

# **Energy Production and Potential in the Peace River Region of Alberta and British Columbia: An Environmental Scan**

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August 2012

Acknowledgements: Funding for this study was provided by a Social Science and Humanities Research Council (SSHRC) Insight Grant, titled “Exploring and transforming a cultural imaginary of energy development in Canada.” The Principal Investigator for this project is John R. Parkins, Resource Economics and Environmental Sociology, University of Alberta.

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## ***Introduction***

This report will overview current energy production in the region of Peace River, which includes portions of northwest Alberta and northeast British Columbia. Electricity generation will be the focus of this report, however other types of energy development in the region, including oil and gas will be analysed. First, the region will be defined and background will be provided on the area. Electricity demands will be overviewed and insight will be provided into how to understand and measure electricity generation. Next oil, gas and coal development, from conventional and unconventional sources will be detailed. Finally, alternative energy sources will be reviewed, including hydroelectric, solar, nuclear, wind, geothermal and biomass. Current and proposed projects will be listed, stakeholders will be defined and the potential for future development will be provided. Each resource will also be simply explained and defined, to provide a basis for understanding what the development entails.

## ***Background***

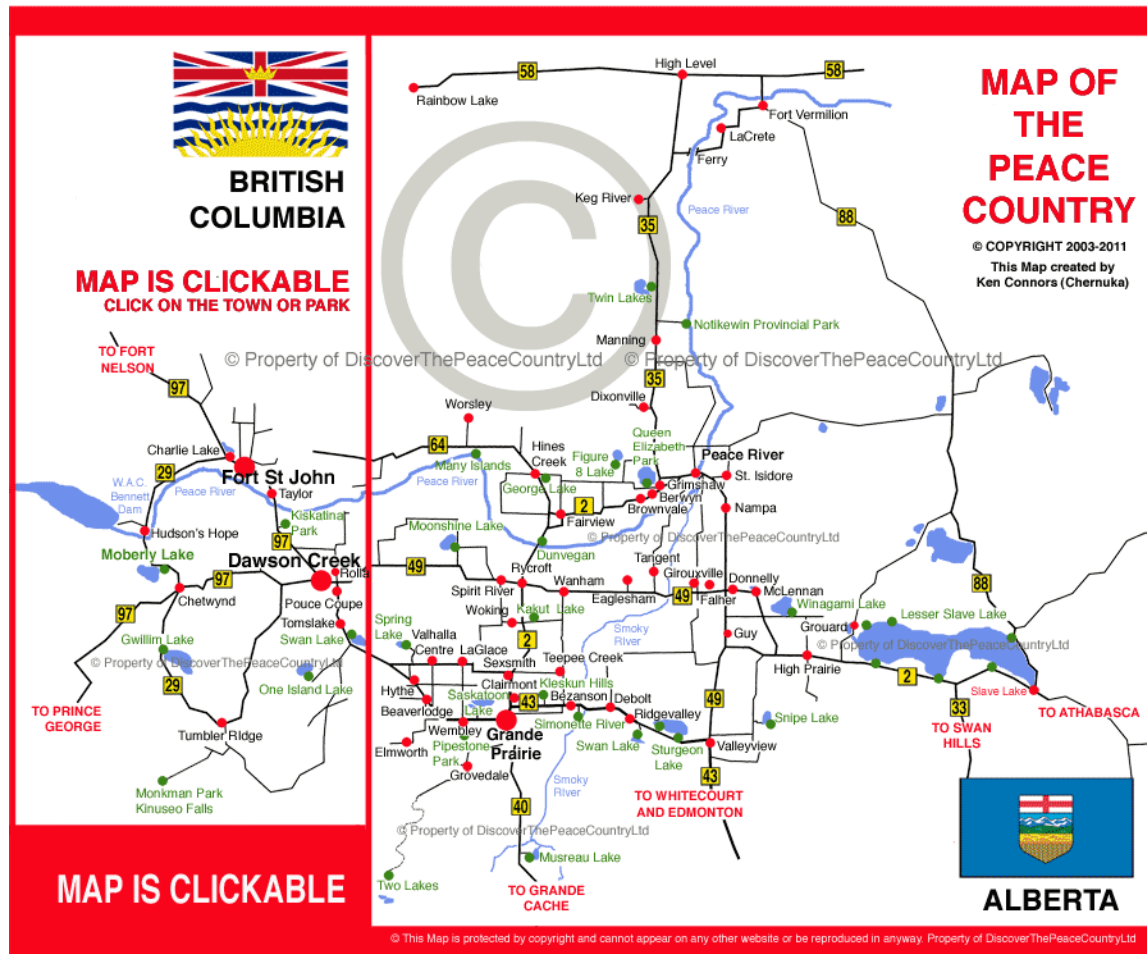
The Peace River region is a growing northern region that spans Alberta and British Columbia. Given the recent increase in population, employment and development in the region (Statistics Canada 2011a, 2011b, 2006), determining the source of future energy needs will be important. This section will provide background on the region, including an overview of the current electrical system. Future energy needs will be explored and stakeholders will be identified throughout.

## **Introduction to the Peace River Region**

The Peace River region includes numerous communities, such as Fort St. John, Dawson Creek and Chetwynd in British Columbia, and Grande Prairie, Peace River and Fairview in Alberta (Discover the Peace Country 2011). A map is included in Figure 1 and an interactive version is also available online. In 2010, the Alberta side of the region was home to 131,200 people and 60,082 people lived on the BC side, a total of 191,282. The region has experienced growth over the past decade (Statistics Canada 2006), increasing in population by 5.7% in Alberta (Statistics Canada 2011b) and 3.1% in BC (Statistics Canada 2011a) from 2010 to 2011. The city of Grand Prairie experienced the highest growth in the region, over 27% between 2001 and 2006 (Statistics Canada 2006).

In addition to numerous cities and towns, the region is home to a number of First Nations reserves (Government of Alberta 2012c). Over 19,400 Aboriginals reside on the Alberta side (Statistics Canada 2007), 8,525 of which are Registered Indians (Statistics Canada 2007). Approximately 60% of these residents live on reserve or Crown land (Government of Alberta 2012c). In BC, almost 7000 residents are identified as Aboriginal, 2,030 of whom are registered status Indian (Statistics Canada 2007). Reserves including East and West Moberly Lake, Blueberry River, Doig River, Fort Ware and Halfway River, as well as the Settlement of Ingenika Point are located on the BC side (Statistics Canada 2011a). The entire region is part of treaty 8, which spans northern Saskatchewan, Alberta and BC and the south western part of the

North West Territories, including 39 First Nation communities. Aboriginal groups are important stakeholders and have a strong presence in the energy development in the region.



**Figure 1. Map of the Peace River Region**

Source: Discover the Peace Country 2011 (Interactive version found at: [www.discoverthepeacecountry.com/htmlpages/mappeacecountry.html](http://www.discoverthepeacecountry.com/htmlpages/mappeacecountry.html)).

