emphasize the significance of developing the 'quality of place' in sustaining community excellence.
- Official Plans underscore the strong link between efficient energy systems and consumption, economic development and healthy community.
- Official Plans promote energy efficiency programs as energy efficient sub-divisions, street and building designs and access to green energy sources – renewable energy systems and energy efficient technologies, and transportation.
- Official Plans encourage the use of advanced energy-efficient technologies that are consistent with high-energy efficiency standards, design features and construction practices.
- Eco-industry serves as a primary engine for growth, and provides goods and services as clean technologies, renewable energy, waste recycling, nature and landscape protection, and ecological renovation of urban areas for environmental protection.
- Energy conservation is facilitated through alternative modes of transportation, encouraging energy efficient urban design, and anticipating renewable energy projects.
- Water and energy conservation and water and energy use efficiency is promoted across all sectors.

Closely related to the concepts highlighted above, the following could provide useful guidelines in developing sustainable energy efficient policies in Peel.

[141] www.smallwindenergy.ca/downloads/Small_Wind_Siting_Guidelines.pdf-
[142] www.canhydro.com/projects/wolfeislandwind/planning_docs.htm-20k-

i. Create long-term reliable energy sources, at competitive prices, to support sustainable economic development; personal requirements such as transportation, residential heating and electricity; and industrial usage.
ii. Create an attractive business climate for the energy sector. The energy industry should be the catalyst for additional economic developments in Peel. New wind/solar exploration activities alternative energy systems have the potential to increase employment, contribute to the growth and profitability of existing and new businesses, and increase government revenues.
iii. Introduce policies related to air contaminants such as sulphur dioxide, nitrogen oxides, mercury, and particulates that are released at various stages of energy production and consumption, as part of an energy strategy that could alleviate climate change and environmental issues.
iv. Establish programs to improve efficiency, and incentives to promote conservation in the production and consumption of electricity, heating fuels, and transportation fuels
v. Encourage the development of new technologies and promote renewable energy sources - "green power".
vi. Provide regulations for the energy industry that support fair competition and protect the environment, while balancing the Region's economic and social needs.

Develop a comprehensive and forward-thinking energy strategy that can have a profound long-term impact on the economic and social development in the Region.

APPENDIX IV: SMALL WIND SITING AND ZONING STUDY DEVELOPMENT OF SITING GUIDELINES AND A MODEL ZONING BY-LAW FOR SMALL WIND TURBINES (UNDER 300 KW): developed for the Canadian Wind Energy Association
Released April 2006, Revised September 2006[143]

Prerequisites for zoning policies and model ordinances for the siting of small wind energy facilities

1. **Site selection and assessment*: Appropriate sites and towers for small wind turbines***

Site determination is based on an assessment of the wind resource and the topography of the site. The assessment must take into account required setbacks from property lines and the proximity of other structures or natural features that might obstruct the wind or create turbulence. Suitable sites for on-site wind use include; farms, rural homes, businesses and schools or other campus-based facilities.

Assessment of wind patterns in a general area can be done with up-to-date wind maps and monitoring equipment to measure wind speeds. It is necessary to point out that,

> "wind power on a particular site is greatly affected by nearby terrain. Obstructions may slow down wind, or features such as a hill, trough or valley may accelerate it… Within a site, the ideal turbine position is where wind is least obstructed – often but not necessarily the highest point on the site. At a minimum, it is best to elevate wind turbines into the laminar flow of the dominant wind direction in order to optimize productivity and reduce stress on mechanical components that reduces turbine life." (p 12)

2. Tower height

Wind speed increases with height, and gaining even a small increase in velocity boosts a turbine's generating potential significantly. The height of a tower is critical and must meet engineering safety requirements; tower is accommodated within property lot lines according to property dimensions, with setback considerations. Other restrictions take account of neighbours, sound, and visual impacts. These considerations may not apply in more remote or less populated areas.

3. Sound and visual impact - *Neighbourliness considerations*

Usually, the sounds wind turbines make when operating typically blend in with background sound from cars, animals, airplanes, and trees in windy conditions. Few formal complaints are filed against installed wind turbines. But progress toward making quieter turbines is important.

