

# A study of Canada's Energy Situation and Probable Future in the Energy Sector

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**Abstract**— Energy efficiency is one of the most important issues for the next generation scientists. Energy efficiency is one of the most important factors for power generation and distribution. As loss is one of the major thing of our concern so the scientists all over the world is working day and night to make the power or energy system more efficient. This work represents a brief discussion on the energy efficiency of Canada; its policy for energy use and production and their future roadmap. This paper work relies on an objective and credible analysis underpinning for scientific decision and program implementations.

**Index Terms**— Energy Efficiency, CO<sub>2</sub> emission, energy policies.

## 1 INTRODUCTION

**E**NERGY efficiency is a term which defines actually the efficiency in energy generation and distribution. Efficiency is a term which means the ratio of output and input power given to a system. This research study analyses the energy efficiency in terms of primary intensity, CO<sub>2</sub> intensity and CO<sub>2</sub> emissions per capita, efficiency of thermal power plants, rate of electricity transmission and distribution losses etc; their policies through the future and roadmap.

## 2 ENERGY: CANADA

Canada is the 5<sup>th</sup> largest energy producer in the whole world. Canada produces about 6% of global supplies. It is the world's largest producer of natural uranium (for using as fuel in nuclear power plant) and produces one third of the global supply [1]. Canada is also leading producer of hydro electricity in the whole world. It is a significant producer of petroleum, natural gas and coal etc. Canada exports around 98% of its total exports to the United States. Canada is not only is an exporter of energy, it also imports energy from the world outside [2].

## 3 ENERGY AVAILABILITY: CONVENTIONAL ENERGY SOURCES

Here the availability in terms of reservation of the conventional sources of energy is discussed and focused based on three major sources. They are Coal, Natural gas and oil. According to the survey of energy resources report of 2004 North America has the reservation of coal about 250 billion tones. Among the countries of northern America, Canada has the largest reservation [3]. In the year 2008, coal accounted for 9.6% of the country's total primary energy supply (TEPS). In that year Canada produced almost about 48.4 million tons of coal equivalent, of which 28.31 Mtce was mostly coking and some steam coal in terms of hard coal and 20.07 Mtce was sub-bituminous and lignite in terms of brown coal. There are 22 coal mines in operation. There are 21 coal fired electricity generation plants are operating in six provinces. Canada's

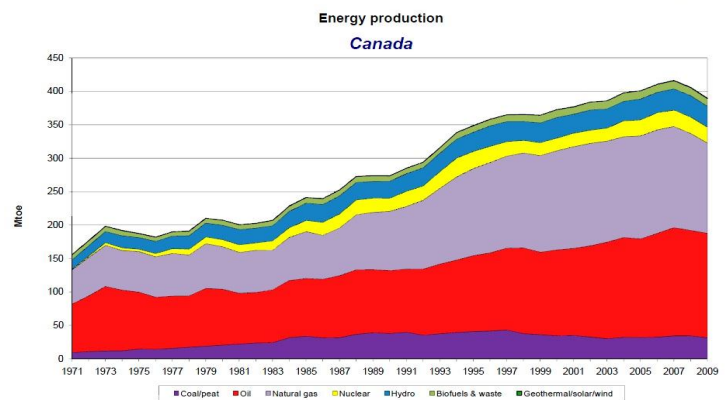


Figure: Energy Production from 1971 to 2009  
coal production has been relatively steady since the year 2000 particularly of brown coal. This is mainly because of long term supply agreements between producing mines and nearby electric generation plants, which account almost 90 percent of Canada's total coal consumption. In case of oil and gas, Canada's TPES mix accounting for almost two third of the total is dominated by Gas. For Canada's total primary energy supply for the upcoming year's gas are likely to account. Canada is the main supplier of natural gas to the United States. Since the year 1999, the production of natural gas is largely driven by the demand from the United States which remained consistently above 160 billion cubic meters (bcm).

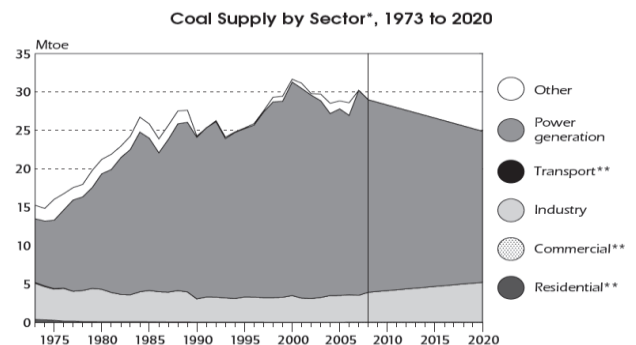


Figure: Coal supply by sector from 1973 to 2020

The Western Canada Sedimentary Basin (WCSB) accounts for 98% of production. Among them Alberta, British Columbia and Saskatchewan account for 80%, 16% and 4% respectively. The remaining 2% of domestic output is produced in Atlantic Canada, the majority from the SOEP [4]. In the year 2008 Canada's demand for the natural gas was 100 bcm which is greater than the demand of the year 2007.