## Economic climate

The region has rich deposits of natural resources, including conventional oil, oil sands, natural gas, forestry, agriculture, fresh water, sand and gravel (PREDA N.d.). Subsequently, the main economic drivers include forestry, oil and gas, retail and construction (Statistics Canada 2011a, 2011b). Unemployment ranges from average to low, at 4.79% in Peace River, AB (Statistics Canada 2011a) and 0% in Fort St. John, BC (NPEDC N.d.). The top employers are mining, oil and gas (Statistics Canada 2006), and the region is the largest producer of conventional oil and gas in Alberta (Government of Alberta 2012b). Construction is also a growing industry, while the agricultural sector is in decline (Statistics Canada 2006). The region boasts 10% of Alberta's farms and croplands (Statistics Canada 2006) and produces 20% of Alberta's canola (PREDA N.d.). On the BC side, this fertile northern region produces 90% of BC's total grain and 95% of total canola production (SPEDC N.d.; NPEDC N.d.). Given the dominance of natural resources,

here is also significant employment in the associated service sectors (Statistics Canada 2011a, 2011b).

## **Governance and Stakeholders in the Peace Region Energy Sector**

Despite a lack of direction from the Government of Canada and the Government of Alberta, many municipalities and local groups have taken on a leadership role in renewable energy development in the Peace Region. The Government of British Columbia (2008) has also provided support, with the development of an *Energy Plan* that clearly aims to increase alternative energy generation in the province. Along with provincial and national energy strategies, this section will detail the role municipal governments play in renewable energy development in the Peace Region.

At the national level, the federal government has attempted to draft a *Canadian Energy Strategy*. At the annual premier's conference in July 2012, most provinces expressed support for the strategy. While Alberta premier Alison Redford was a big supporter of the plan, BC premier Christy Clark refused to sign on. More discussions are to come, as the Northern Gateway pipeline remains at the heart of the debate (Thomson 2012).

The BC Government's *Energy Plan*, released in 2009, aims to promote provincial energy self-sufficiency by 2016, using clean and renewable sources. Under the plan, all new electricity generation stations are required to produce net zero carbon emissions. To ensure a locally produced supply of electricity, the plan states that further development of hydroelectric resources is necessary to provide electricity during "critical water conditions". In addition, the plan includes provisions for BC Hydro to supply contracts and provide transmission infrastructure to smaller clean energy projects generating 10 MW or less. A clean energy fund has also been established to encourage the development of renewable energy sources. Clearly, this plan will have significant influence over the development of energy resources in the Peace River Region (Government of BC 2009).

Although The Government of Alberta's (2008) *Climate Change Action Plan* includes some provisions for greening energy production in the province, the plan does not directly promote renewable energy production. Instead, the plan mandates carbon emission intensity for companies, who can reach emission reduction goals through efficiency, carbon credits, or by purchasing carbon offsets. The plan also encourages carbon capture and storage, which could be used as a means of reducing the overall carbon footprint of oil and gas recovery. Given the lack of provincial direction, it is up to individuals, groups and municipalities to become leaders in renewable energy development in Alberta.

Some municipalities and local organizations have become leaders in renewable energy throughout the Peace Region. Numerous sustainable initiatives have been undertaken in local municipalities and citizen groups have played a key role in alternative energy development. These stakeholders will be further discussed throughout the next sections (Peace Energy 2012; Town of Fairview 2010; City of Dawson Creek 2012a & 2012b; City of Fort St. John 2012a & 2012b; One Sky 2012).

## **Sustainable energy initiatives in the Peace Region**

A number of NGOs operate in the region, including an energy cooperative as well as numerous environmental and citizen groups. Municipal governments have also undertaken significant sustainable initiatives, including regional partnerships. For instance, two Dawson Creek residents started the Peace River Energy Cooperative in 2002. The cooperative was initiated as an alternative to the large multi-national energy companies that dominated the energy sector in the region. Using the expertise and resources of local residents, the cooperative initiated the first wind farm in BC in 2004. This project, the Bear Mountain Wind Farm, will be discussed in further detail in the following section, under Wind Energy (Peace Energy 2012). In addition to initiating renewable energy projects, the group also acts as an advocate for renewable energy development in the province of BC.

Some of the initiatives in the region include:

- South Peace Chapter (2012) of the BC Sustainable Energy Association
- The Town of Fairview's (2010) *Integrated Community Sustainability Plan*
- The District of Hudson's Hope has created a solar heated community pool using a grant from NDBC. The project has provided cost savings and reduced electricity use in the city (Northern Development BC 2012).
- The Peace River Environmental Society
- The City of Dawson Creek (2012a; 2012b) has a "Climate Action Plan" and "Sustainable Dawson Creek Initiative" which provides direction for renewable energy use.
- Local programs in the city of Fort St. John (2012a; 2012b) including "Be the Change" and "Community Energy & Emissions Plan" include an awareness campaign and requirements for GHG emissions mapping. They are currently developing a plan to reduce emissions. They have also developed a program to encourage solar hot water use called "Solar Ready" and have installed solar powered lights in bus shelters.
- The Grand Prairie (2012) Municipal and Regional Sustainability Plans was first adopted in 2010 and includes a broad vision for reducing the environmental impact of the community and creating a sustainable environment.
- Northern Environmental Action Team
- Energetic Olympics competition in BC communities (One Sky 2012)
  - Chetwynd installed windmill powered boulevard Christmas lights; solar powered crosswalk lights, and has an airport terminal heated using geothermal.
  - Dawson Creek upgraded 14 bus stops with solar lights. The local Northern Lights College also offers wind turbine maintenance and geothermal installation courses.
- Sci-Tech North (2012) aims to stimulate innovation in technology in northeastern BC. They recently partnered with Peace River Energy Co-op to provide equipment for wind development.

## **Other stakeholders and key players**

The primary utility provider in British Columbia is BC Hydro, which is the consolidation of BC Hydro and the BC Transmission Corporation. The company plans and delivers energy to all BC residents and is required to provide a clean, sustainable energy source under the province's

*Clean Energy Act* (Government of BC 2010). The industry also is required to monitor and reduce GHG emissions and provide jobs for local residents. Electricity provision is regulated by the British Columbia Utilities Commission (BCUC 2012).

In Alberta, energy production has been deregulated, meaning generators can sell their power on a competitive market. Utility provision is undertaken by a number of companies, including ENMAX Power Corp., EPCOR Distribution, ATCO Gas, ATCO electric, Fortis Alberta Inc. and Direct Energy. Energy transmission is still regulated, so the Alberta Electrical Supply Operator (AESO 2012) ensures long-term operation and planning of the electrical transmission system, which is regulated by the Alberta Utilities Commission (AUC).

Over 25 communities in the Peace Region of Alberta have partnered to create the Peace Region Economic Development Alliance (PREDA). The group works to promote economic development and well-planned growth by building capacity among communities members. They also provide statistical data about the region, including economic indicators (PREDA N.d.).

Community Futures Peace Country is another organization that works with community members to support the growth of rural communities by fostering innovation and diversification. They offer financial and support services to entrepreneurs, including loans, a resource library, business counseling, planning and training. The group also works with local leaders and stakeholders to develop strategic and visions for the region, aiming to create resilient communities through support and leadership. The initiative is supported by the federal government's program, Western Economic Diversification Canada (Community Futures Peace Country N.d.).

In the Peace River region of BC, two commissions support economic development. The South Peace Economic Development Commission (SPEDC) and the North Peace Economic Development Commission (NPEDC) share similar mandates to promote sustainable economic development. Each commission focuses on a specific area of the Peace Region, following electoral boundaries (SPEDC N.d.; NPEDC N.d.).