Visibility and visual impact play a major part in wind turbine installations, and turbines may not always be positioned so as to avoid visibility. Turbines must be mounted on tall towers in order to maximize wind conditions and avoid turbulence. It is important to maintain a clearance of at least 8-9 m (25-30 ft) above trees or other natural or manmade structures that cause turbulence. Ridgelines and other sites for instance, in

[143] www.smallwindenergy.ca/downloads/Small_Wind_Siting_Guidelines.pdf-; www.amo.on.ca/AM/TemplateRedirect.cfm?template=/CM/ContentDisplay.cfm&ContentID=149130

the Oak Ridges Moraine and the Niagara Escarpment that are part of significant scenic or historic value may be sensitive enough to warrant restrictions. Issues regarding visibility must be addressed in advance through consultation with neighbours.

Property line setbacks and distance to dwellings - *Recommended setbacks and distances to dwellings*

Safety and liability considerations are the primary justifications cited for setback recommendations. Sound and visual impacts are secondary considerations. Setback recommendations vary from property line setbacks based on the height of the turbine tower, in most cases equivalent to a single tower height to specific setback distances ranging from 6-9 m (20-30 ft) from the property line and two-thirds of tower height for "mini" turbines to 1.5 times the height of the tower up to 305m (1,000 ft) from neighbouring residences for larger turbines. Some installers distinguish between habitable and non-habitable structures, with the latter not subject to setbacks. Some recommend that guyed towers should only be subject to setbacks from the base of the tower, as tethers and rock bolts should not be treated the same as the main foundation.

Property values - There is no documented evidence that wind turbines, including commercially sized wind farms have ever lowered the values of surrounding properties. Instead, a study of 25,000 property transactions within 5 miles [8.05 km] of 10 wind installations conducted by the Renewable Energy Policy Project in 2003 found that values rose faster in those areas than in similar communities without turbines.[i] Bergey Windpower Co.[ii] the world's leading supplier of small wind turbines supports this view and argue that the fear of diminished property values is a charge that is sometimes raised by abutters or other concerned neighbours opposed to small wind turbine being installed in their neighbourhood. With the exception of one case, clients sold their homes, and adjacent lots they owned, and direct and nearby neighbours sold their homes. Evidence would suggest, "diminished property values from small wind turbine installations is a false and unsubstantiated charge [that could] "deny the definite financial and environmental benefits of owning a small wind turbine[144].

Public safety – Generally, existing building and safety codes are considered as adequate to address the installation of small wind energy turbines. A prerequisite for safe operation is sound engineering design of both the wind turbine and its tower. The major concerns regarding public safety include whether wind turbines may interfere with communications broadcasts and the operation of electronic devices, or pose a threat to utility line workers responding to power outages. Some of the wind turbine-specific issues are addressed below.

- ***Interference*** The rotors on small-scale turbines are not large enough to interfere with TV or communications signals, and their blades are made from materials that signals can pass through: e.g. wood, fiberglass, and plastic. Wind turbine generators also do not disrupt telecommunications or radio waves through electromagnetic interference. One of the major niche markets for small wind systems is powering remote telecommunications sites and military applications.

[144] http://www.est.org.uk/myhome/generating/types/wind/

- ***Climbing Hazard*** Wind turbine towers do not need to have greater access restrictions (e.g., special fencing or warning signs) than other similar poles and towers. The towers can be equipped with devices that prevent falls like other climbable structures. Some wind turbine tower models currently on the market lack hand- and footholds, discouraging trespassers. Some are designed not to be climbed, but to be lowered to the ground for maintenance and repairs.

- ***Guyed Wires and Electrical Lines*** It is recommended that all guyed wires should be marked up to at least 2 m and that electrical lines are buried from the base of the tower to whichever structure houses the balance-of-system components.

- ***Line Worker Safety*** National standards address the safety of the electrical equipment. All small wind equipment must adhere to, and be installed consistently with, local utility and safety requirements. Systems can be set up to run independently from the grid if the grid goes down. Wind systems that are not connected to the electric grid, though they pose no risk to line worker safety, should be installed or at minimum inspected by a contractor qualified by the provincial or territorial electrical authority (e.g., the Electrical Safety Authority in Ontario).