The South Peace Economic Development Commission (N.d.) identifies stakeholders in energy development in the region, including:

- Aeolis Wind
- Apache Energy
- Canadian Association of Petroleum Producers
- Canadian Energy Pipeline Association
- Canadian Gas Association
- Canadian Society for Unconventional Gas
- Centre for Energy
- Environmental Assessment Office
- Enbridge
- EnCana Corporation
- Energy Services BC
- Ferus
- Geologic Survey of Canada
- Geoscience BC



- Ministry of Energy
- Ministry of Environment: Environmental Protection Division, Peace Region
- The National Energy Board
- Natural Resources Canada
- The Oil and Gas Commission
- Peace Energy Cooperative
- Petroleum Services Association of Canada
- Small Explorers and Producers Association of Canada (SEPAC)
- Shell Canada
- South Peace Oilmen's Association
- Talisman Energy Inc.

During its review of the transmission system, AESO also identified a number of stakeholders in transmission expansion in the Peace Region:

- Alberta Energy and Utilities Board
- Alta Link Management
- ATCO Electric
- ATCO Power
- BC Hydro/PowerEx
- BC Transmission Corporation (Now part of BC Hydro)
- Canadian Hydro Developers Inc.
- Diashowa
- FIRM Customers group
- Fortis Alberta
- Husky Energy
- Industrial Power Consumer Association of Alberta
- Alberta Direct Connects
- Milner Power Inc.
- Shell Canada Limited
- Trans Canada

It is important to note that the stakeholder lists both concentrate on corporations with a stake in the energy future of the region, notably excluding Aboriginal groups, Environmental groups and other NGOs in the region. The role and stake of these important groups should be further explored.

### ***How to Measure and Understand Electricity Generation and Use***

Before we discuss the current situation in Peace River, it is important to understand how electricity generation capacity and demand is measured. Electricity demand is usually measured in kWh (AESO 2012). The average household in BC Hydro's (2012) service area uses 11,000 kWh per year. By comparison, a large industrial customer may use around 400 GWh per year and a large retail outlet might consume closer to 4 GWh per year.

kWh= 1,000 watts for 1 hour

MWh= 1,000 kWh  
GWh= 1,000 MWh

The capacity of an electricity generation source will often be listed in MW or GW, referring to the maximum amount of energy that can be produced at one point in time. Most energy generation sources do not operate at capacity all the time, thus real electricity output will be much lower. A ratio called the power to energy ratio can be used to calculate the average output of a source in watt-hours. For example, a large hydro plant's power capacity in MW, may be multiplied by 5 to determine the total energy output in GWh per year (BC Hydro 2012).

kW= 1000 watts  
MW= 1 million watts  
GW= 1 billion watts

### ***Current Electricity Production and Use in the Peace Region***

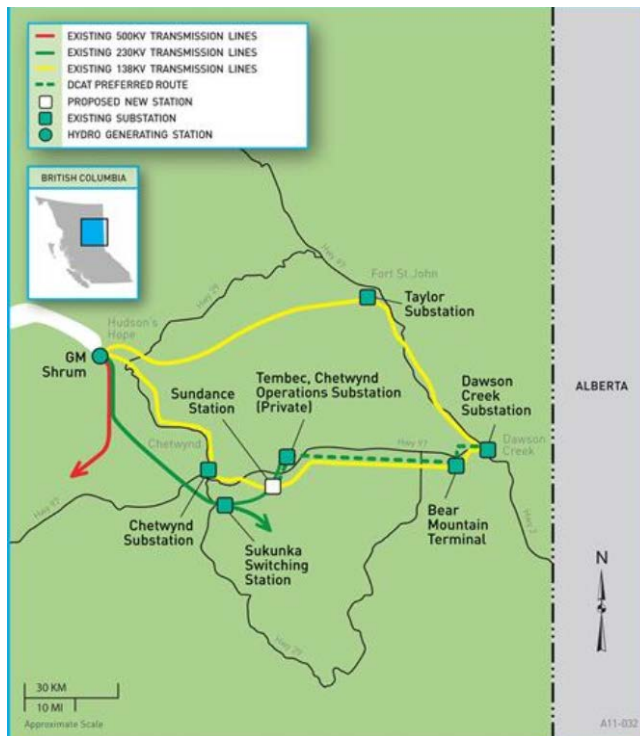
The electrical grids in BC and AB are interconnected, however the two provinces have very different electricity sources (BC Hydro 2012). In British Columbia, the predominant electricity source is hydroelectricity, whereas in Alberta, coal dominates (Pembina Institute 2012). Over 80% of electricity generation in BC is sourced from hydro (BC Hydro 2012). Although there are coalmines located in the BC portion of the region, the majority of coal in BC is exported (SPEDC N.d.). In Alberta, over 70% of electricity is generated from coal fired plants (Wies and Bell 2009). Given the significant natural gas resource throughout the Peace Region, there are some natural gas fired facilities that supply electricity (Atco Power 2008). A complete list of Canadian electricity generating stations can be found here:

<http://atlas.nrcan.gc.ca/site/english/maps/energy.html>.

The Atlas of Canada (2007) also provides other interactive maps of energy sources in Canada. In British Columbia, a complete interactive map of electricity generation sources can be found here: <http://www.energybc.ca/map/bcenergymap.html>. The following sources are located in the Peace Region (Energy BC 2012):

McMahon Co-Generation Natural Gas Plant- 120 MW  
Peace Canyon Dam- 694 MW  
W.A.C. Bennett Dam- 2,730 MW  
Bear Mountain Wind Park- 144 MW  
Dokie Wind Farm- 144 MW  
Bullmose Wind Farm- 60 MW  
Tumbler Ridge Wind Farm- 45 MW  
Quality Wind, Wind Farm- 142 MW

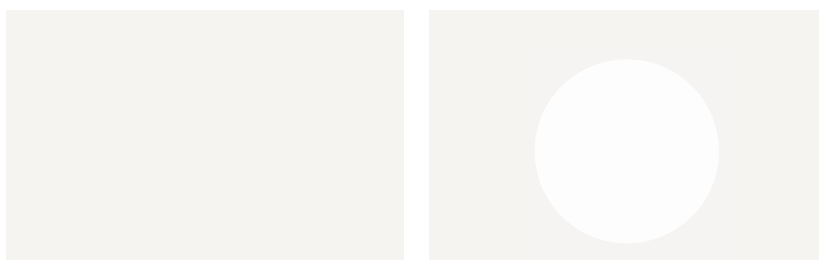
These energy sources are all tied to the main grid and supply electricity to local communities as well as the province. A map of the grid in the Peace Region is provided in figure 2.