- ***Insurance for Installers and Owners*** All small wind systems should have property coverage in the event of damage due to weather, fire, or vandalism, as well as liability coverage for property and personal injury. One method of insuring the system is to add it to an existing homeowner's policy. Prospective owners of wind turbines are encouraged to check with their insurance company prior to having the turbine installed.

- ***Notification/Approvals Needed for Air Traffic Safety*** Transport Canada requires that prospective owners accurately provide the location (latitude and longitude) and height of all wind turbines to be installed so that they can be plotted for aeronautical maps and flight paths. Navigation Canada may then impose specific markings and lighting that must appear on the turbines so that helicopters and airplanes in both commercial pathways and search and rescue zones will be able to visually identify the wind turbines.

APPENDIX V: CanWEA MODEL ZONING BY-LAW

Recommendations for local governments

Small wind systems may contribute such public benefits as reduced pressure on the local utility grid, increased local energy independence, and reduced dependence on polluting forms of electric generation. At the same time, because small wind systems are designed for on-site use rather than for commercial production and sale of electricity, it is more ***appropriate to treat them like improvements to an individual property than as commercial or industrial projects.*** The following recommendations are based on an analysis of experiences from local permitting officials and consumers dealing with small wind turbine installations.

Zoning and Permitting Recommendations

Make small wind systems a permitted or accessory use

- Classifying small-scale on-site wind energy systems as a permitted use or accessory use in all zoning classifications where structures of any type are allowed eliminates the need for public hearings while providing that specified requirements must be met.
- If it is not appropriate to classify all small-scale wind systems as permitted or accessory uses, consider ***creating a tiered application process*** that allows uncontroversial projects to proceed on a faster track.

Make permitting fees commensurate with non-commercial end-use

- Generally speaking, fees should not exceed ***two percent*** of the original equipment cost of a small wind turbine. No extra fee should be assessed for installing controllers, inverters or batteries, which are no different than adding extra lights or circuits to an existing power panel.

Make sure height restrictions reflect the unique requirements of small-scale wind technology

- While small-scale wind energy systems are a fraction of the size of utility-scale turbines, the lowest reach of the blades nevertheless should clear nearby structures and trees by a minimum of 8-10 m (25-30 ft) to avoid turbulence. To perform optimally, small-scale wind turbines typically are mounted on 24-50 m (80-164 ft) towers. Provided that the wind turbine tower, base and footings conform to national standards and do not exceed the height recommended by the system manufacturer, it is not necessary to restrict tower height.
- Likewise, setback requirements should take into account the fact that wind turbine towers are necessarily tall.
- Because of their height, small-scale wind turbines often are visible from beyond the property line. Visibility does not equate to visual impact, however, and it is not necessary to require that turbines always "blend in" with their environment. The need for visual impact mitigation measures should be assessed on a site-specific basis and is required only where there is a clear public benefit.

Establish reasonable standards for public safety.

- For wind turbine towers supported by guy wires, require the outer and innermost wires are clearly visible to a height of 2 m (6 ft) above the guy wire anchors.
- In most cases, turbines can be treated as any other climbable object (e.g., trees), and do not require fencing.

• Permit criteria should be sufficient to assure the public that the turbine is in compliance with public safety requirements.

Require permit applications to include documentation demonstrating the safety of electrical components and wind turbine tower.

• Require a single line drawing of the electrical components in sufficient detail to allow for a determination that the manner of installation conforms to electric codes if applicable. This is not necessary if local electric codes or utilities require separate inspection of electrical equipment outside zoning approval.

• Require standard drawings and an engineering analysis of the wind system's tower, base and footings and certification by a professional mechanical, structural, or civil engineer, but do not require a "wet stamp" – provided that the application demonstrates that the system is designed to meet or exceed the requirements of the International Building Code, or other locally-adopted code, appropriate for the installation location.

Encourage, but do not necessarily require notification of neighbours.

• A short letter to one's neighbours can answer most questions, avoiding misperceptions and letting neighbours know that the applicant has properly researched the installation.

• However, it is best to leave the process of whether and how to notify neighbours to the discretion of the wind turbine permit applicant (see sample letter in Appendix E).

Lighting requirements are costly and are generally unnecessary for towers under 90 m (295 ft)

• Navigation Canada may impose specific markings and lightings that must appear on the turbines so that helicopters and airplanes in both commercial pathways and search and rescue zones will be able to visually identify the wind turbines. However, unless required by NavCanada, lighting requirements should not be locally imposed on small wind turbine towers.

• Lit towers are more attractive (and therefore more dangerous) to night migrating birds, especially during low-visibility weather conditions.

Any applicable sound restrictions need to take background sound and distance into account.

• To ensure enforceability, do not prohibit decibel levels from exceeding 6 decibels (dBA) above background sound as measured at the closest neighbouring inhabited dwelling.

• Allow sound limits to be exceeded during short-term events such as utility outages and severe windstorms.

The model by-law below provides a starting point that can save planning staff valuable time. It may need to be fine-tuned to accommodate existing regulations and emerging incentive programs.

PROPOSED CANWEA MODEL SMALL WIND TURBINE ZONING BY-LAW

Section 1. Intent and Purpose:

It is the purpose of this regulation to promote the safe, effective and efficient use of small wind energy systems installed to reduce the on-site consumption of utility-supplied

electricity, while providing reasonable controls to protect public health and safety without significantly increasing the cost or decreasing the efficiency of a wind energy system.
The [City/Region] of _____ recognizes that privately-owned small wind turbines are non-polluting, help reduce Canada's reliance on fossil fuels, help reduce public utility electrical demand and contribute to the efficiency of the utility grid.
The [City/Region] of _____ further recognizes that small wind turbines are substantially different from commercial wind farms and from commercial cellular or radio towers as they are designed to supply electrical power for the owner and are not typically revenue-generating ventures. The much larger scale wind turbines and wind farms intended to sell energy directly to power companies or retail users are not covered by this Local Land Use Guideline and will be addressed independently.
This regulation requires the [City/Region] of _____ to approve an application for a small wind energy system by right if the criteria below are met, and authorizes the local agency to charge a fee of not more than fifty dollars ($50) per small wind energy system. If any portion of the proposed small wind system does not meet the requirements set under this Local Land Use Guideline, a zoning variance will be required. No other local ordinance, policy, or regulation shall be the basis to deny the siting and operation of a small wind energy system.

Section 2. Findings:
The [Municipality] finds that wind energy is an abundant, renewable, and non-polluting energy resource and that its conversion to electricity will reduce our dependence on non-renewable energy resources and decrease the air and water pollution that results from the use of conventional energy sources. Distributed small wind energy systems will also enhance the reliability and power quality of the power grid, reduce peak power demands, and help diversify the local energy supply portfolio. Small wind systems also make the electricity supply market more competitive by promoting customer choice.
The [Province] of _____ has enacted a number of laws and programs to encourage the use of small-scale renewable energy systems including rebates, net metering, property tax exemptions, solar easements, and other incentives [as appropriate]. However, many existing local zoning ordinances contain restrictions, which while not intended to discourage the installation of small wind turbines that can substantially increase the time and costs required to obtain necessary construction permits.

Therefore, we find that it is necessary to standardize and streamline the proper issuance of building permits for small wind energy systems so that this clean, renewable energy resource can be utilized in a cost-effective and timely manner.

Section 3. Definitions:
Small Wind Energy System: A wind energy conversion system (WECS) consisting of a wind turbine, a tower, and associated control or conversion electronics, which has a rated capacity of not more than 300 kW, and which is intended to provide electrical power for use on-site (either behind the meter or off-grid) and is not intended or used to produce power for resale.
Turbine: The parts of a wind system including the rotor, generator and tail.
Total System Height: The height from ground level to the tip of the rotor at its highest point.
Wind Turbine Tower: The guyed or freestanding structure that supports a wind turbine generator.