**Figure 2. Main Transmission Lines in BC**

Source: BChydro 2012a:2-47

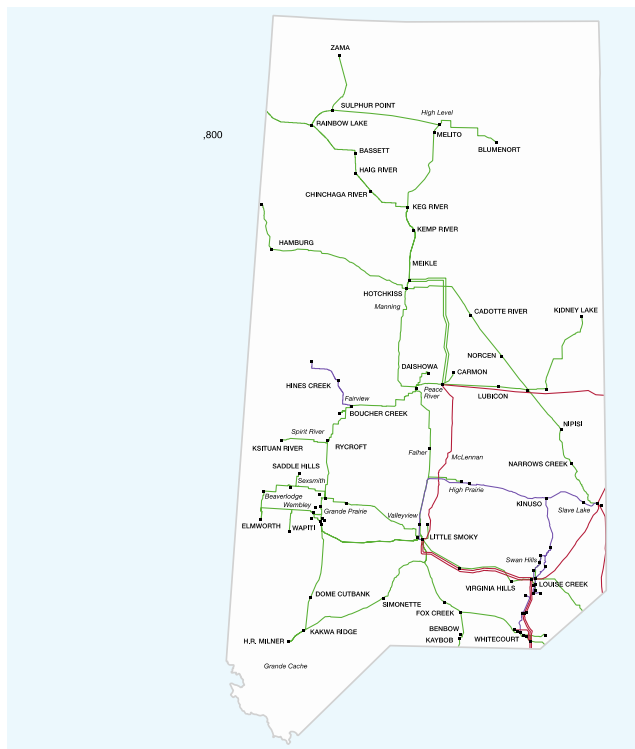
The Alberta side of the region has fewer generation stations. An interactive energy map of Alberta is located at <http://www.energy.alberta.ca/OurBusiness/1071.asp>. The maps show the gas and oil sands resources in the region, as well as the natural gas and crude pipelines that cross it. No coal, wind, shale, crude, or hydro resources are currently being used on that side of the region, however there is the potential for these resources to be developed in the future. Province wide, the mix of electricity sources is demonstrated in Figure 3, showing the dominance of coal and gas. The Alberta Electrical System Operator (AESO 2012) expects the use of wind resources to increase over the next few years, while coal use is expected to decline. According to AESO (2012), the vast majority of Alberta's electricity supply is still expected to originate from non-renewable sources in 2020.



**Figure 3. Current and Predicted Generation Sources in Alberta to 2012**

Source: AESO 2012

Figure 4 demonstrates the existing transmission line routes in the Peace Region of Alberta. Currently, the region is powered predominately by gas-fired substations. The H.R. Milner coal plant, located near Grande Cache, Alberta supplies 145 MW and is expected to be decommissions in 2020. AESO lists hydro, wind, geothermal, coal, gas and biomass as resources with the potential to be developed in the future (AESO 2012).



**Figure 4. Location of Substations and Transmission Lines in the Peace Region of Alberta**

Source: AESO 2012:103

## Electricity Demand and Infrastructure

Given the growing population of the region and increased oil and gas development (Statistics Canada 2012), electricity demand is expected to rise. This raises important questions about the sources of energy in the region and the potential impacts the development of new energy resources will have.

BC Hydro (2012a) outlined the projected electricity demand for the Peace Region in its *Integrated Resource Plan*. The company expects demand to grow significantly in the region and has planned for an upgrade to the Dawson Creek transmission system to accommodate the increase. This load growth will largely be driven by natural gas resource development and many project proponents have expressed the desire for grid tied operations in the area.

To determine how to meet the growing demand in the region, BC Hydro (2012a) explored a variety of options including biomass, wind, hydro, gas and geothermal. They identified 3 potential sites for biomass generation, using timber and wastes, with a total possible capacity of 1,090 MW (p. 3-27). In addition, 45 potential sites for wind development were listed, with a capacity of 5,864 MW (p. 3-32). Run of river hydro generation is also a possibility, with 32 possible sites totaling 115 MW (p. 3-35). Site C is another potential hydro development, which would create a large dam with a capacity of 1,100 MW (p. 3-36). Only one site with geothermal potential is identified, with a capacity of 20 MW (p. 3-39). One coal plant could also be constructed, with a capacity of 745 MW (p. 3-42). Finally, one solar site is identified, with a capacity of 5 MW (p. 3-47). Clearly, there are many options to meet growing demand and a diverse generation system is possible.

The Alberta Electrical Supply Operator (AESO 2012) expects electrical load growth in the northwest region of Alberta, as depicted in figure 4, to increase from 1,039 MW in 2010 to 1300-1800 MW in 2020. This growth will be driven by the expansion of the forestry and gas industries in both BC and AB. The completion of the Dunvegan Hydro project and the Swan Hills Synfuel underground coal gasification projects will also be a driver of capacity increase. The H.R. Milner coal site could also be expanded.

The northwest regions of Alberta and BC both have “very long transmission lines” (AESO 2012:104), straining transmission capacity. Reinforcements are planned, particularly in the Grande Prairie region, where load capacity has already been reached. Further development of oil sands and gas resources in this region would also impact transmission needs, requiring further capacity increases in generation and transmission (AESO 2012; BC Hydro 2012a).

### ***Non-Renewable Energy Development in the Peace River Region***

This section will outline current and potential coal, oil and gas development in the region, demonstrating the significant size of petroleum resources and describing the current activity in the region.

#### **Conventional Oil & Gas**

The Peace River region is part of the Western Canada Sedimentary Basin, which holds some of the largest reserves of petroleum and natural gas in the world (SPEDC N.d.). Over 99 companies operate in the North Peace Region of BC alone, where there were 254 oil and gas wells operating in 2009 (SPEDC N.d.). The Peace Country contains approximately 24% of Alberta’s oil and gas reserves (Government of Alberta 2012).

#### **Current oil and gas production**

The Peace Country was Alberta’s largest gas and conventional oil producing region in 2009. Gas production declined 4% between 2004 and 2009, coinciding with falling prices, however 25% of Alberta natural gas originated from the region in 2009. Oil production and well drilling also declined in 2008, coinciding with the global economic downturn (Government of Alberta 2012).

Companies including Shell Canada, Penn West, Baytex Murphy, Canadian Natural Resources Ltd., Talisman, and North Peace Energy also operate in the region (PREDA N.d.). There are over 9,000 wells on the Alberta side of the region, producing over 2 million cubic metres of oil per year and 30 billion cubic metres of natural gas (PREDA N.d.). Similar information cannot be located for the BC side, however Shell has over 250 wells in Dawson at the Groundbirch site alone, so it is likely there are a significant number there as well.

As far as revenue, it was challenging to locate numbers for the entire region. As a rough estimate, the production reported by PREDA (2012) for the Alberta side of the region were combined with oil and gas prices (Bloomberg 2012), as of September 8, 2012:

For oil: 2 million cubic metres per year  
=18,869,432 US barrels (bbl) of oil x \$96/bbl of crude  
= ~\$1.8 billion per year

For natural gas: 30 billion cubic metres per year  
= ~30 million MMBtu x \$2.70/MMBtu  
= ~\$81 million

Those numbers are obviously quite crude, however they do provide a rough idea of how much money there must be generated by current oil and gas production in the region.

There are a also number of natural gas fired electricity generation facilities located in the region. Atco's Polar Hill Generating plant is located near Grande Prairie, with a capacity of 45 MW (Atco Power 2008).

### **Current coal production**

BC is one of leading coal producers in Canada, with large coalfields to the west and south of Tumbler Ridge. There are 10 coalmining projects in the South Peace region, as well as a number of new proposals. BC exports coal worldwide, shipping over 24 million tonnes to Japan in 2008. Coal is also used to produce electricity in the province (SPEDC N.d.). There are no coalmines located within the Alberta portion of the region, however 74% of the province's electricity is sourced from coal burning facilities (Wies and Bell 2009). The 144 W, H.R. Milner coal plant provides electricity to the grid, as do a number of smaller gas fired plants (AESO 2012).