Wind Turbine Tower Height: The height above grade of the fixed portion of the wind turbine tower, excluding the wind turbine and rotor.
Off-grid: A stand-alone generating system not connected to or in any way dependent on the utility grid.
Behind the meter: A generating system producing power for use on a grid-connected property, but which may or may not be capable of sending power back into the utility grid.

Section 4. Permitted Use:
Small wind energy systems shall be a permitted use in all zoning classifications where structures of any sort are allowed; subject to certain requirements as set forth below:
4.1 Wind Turbine Tower Height: It is recognized that small to medium wind turbines generally require tower heights of 24-50 m (80-164 ft) to reach wind currents reasonably adequate to generate energy. For property sizes between 0.1 ha (0.25 acre) and 0.2 ha (0.5 acre), the wind turbine tower height shall be limited to 80 ft (25m). For property sizes of 0.2 ha (0.5 acre) or more, there is no limitation on wind turbine tower height, subject to the set-back requirements below, and provided that the application includes evidence that the proposed height does not exceed the height recommended by the manufacturer or distributor of the system.
4.2 Set-back: The turbine base shall be no closer to the property line than the height of the wind turbine tower, and no part of the wind system structure, including guy wire anchors, may extend closer than three (3) m (10 ft) to the property boundaries of the installation site. Additionally, the outer and innermost guy wires must be marked and clearly visible to a height of 2 m (6 ft) above the guy wire anchors. The City/Region Board may waive setback requirements from adjacent properties if such adjacent property owner agrees to grant an easement binding on the current and future owners.

Sound: The mean value of the sound pressure level from small wind energy systems shall not exceed more than 6 decibels (dBA) above background sound, as measured at the exterior of the closest neighbouring inhabited dwelling (at the time of installation or during operation), for wind speeds below 22 mph (10 m/s) and except during short-term events such as utility outages and/or severe wind storms. Applicants may apply for exemptions from this requirement with written authorization from the pertinent building owner(s) and tenants, if applicable.

Approved Wind Turbines: Small wind turbines must be approved by a small wind certification or qualification program recognized by the Canadian Wind Energy Association *(Note that this provision should not be enforced until a North American certification program is in place for small wind turbines, expected by 2007.)*
Compliance with International Building Code: Building permit applications for small wind energy systems shall be accompanied by standard drawings of the wind turbine structure, including the tower, base, and footings, anchoring method and drawn to scale. An engineering analysis of the wind turbine tower showing compliance with the International Building Code and certified by a licensed professional mechanical, structural, or civil engineer shall also be submitted. Documentation of this analysis supplied by the manufacturer shall be accepted. Wet stamps shall not be required.
Compliance with Air Traffic Safety Regulations: Small wind energy systems must comply with applicable air traffic safety regulations. A statement on compliance by the applicant is sufficient. Transport Canada must be notified of the location (latitude and longitude) and height of all wind turbine installations through the aeronautical clearance application

process. Small wind turbine towers shall not be artificially lighted except as required by Navigation Canada.
Compliance with Existing Electric Codes: Building permit applications for small wind energy systems shall be accompanied by a line drawing of the electrical components in sufficient detail to allow for a determination that the manner of installation conforms to existing electrical codes. This information frequently is supplied by the manufacturer.
Utility Notification: No grid-intertied small wind energy system shall be installed until evidence has been given that the utility company has been informed of the customer's intent to install an interconnected customer-owned generator. A copy of a letter to the applicant's utility is sufficient. No response or evidence of approval from the utility is required. Off-grid systems and grid-tied systems that are not capable of feeding onto the grid with advanced control grid fault protection and disconnect switches covered under the electrical code shall be exempt from this requirement.

If the proposed small wind energy system meets the above criteria, the [Municipality/ Region] shall approve an application for the small wind energy system by right without a public hearing. For those proposed small wind energy systems that do not meet the above criteria, a zoning variance will be required.

Section 5. Severability:
If any provision of this Ordinance shall be held to be invalid or unenforceable for any reason, the remaining provisions shall continue to be valid and enforceable.

[ii] http://www.awea.org/faq/propvalue.html Manufacturing small wind turbines since 1980 with over 1,600 installations in all 50 U.S. states and more than 80 countries. Installations in all classes of zoned property including 1- and 10-kW wind turbines in residentially zoned property.

The most comprehensive study to date found the potential of wind power on land and near-shore to be 72 TW (~54,000 Mtoe), or over five times the world's current energy use and 40 times the current electricity use. The potential takes into account only locations with Class 3 (mean annual wind speeds ≥ 6.9 m/s at 80 m) or better wind regimes, which includes the locations suitable for low-cost (0.03–0.04 $/kWh) wind power generation and is in that sense conservative. It assumes 6 turbines per square km for 77-m diameter, 1.5 MW turbines on roughly 13% of the total land area. This potential assumes a capacity factor of 48% and does not take into account the practicality of reaching the windy sites or of transmission (including 'choke' points) or of competing land uses or of wheeling power over large distances or of switching to wind power. Offshore resources experience mean wind speeds ~90% greater than that of land, so offshore resources could contribute about seven times more energy than land. This number could also increase with higher altitude or airborne wind turbines.

Coping with intermittency- As the fraction of energy produced by wind ("penetration") increases, different technical and economic factors affect the need for grid energy storage facilities, demand side management, and/or other management of system load. Large networks, connected to multiple wind plants at widely separated geographic locations, may accept a higher penetration of wind than small networks or those without storage systems or economical methods of compensating for the variability of wind. In systems with significant amounts of existing pumped storage, hydropower or other peaking power plants, such as natural gas-fired power plants, this proportion may be higher. Isolated, relatively small systems with only a few wind plants may only be stable and economic with a lower fraction of wind energy (e.g. Ireland).
On most large power systems a moderate proportion of wind generation can be connected without the need for storage. For larger proportions, storage may be economically attractive or even technically necessary. The profile of other generation facilities in the system (nuclear, coal, natural gas, hydro, etc.) will also influence the potential need for storage. At present, there are few large systems (for example, at the national or regional level) with sufficiently high wind generation to drive demand for storage, and discussion of the issue and potential upper limits for wind penetration remain largely hypothetical.
Long-term storage of electrical energy involves substantial capital costs; space for storage facilities and some portion of the stored power will be lost during conversion and transmission. The percentage retrievable from stored power is called the "efficiency of storage." The cost incurred to "shape" intermittent wind power for reliable delivery is about a 20% premium for most wind applications on large grids, but approaches 50% of the cost of generation when wind comprises more than 70% of the local grid's input power.

Energy Demand Management or Demand-Side Management refers to the use of communication and switching devices, which can release deferrable loads quickly to correct supply/demand imbalances. Incentives can be created for the use of these systems, such as favorable rates or capital cost assistance, encouraging consumers with large loads to take advantage of renewable energy by adjusting their loads to coincide with resource availability. For example, pumping water to pressurize municipal water systems is an electricity intensive application that can be performed when electricity is available. Real-time variable electricity pricing can encourage all users to reduce usage when the renewable sources happen to be at low production.
In energy schemes with a high penetration of wind energy, secondary loads, such as desalination plants and electric boilers may be encouraged because their output (water and heat) can be stored. The utilization of "burst electricity", where excess electricity is used on windy days for opportunistic purposes greatly improves the economic efficiency of wind turbine schemes. An ice storage device has been invented which allows cooling energy to be consumed during resource availability, and dispatched as air conditioning during peak hours. Multiple wind farms spread over a wide geographic area and gridded together produce power much more constantly.
Electricity produced from solar energy could be a counter balance to the fluctuating supplies generated from wind. It tends to be windier at night and during cloudy or stormy weather, so there is likely to be more sunshine when there is less wind.
Wind speeds tend to be higher in the winter and at night, so the appropriateness of wind power in high concentrations may crucially depend on the prevalence of air conditioning in a given jurisdiction. Wind power

may be weakest in the hot summer months, and particularly during the day when air conditioning demand is highest. Conversely, systems where heat is electrical may be well-suited to higher penetration of wind power

Energy payback ratio (ratio of energy produced compared to energy expended in construction and operation) for wind turbines has been estimated in one report to be between 17 and 39 (i.e. over its life-time a wind turbine produces 17-39 times as much energy as is needed for its manufacture, construction, operation and decommissioning). A similar Danish study determined the payback ratio to be 80, which means that a wind turbine system pays back the energy invested within approximately 3 months. This is to be compared with payback ratios of 11 for coal power plants and 16 for nuclear power plants, though such figures do not take into account the energy content of the fuel itself, which would lead to a negative energy 'payback'.