One of the largest coal developments in the Peace Region is the Trend Mine, located 25 km south of Tumbler Ridge, BC and operated by Peace River Coal. The mine has been in operation since 2005 and is slated to produce 2 million metric tons of a coal per annum over approximately 10 years. The Willow Creek and Wolverine are open pit mines also located near Chetwynd. Both are operated by Western Canada coal (Peace River Coal 2009).

### **Proposed and potential coal production**

A number of proposed projects, including the Belcourt-Saxon Coal Limited Partnership, the Roman Mountain project, and the Horizon project are located nearby the existing Trend Mine.

Each project could produce between 2 and 3 million tonnes of coal per year for 10 to 15 years, if approved (Peace River Coal 2009). Coal resources are significant, with a large deposit running 400km through the northern part of BC and AB. The Peace River deposit is estimated to contain between 60 and 200 trillion cubic feet (Hannigan et al. 1998). A number of players are actively searching for exploitable deposits.

## **Unconventional Oil & Gas: Shale Gas, Fractal Drilling, Oilsands and In Situ**

There are 3 major oil sands deposits in Alberta, as depicted in figure 5. Peace River has the smallest deposit, which is primarily extracted using Cyclic Steam Stimulation (CSS) and Steam Assisted Gravity Drainage (SAGD) (Government of Alberta 2012a). Shell Canada is the primary developer of the Peace Country oil sands in Alberta, with a capacity of 12,000 barrels per day and over 100 employees (PREDA N.d.). There is an estimated 1.6 billion cubic metres of bitumen on site and Shell is looking for ways to expand the site and enhance recovery (National Energy Board 2000). Oil sands projects in Alberta were valued at \$3,450 million in 2011 (Government of Alberta 2012a).



**Figure 5. Major Oil Sands Deposits in Alberta**

Source: Environment Canada 2010

## **Proposed and potential unconventional oil extraction**

The Peace Region holds an estimated 1.6 trillion barrels of crude bitumen, 18.6 billion barrels recoverable using existing technology. Approximately 5% can be removed using existing heavy oil conventional extraction methods, while the rest requires advanced recovery methods. Technological advances are expected to increase recovery rates in the region (PREDA N.d.).

Two new extraction projects have been proposed in the region and the Northern Gateway pipeline would also run through the area. Shell's proposed Carmon Creek project would expand existing production to 100,000 barrels of bitumen per day. In addition Shell's proposed Seal Lake project would provide an additional 15,000 barrels of bitumen per day. The proposed Northern Gateway pipeline would go from Edmonton to Kitimat, BC, traveling through the Peace Region, specifically Tumbler Ridge, BC. The pipeline has sparked controversy among many groups in the region, including environmental NGOs, aboriginal groups and local residents (SPEDC N.d.).

## **Unconventional gas extraction**

Unconventional gas extraction involves drilling into gas formations that do not flow easily. To help extract the gas, pressurized gases, chemicals and liquids are injected into the formation. This process is called hydraulic fracturing. Directional drilling is also undertaken, and numerous horizontal wells may be drilled to reach the formation. This extraction of shale gas is often referred to colloquially as "fracking" and was not economically or technically feasible until the past few years (Campbell and Horne 2011).

## **Proposed and potential unconventional gas extraction**

The development of shale gas is surrounded by controversy, particularly over the water use associated with fractal drilling. Recently, Shell and the city of Dawson Creek constructed an effluent treatment facility, to provide treated city waste water for fracktal drilling, reducing fresh surface water use by approximately 4000 cubic metres per day (Hamilton 2012). Despite improvements, the technology is still controversial. There is significant push from the gas industry to develop the shale gas resource in Northern BC. Reserves are an estimated 52 billion cubic metres per annum, enough to supply 70% of Canada's gas demand for a year (Campbell and Horne 2011).

## **Coalbed Methane**

A number of coalbed methane wells have been drilled throughout BC and Alberta. Over 90% of BCs coalbed methane is located in the Peace Region. The Peace River Coalbed Gas Project, located near Hudsons Hope, BC was the first site of commercial coalbed methane production in BC. The total resources is an estimated 1 trillion cubic feet. This development is also controversial, given the environmental implications including habitat fragmentation and loss as well as water and air pollution (West Coast Environmental Law 2003).



## ***Alternative Energy Development in the Peace River Region***

Currently, numerous alternative energy sources have been developed in the Peace River region, including hydroelectricity, solar generation and wind power. The area has high potential for further alternative energy development and a variety of projects have been proposed for the region. This section will highlight current development, overview proposed projects and describe the potential for alternative energy development in the region. Hydroelectric, solar, nuclear, wind, geothermal and biomass sources will all be reviewed.

### **Hydroelectricity**

Hydroelectricity generation is a significant source of energy in Canada, providing over 75% of electricity in British Columbia. Power is generated by falling or running water, which is used to spin turbines. Dams can be used to collect water, which is then released as needed to spin turbines. Dams range in size, with the largest having a capacity of more than 50 MW. Smaller systems, often generating less than 500 kW often use “run-of-river” technology. In these dams, water is diverted to a channel running parallel to the river, which delivers water to the turbines. In both types of dams, the mechanical energy created by turbine spinning is then converted into electrical energy using a generator. Electricity can then be transported significant distances to the end user, via transmission lines (Pembina Institute 2012).

Peace River is one of the main river basins in Alberta and British Columbia. At the town of Peace River, the average flow of the river is 1,830 m<sup>3</sup>/s, with a maximum flow of 10,400 m<sup>3</sup>/s and a minimum flow of 200 m<sup>3</sup>/s. To even out the flow, water can be stored in dams and released during slower flowing winter months, to provide a steady supply of electricity year round. (AUCH 2010).

### **Current hydroelectricity generation**

The Peace River region currently has two large hydroelectric dams, located on the Peace river, near Hudson’s Hope, about 86km west of Fort St. John in British Columbia (PREDA N.d.). The Peace Canyon Dam has a capacity of 700 MW. Just a short distance away, the W.A.C. Bennet Dam is the largest dam in BC, generating over 13 billion kwh annually, with a capacity of 2730 MW (City of Dawson Creek 2012a). The W.A.C. Bennet Dam has been producing electricity since 1967. Combined, the dams currently supply 40% of BC’s hydroelectric power and the plants are connected to major transmission supply lines that span the province, as depicted in figure 6 (NPEDC N.d.). Although the same river flows through the Alberta side of the region, there are currently no dams there.



**Figure 6 Hydroelectric Generation Facilities and Transmission Lines in BC**

Source: KnowBC N.d.

### **Proposed hydroelectric projects**

In British Columbia, “Site C” has become notorious and the decades of debate over the site highlights the controversy surrounding hydroelectric development. Site C is located on Peace River, 7 kilometers southwest of Fort St. John. A proposal to dam the river there in the 1970s received significant opposition based on the environmental and social implications. Residents expressed concern regarding the potential impacts on First Nations, including dislocation. The project was ultimately not approved by the BC Utilities Commission due to issues with demand forecasting (Evenden 2009).

Decades later, another dam has been proposed on the site. The proposed dam could generate 4,600 GW hours of electricity annually by 2020 (Hume 2010). The BC Government’s Energy Program is one of the drivers of the project and numerous viewpoints on all sides of the debate have emerged. Evenden (2009) compiled the proceedings of the attendees of a workshop at the

University of British Columbia, presenting many sides of the debate, including First Nations, residents and environmentalists. The project is currently undergoing environmental and regulatory review (City of Dawson Creek 2012a).