Unlike fossil fuel or nuclear power stations, which circulate or evaporate large amounts of water for cooling, wind turbines do not need water to generate electricity.
Studies show that the number of birds killed by wind turbines is negligible compared to the amount that die as a result of other human activities such as traffic, hunting, power lines and high-rise buildings and especially the environmental impacts of using non-clean power sources. For example, in the UK, where there are several hundred turbines, about one bird is killed per turbine per year; cars alone kill 10 million per year. In the United States, turbines kill 70,000 birds per year, compared to 57 million killed by cars and 97.5 million killed by collisions with plate glass. Another study suggests that migrating birds adapt to obstacles; those birds, which don't modify their route and continue to fly through a wind farm are capable of avoiding the large offshore windmills, at least in the low-wind non-twilight conditions studied. In the UK, the Royal Society for the Protection of Birds (RSPB) concluded, "The available evidence suggests that appropriately positioned wind farms do not pose a significant hazard for birds." It notes that climate change poses a much more significant threat to wildlife, and therefore supports wind farms and other forms of renewable energy.
Clearing of wooded areas is often unnecessary, as the practice of farmers leasing their land out to companies building wind farms is common. Farmers receive annual lease payments of two thousand to five thousand dollars per turbine. The land can still be used for farming and cattle grazing.
The ecological and environmental costs of wind plants are paid by those using the power produced, with no long-term effects on climate or local environment left for future generations.
Less than 1% of the land would be used for foundations and access roads, the other 99% could still be used for farming. Turbines can be sited on land unused in techniques such as center-pivot irrigation.

Conventional and nuclear power plants receive massive amounts of direct and indirect governmental subsidies. Nuclear power plants receive special immunity from the disasters they may cause, which prevents victims from recovering the cost of their continued health care from those responsible, even in the case of criminal malfeasance.
Conventional and nuclear plants also have sudden unpredictable outages (see above). Statistical analysis shows that 1000 MW of wind power can replace 300 MW of conventional power.

Newer wind farms have more widely spaced turbines due to the greater power of the individual wind turbines, and so look less cluttered. Wind turbines can be positioned alongside motorways, significantly reducing aesthetic concerns. The aesthetics of wind turbines have been compared favourably to those of pylons from conventional power stations. Areas under wind-farms can be used for farming, and are protected from development. Offshore sites have on average a higher energy yield than onshore sites, and often cannot be seen from the shore.

Arguments of opponents

Economics
To compete with traditional sources of energy, wind power often receives financial incentives. In the United States, wind power receives a tax credit currently of 1.9 cents per kilowatt-hour produced, with a yearly inflationary adjustment. Another tax benefit is accelerated depreciation. Many American states also provide incentives, such as exemption from property tax, mandated purchases, and additional markets for "green credits." Countries such as Canada and Germany also provide tax credits and other incentives for wind turbine construction.
Many potential sites for wind farms are far from demand centers, requiring substantially more money to construct new transmission lines and substations.

Yield

The goals of renewable energy development are reduction of reliance on fossil and nuclear fuels, reduction of greenhouse gas and other emissions, and establishment of more sustainable sources of energy. Critics question wind energy's ability to significantly move society towards these goals. They point out that 20-30% annual load factor is typical for wind facilities. The intermittent and non-dispatchable nature of wind turbine power requires that "spinning reserves" are kept burning for supply security. The fluctuation in wind power requires more frequent load ramping of such plants to maintain grid system frequency. This can force operators to run conventional plants below optimal thermal efficiency, resulting in greater emissions. A recent European Nuclear Society study estimates that the equivalent of one third of energy saved from wind generation is lost to these inefficiencies.