The Dunvegan Hydroelectric project, first proposed in the 1980s, would span Peace River, just north of Dunvegan, Alberta. The unique design does not involve water storage, reducing the environmental impact downstream, as the regular flow of the river would not be altered. The project could generate approximately 600,000 MWh of electricity per annum and is expected to last 100 years or more. Despite positive feasibility studies in the 1980s, the project was not further pursued until recently. The site has been approved for 100MW of generation and construction is slated to begin soon (Transalta 2011).

### **Hydroelectricity generation potential**

The Alberta Utilities Commission (AUCH) have identified 17 sites along the river basin as having hydroelectric potential, with a total potential capacity of 39,490 GW hours annually. Dams could be constructed on the Peace, Smoky, Wapiti, Little River and Wabasca Rivers. Creating more dams on the Peace River could actually increase the efficiency of existing dams, however the additions would have to be carefully planned to minimize the potentially negative social and environmental implications (AUCH 2010).

### **Solar Energy**

Solar development can take different forms depending on the scale of the project. Home and commercial scale projects may use photovoltaic panels, which convert solar rays into electricity. Solar hot water heaters are also common, using passive solar energy to heat water for domestic use. At a larger scale, reflective parabolic rays can be used to direct and concentrate the sun's energy, heating water into steam to spin turbines. Construction of large-scale solar farms, using multiple PV panels is also an option (Pembina Institute 2012).

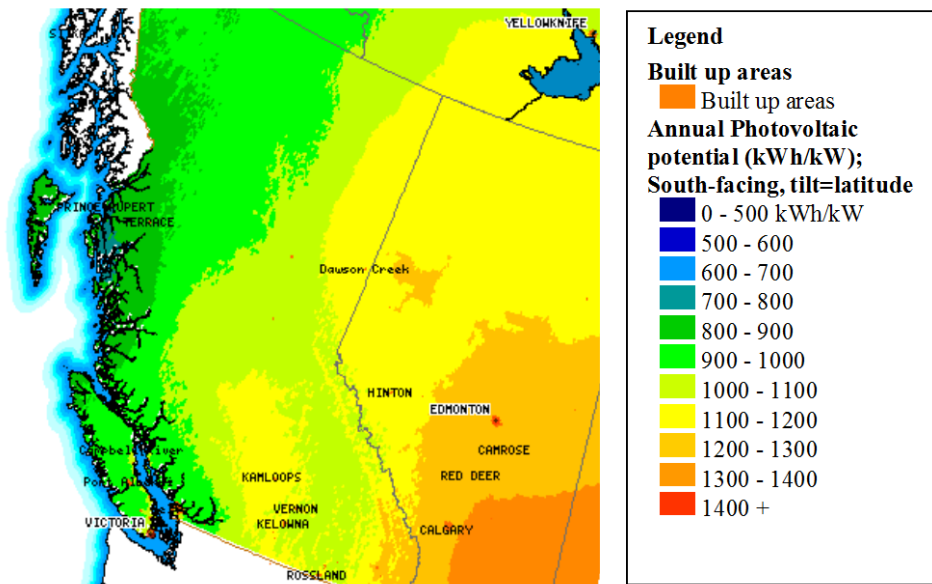
### **Current solar energy production**

No large-scale solar projects have been undertaken in the region, however many cities are studying the potential for development. A number of smaller scale projects have also been undertaken, including solar powered traffic signs, pedestrian crossings, bus stops and trail lights in the city of Dawson Creek (City of Dawson Creek 2012b). In Fort St. John, a few 1 or 2 PV panel systems have been installed (Solar BC 2012a).

### **Proposed and potential solar energy production**

The Peace River Region has high potential for smaller scale solar development and the AESO (2012) identified one site suitable for a larger scale, 5 MW installation. The city of Dawson Creek has 2215 hours of sunlight annually (City of Dawson Creek 2012) while Grand Prairie has 2203 days (Current Results 2012). Solar BC (2012b) reports that most northern cities receive around 2,200 hours a year, while southern cities receive 2100. In comparison Regina, which is identified in Figure 7 as the number one hot spot for PV potential in Canada, receives just over 2,300 hours a year (Current Results 2012). Despite the Peace Region's northern latitude, it still

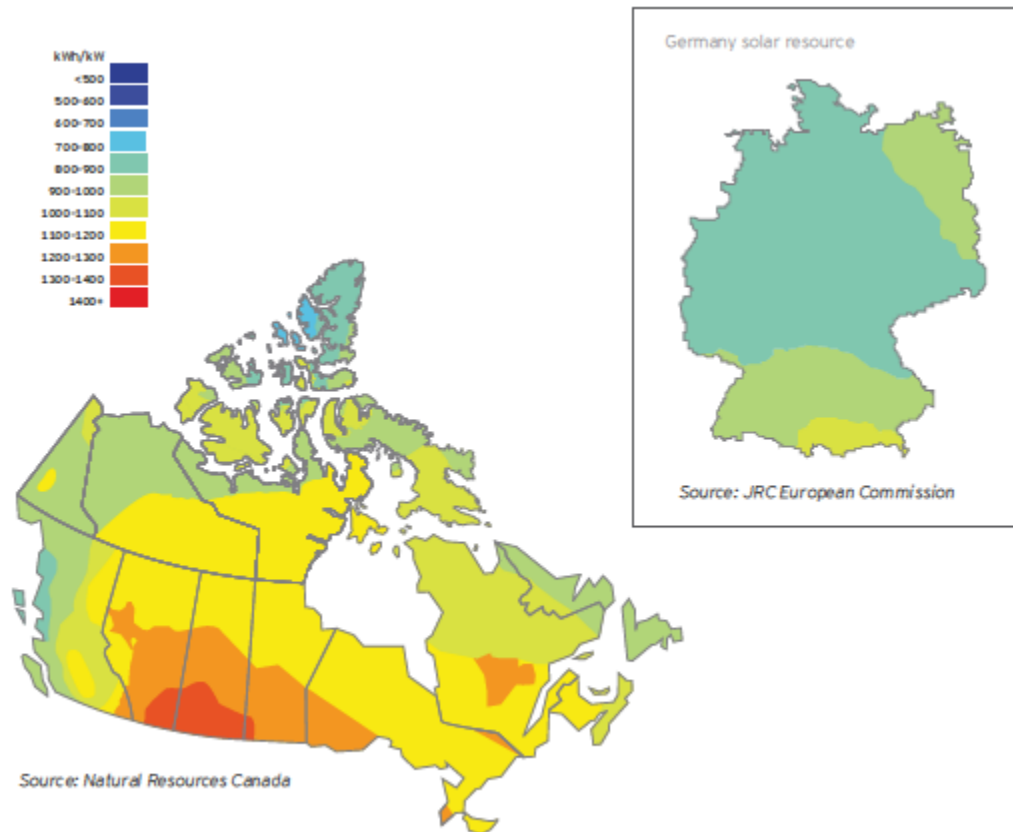
receives more than enough sun to support solar generation, with an average PV potential of 1196 kWh in Peace River and 1169 kWh in Fort St. John (Natural Resources Canada 2012).



**Figure 7. Photovoltaic Potential of Western Canada**

Source: GENI N.d.; Natural Resources Canada 2012

Although the Peace Region is not identified as a “PV hotspot” by Natural Resources Canada (2012), the region does have a PV potential between 1,100 and 1,300, on average, as seen in figure 7. Compared to other regions already using solar energy, this level appears to be high enough to support further development. To demonstrate the high solar potential of Canada, Figure 8 compares the PV potential of Canada to that in Germany, where solar resources have been successfully and extensively developed (CanSIA N.d).



**Figure 8. Solar Energy Potential of Canada vs. Germany**

Source: CanSIA N.d.

The city of Dawson Creek commissioned a study of local solar resources in 2008. The study, conducted by Tim Weis (2008) of the Pembina Institute, concluded that the region is well suited to PV panel, provided they are installed at the correct incline for the latitude. As the price of solar technology declines, solar energy may be an increasingly viable option to fulfill Peace River's growing energy needs.

## Nuclear Energy

Nuclear energy uses radioactive uranium to heat water and create steam, which is used to spin turbines and generate electricity. Although it has been promoted as an emission free source of energy, there are significant environmental issues created by waste generation, including water contamination and spent fuel disposal. Nuclear power is particularly controversial and startup costs are also prohibitive (Pembina Institute 2012).

There is currently no nuclear power production in the Peace Region. A nuclear plant was proposed by Bruce power near the city of Peace River in 2007, however it was later dropped in 2011. Critics speculate it was dropped due to local opposition (CBC News 2011), however it is also possible that the economic downturn in 2008 played a role. The company claims it dropped the project to pursue opportunities in other areas (Bruce Power 2011). The project proposal sparked a debate in the region, which was published in *Mile Zero News* and the *Banner Post* in

March of 2010. The 8-part debate features opinions from experts on all sides of the issue, detailing the controversy surrounding the environmental and social implications of nuclear development.

### **Proposed and potential nuclear production**

Although it has not yet been developed, PREDA (N.d.) identifies nuclear power as having high potential as emerging economic driver in the region. No further proposals have arisen since the Bruce power project was dropped, yet officials from Bruce Power (2011) claim they received strong support from the local community, meaning potential for future nuclear development in the region is high.

### **Wind Energy**

Wind energy is captured using turbines that spin when wind hits their blades, turning a generator located inside the turbine, creating electricity. Wind is a variable resource, as it only generates power when the wind blows. Thus, most turbines operate below their full capacity, normally only spinning 80% of the time. Developing wind power costs between \$1,800 and \$2,300 per kilowatt of capacity. This figure is expected to decline as turbine production capacity increases in North America (Weis 2012).

Coastal regions, high elevations and flat landscapes tend to be best for wind power development. Wind tends to blow more during the day than night, which corresponds well with average electricity use. Wind speed is measured at 80 m above ground, the ideal height for a wind turbine. Suitability for wind power is rated on a 7 category scale, with class 7 being the best. Generally, commercial installations are only undertaken on locations with a wind resource of class 3 or higher (Pembina Institute 2012).

### **Current wind energy production**

BC's "first industrial scale wind farm" became operational (grid tied) in 2009 near Dawson Creek (Fairley 2011). The site, called the Bear Mountain wind park, produces 102 MW annually, powering most of the South Peace Region in BC (SPEDC N.d.). A single row of 34 turbines stands along a ridge. Although the farm takes up 25 hectares, the land is still used for grazing, forestry, oil and gas exploration and recreation. Although it is now managed by Aeolis wind, the project was initiative by local residents under the Peace Energy Cooperative in 2003 (Alta Gas 2011; SPEDC N.d.)

The largest wind farm in BC is also located in the region. The Dokie wind project, operational since 2011, consists of 43 turbines located near Chetwynd, BC. The site can produce between 320,00 and 340,000 MW annually and produces power under a 25 year purchase agreement with BC Hydro. The farm is jointly operated by GE Energy and Financial Services and the Plutonic Power Corporation (SPEDC N.d.).

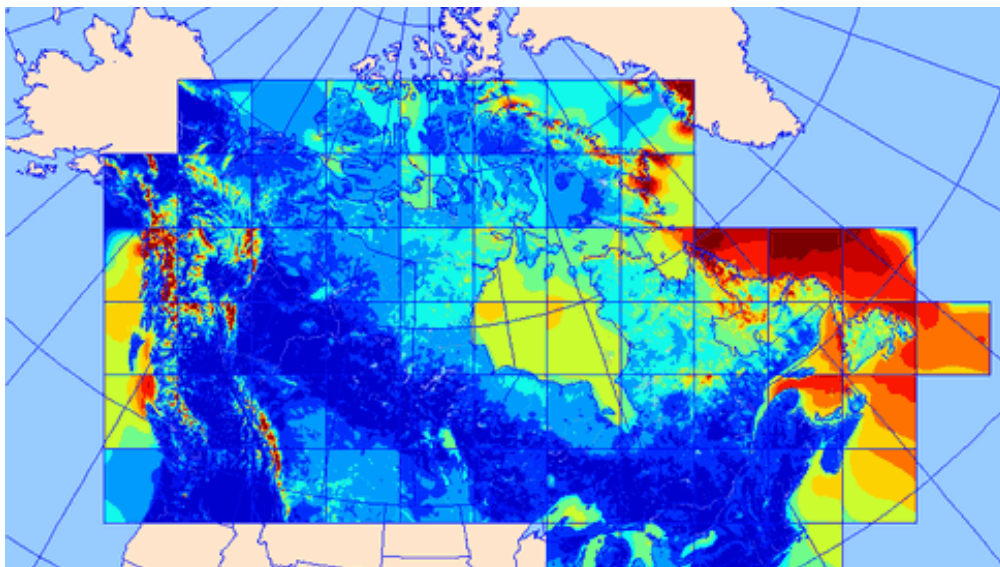
### **Proposed wind energy production**

Recently, 4 wind projects in the Tumbler Ridge area of BC were given purchasing agreements with BC Hydro under their “Clean Power Call” purchase program. The projects will have a combined capacity of 364 MW. Proponents include CP renewable Energy Ltd. and Finavera Renewable Inc. (SPEDC N.d.)

The Peace Energy Cooperative has also proposed another wind project, the Centennial Green Project, near Dawson Creek. The proposal is for a public facility in the old Dawson Creek swimming pool building that will showcase renewable energy use. The design features a library, public square, farmers market, playground, café. The site will also feature a district heating utility that uses heat from the refrigeration units of the nearby skating rinks to heat the old pool, which can then be used to heat up to 300,000 square feet of space in nearby buildings (SPEDC N.d.).

### **Potential wind energy production**

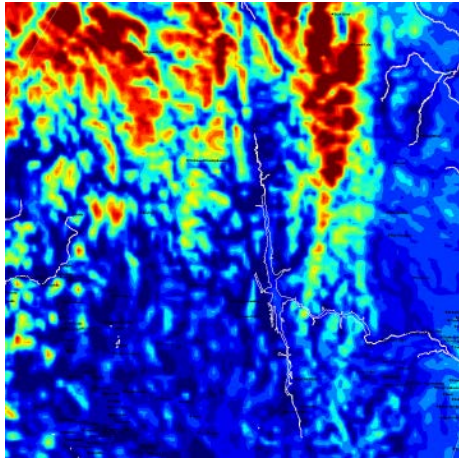
The city of Dawson is currently monitoring the wind potential of the area (City of Dawson Creek 2012b) and hired Tim Weis (2008) of the Pembina Institute to study the potential of the area. The report assessed the technical feasibility of further wind development around the city, including an examination of the economic implications. The 7 class scale for wind resources is depicted in figure 9, showing the average wind speed at 80 m. A closer look at the region in figure 10 demonstrates that it is considered class 2, with wind speeds ranging from 5.5-6.0 m/s at 80 m above ground. Although the class 2 ranking means it would not normally be considered for commercial development, selection of a flat site with little wind obstruction could make further development possible. With the number of successful existing projects in the region, it is likely more are feasible as well. The city is currently undertaking further monitoring of wind at 10 m, 20 m and 50 m above ground, to determine the best location for development in the region (Weis 2008).