CO_2 Emissions

Electric power production is only part (about 39% in the USA of a country's energy use, so wind power alone does little to mitigate the larger part of the effects of energy use (except with a potential transition to electric or hydrogen vehicles). For example, despite more than doubling the installed wind power capacity in the U.K. from 2002 to 2004, wind power contributed less than 1% of the national electricity supply, and that country's CO_2 emissions continued to rise in 2002 and 2003 (Department of Trade and Industry). Six of the U.K.'s nuclear reactors were closed in this period. Groups such as the UN's Intergovernmental Panel on Climate Change state that the desired mitigation goals can be achieved at lower cost and to a greater degree by continued improvements in general efficiency — in building, manufacturing, and transport — than by wind power.

Ecological Footprint

The clearing of trees around tower bases may be necessary to enable installation. This is an issue for potential sites on mountain ridges, such as in the northeastern U.S. Wind turbines should ideally be placed about ten times their diameter apart in the direction of prevailing winds and five times their diameter apart in the perpendicular direction for minimal losses due to wind park effects. As a result, wind turbines require roughly 0.1 square kilometres of unobstructed land per megawatt of nameplate capacity. A wind farm that produces the energy equivalent of a conventional power plant might have turbines spread out over an area of approximately 200 square kilometres.

A wind turbine at Greenpark, Reading, England - Some windmills kill birds, especially birds of prey. More recent siting generally takes into account known bird flight patterns, but some paths of bird migration, particularly for birds that fly by night, are unknown. A Danish survey in 2005 (Biology Letters 2005:336) showed that less than 1% of migrating birds passing a wind farm in Rønde, Denmark, got close to collision, though the site was studied only during low-wind non-twilight conditions. A survey at Altamont Pass, California, conducted by a California Energy Commission in 2004 showed that turbines killed between 1,766 and 4,721 birds annually (881 to 1,300 of which were birds of prey). Radar studies of proposed sites in the eastern U.S. have shown that migrating songbirds fly well within the reach of large modern turbine blades. A wind farm in Norway's Smøla islands is reported to have destroyed a colony of sea eagles, according to the British Royal Society for the Protection of Birds. The society said turbine blades killed nine of the birds in a 10-month period, including all three of the chicks that fledged that year. Norway is regarded as the most important place for white-tailed eagles.

The numbers of bats killed by existing facilities has troubled even industry personnel. A six-week study in 2004 estimated that 63 turbines at two sites in the eastern U.S killed over 2200 bats. This study suggests some site locations may be particularly hazardous to local bat populations, and that more research is urgently needed. Migratory bat species appear to be particularly at risk, especially during key movement periods (spring and more importantly in fall). Lasiurines such as the hoary bat (Lasiurus cinereus), and red bat (Lasiurus borealis) along with semi-migratory silver-haired bats (Lasionycteris noctivagans) appear to be most vulnerable at North American sites. Almost nothing is known about current populations of these species and the impact on bat numbers as a result of mortality at wind power locations.

Scalability

To meet the energy demands worldwide in the future in a sustainable way, a much larger number of turbines than we have today will be required. Naturally this will affect more people and wildlife habitat. In Denmark, wind power now accounts for close to 20% of electricity consumption and a recent poll of Danes show that 90% want more wind power installed. Danish wind power is dependent on the import and export of electricity to Germany, Sweden, and Norway at short notice when wind generated power is less than or greater than current demand, respectively. As its neighbours increase their own wind energy, this will not be as simple a solution.

Aesthetics

Recorded experience that wind turbines are noisy and visually intrusive creates resistance to the establishment of land-based wind farms in most places. Moving the turbines far offshore mitigates the problem, but offshore wind farms are more expensive to maintain and there is an increase in transmission loss due to longer distances of power lines. Some residents near windmills complain of "shadow flicker," which is the alternating pattern of sun and shade caused by a rotating windmill casting a shadow over residences. Efforts are made when siting turbines to avoid this problem.

Large wind towers require strobe lights, which "pollute" the rural night sky.