**Figure 9. Mean Annual Wind Energy Map of Canada**

Source: Canadian Wind Energy Atlas 2003





**Figure 10. Wind Map of the Peace River Region**

Source: Canadian Wind Energy Atlas 2003; Weis 2008

To encourage wind development, BC Hydro offers a Standard Offer Program to wind power producers. Similar to a feed-in-tariff program, BC Hydro provides a variable purchase rate for wind power generated in BC. The Standard Offer rate in the Peace Region is the lowest rate offered in the province (Weis 2008). In Alberta, wind power developers must negotiate purchase rate with the electrical provider in the region (Pembina Institute 2012).

## **Geothermal Energy**

Geothermal energy can be captured in two different ways. Underground heat sources, including hot water and steam can be used to directly drive turbines. Alternatively, the temperature differential between the surface and underground can be used to heat or cool buildings. This form of geothermal energy is also sometimes called earth energy, which is captured using a heat pump, which brings heat from below the earth's surface into a building to heat it, or pumps hot air out of a building to cool it. The pump moves fluid around pipes that run under the earth and through the building, absorbing or emitting heat as needed (Pembina Institute 2012).

### **Current geothermal energy production**

There is currently no large-scale or grid tied geothermal energy development in the region, however some smaller commercial and residential projects have been undertaken.

### **Geothermal energy potential**

A report published by the Geologic Survey of Canada in 2012 details the significant potential for geothermal development in Canada. The report estimates that a minimum of 5000 MW of power could be produced on sites throughout BC, Alberta and the Yukon, however many of the sites identified are relatively inaccessible and are currently not grid tied. The map provided in figure 9 shows the geothermal potential in Canada, demonstrating that the Peace Region has the potential



for low energy electrical generation, given it's placement over a warm sedimentary basin (Grasby et al. 2012).

### **Figure 11. Map of Geothermal Energy Potential in Canada**

Source: Grasby et al. 2012:IX

Majorowicz and Moore (N.d.) also identify the Peace Region of Alberta as an area with poor geothermal potential. Given that the BC side of the region is located in the same warm sedimentary basin, it is safe to assume that there is low potential throughout the entire Peace Region. Although smaller scale projects may be feasible, particularly as the costs of production decline, it is unlikely that large-scale geothermal production will occur in the region.

### **Bioenergy**

Bioenergy is produced using biomass, which is organic matter originating from animal wastes, agricultural products, municipal wastes, forest products or other organic wastes. Through processing techniques, biomass can be transformed into fuel, electricity, heat or chemicals. Biofuels production is increasing in Canada, using first generation technology to convert grains and oilseeds to ethanol (Pembina Institute 2012). Canadian fuel standards require 5% of gasoline

to be sourced from renewable sources, driving the push for biofuel development (Agriculture and Agri-Food Canada 2008). Second generation methods, using wastes to create energy without devoting land specifically to energy production, are also growing in popularity (Pembina Institute 2012).

### **Current bioenergy production and processing**

After the Federal government invested \$1.5 million into biofuel R&D in the region in 2007, research into the best crops for biofuel production was undertaken. The BC Grain Producers Association (BCGPA 2007) also undertook a feasibility study, examining the economic implications of biofuel development in the region. The study concluded that positive economic benefits could be attained through the development of a biofuel production and processing industry in the region. They outline the best-case scenario, a \$22 million biodiesel processing plant that produces 22.7 million litres of biofuel annually, using 56,000 tonnes of canola (BCGPA 2007).

There is currently one bioenergy project under construction near Grand Prairie (Gov of AB 2012b). The Aquatera bioreactor gas-to-energy project will collect landfill gas and convert it into biofuel, which can be used to power vehicles (Jackson 2012).

### **Bioenergy production potential and proposed projects**

In 2009, a number of projects were proposed, including small-scale wood and residential waste projects as well as larger scale biofuel plants (PREDA N.d.). The city of Fort St. John (2012) is also pursuing a landfill gas recovery project. Research has also been undertaken at Olds College to develop the means of producing biofuel in the Peace Region using the common stinkweed (Olds College Centre for Innovation 2011).

Given the quality of the land and current agricultural and forest product production, significant potential for bioenergy development exists in the Peace Region. There is over 4.3 million acres of cropped land in the region (Government of Alberta 2012) and millions of hectares of forested land (NPEDC N.d.; PREDA N.d.; SPEDC N.d.). Dominant crops are grains, oil seeds and forage grasses (Wong 2010). Currently, 90% of grain and 95% of canola in BC, as well as 20% canola in Alberta is produced in the Peace Region (SPEDC N.d.; NPEDC N.d.). The livestock (beef and buffalo) industry is also significant in the region (Statistics Canada 2011a; 2011b), making animal wastes another potential source of bioenergy.

Not only could biofuels be produced from the grains and oil seeds grown there, but second-generation biofuel technology could be used to produce energy from agricultural or domestic wastes. Agricultural, forest products and domestic waste could all be used to create energy to produce electricity for the region. Given that trees are already processed in local mills, it may be feasible to add biomass recovery facilities into the existing production process, using the waste to generate energy locally.

## ***Conclusion***

A variety of energy sources are currently used in the Peace Region for electricity generation, including mostly hydroelectricity on the BC side (BC Hydro 2012a), and gas on the Alberta side (AESO 2012). Numerous alternative energy sources have also been developed in the Peace River region, including hydroelectricity (BC Hydro 2012a; AUCH 2010), solar generation (City of Dawson Creek 2012b; City of Fort St. John 2012a; 2012b) and wind power (Fairley 2011; SPEDC N.d.). A number of proposed projects are also on the horizon.

Given the growing population and potential for increased oil and gas development (Statistics Canada 2012), electricity demand is expected to increase in the near future, raising important questions about where this energy will come from and the potential impacts the development of new energy resources will have on the region. Alongside significant petroleum resources (PREDA N.d.), the area has high potential for alternative energy development. A number of new dams could be constructed, increasing the efficiency of the existing dams (AUCH 2010). The region also has a PV potential between 1,100 and 1,300, on average, which appears to be high enough to support further development (Natural Resources Canada 2012). Although the majority of the region has class 2 wind resources (Weis 2008), the potential for further wind development remains a possibility. Careful study to determine the most favorable locations, with flat landscape and little wind obstruction is important (Weis 2008). Given the regions location, in a warm sedimentary basin, large scale geothermal development is unlikely (Natural Resources Canada 2012), however biofuel development is possible, as the region is a large grain producer (NPEDC N.d.; PREDA N.d.; SPEDC N.d.).

There are many options for the Peace Regions energy future and the impacts of each energy source must be carefully considered. Important stakeholders, including environmental groups, Aboriginals, residents, and NGOs should not be excluded from this process.

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