Natural Gas Supply by Sector\*, 1973 to 2020

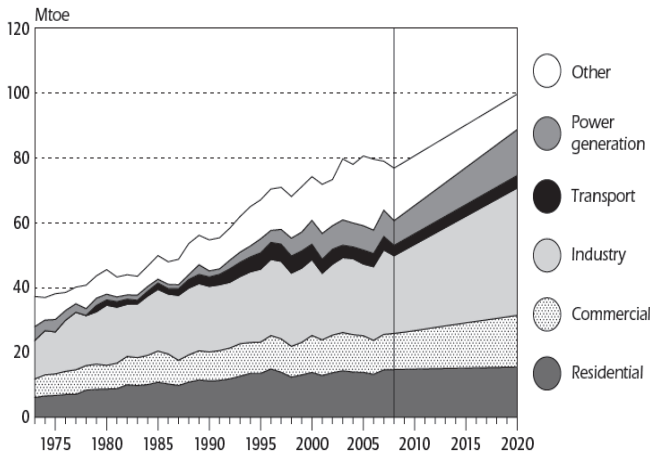


Figure: Natural Gas supply by sector from 1973 to 2020

Canada is also the OECD's largest exporter of Oil and the second largest OECD producer of crude oil after the United States and Mexico. There has been a sharp increase in investment in Canada's petroleum industry. Investment has tripled from CAD 16.2 billion in 1998 to about CAD 46.8 billion in 2007 and it was estimated CAD 47.7 billion in 2008. Conventional oil reservation in Canada are estimated at approximately 4.8 billion barrels. In between the year 2002 and 2008, total crude oil production grew at an annual average of 3 percent. It is estimated by the Canadian Energy Research Institute that by 2015, total oil production could reach 4 mb/d, with oil sands production accounting for 2.1 mb/d.

Oil Supply by Sector\*, 1973 to 2020

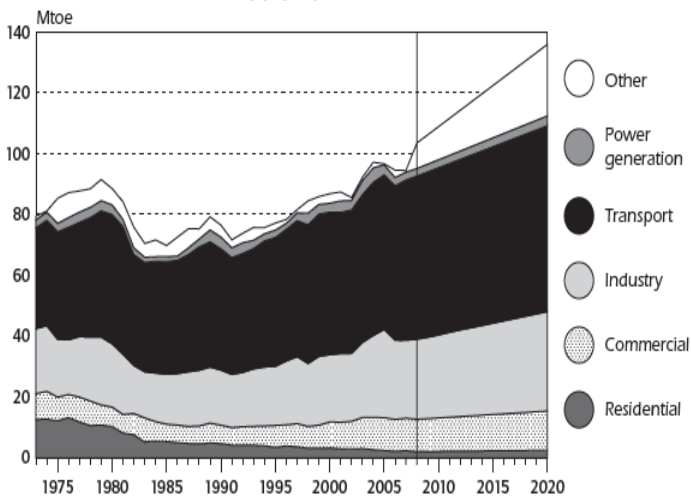


Figure: Oil supply by sector from 1973 to 2020

#### 4 ENERGY AVAILABILITY: NON CONVENTIONAL ENERGY SOURCES

Canada is one of the largest countries of the world in producing a large amount of substantial renewable energy and power. It has renewable energy sources of hydropower, biomass, wind, solar, geothermal and ocean energy.

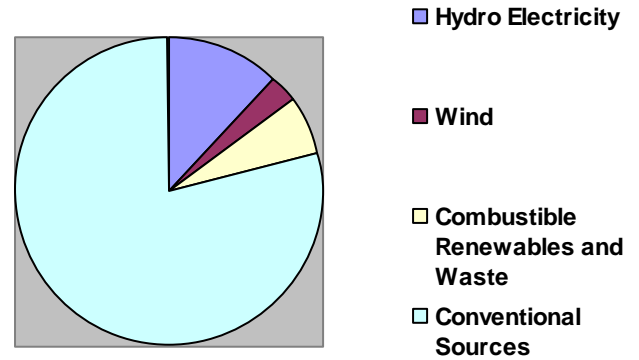


Figure: Energy Availability of Canada

Renewable Energy as a Percentage of Total Primary Energy Supply, 1973 to 2008\*

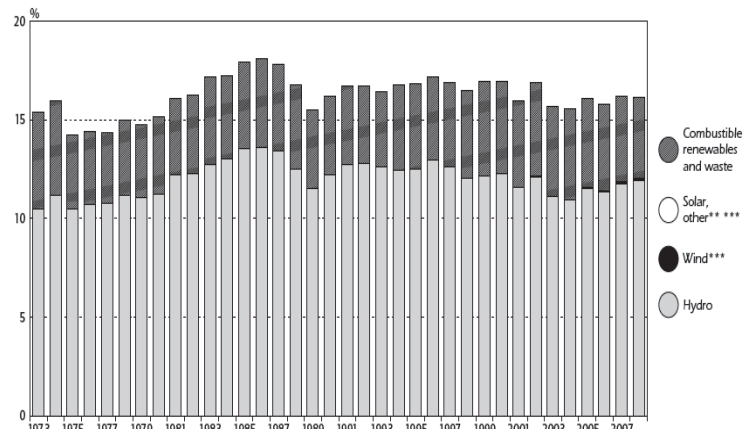


Figure: Renewable Energy as a percentage of total primary energy supply

In the year 2008, the country's total primary energy supply was 272.7 Mtoe of which 44 Mtoe or 16.1% belongs to renewable sources. In the year 2007, 62% of Canada's electricity generation capacity came from renewable energy sources. Among them 73.4 GW (almost about 57.6%) was from renewable hydropower, 1.8 GW from wind energy and 1.6 GW from Wind energy. A very small portion of electricity supply for Canada comes from solar photovoltaic (26MW) and tidal energy (20 MW).

#### 5 ENERGY POLICIES

##### 5.1 Energy Efficiency Labels and Standards

Canada has energy efficiency labels and minimum energy performance standards for a large range of appliances and equipment. In the year 2010 for standby power use minimum

performance standards were implemented. More stringent standards will follow in 2012. Between the year 2007 and 2011, to promote smarter energy use in dwellings, public buildings, transport and industries a program called "ecoENERGY Efficiency initiative" involves the investment of more than \$1 billion (US\$970 million). The major part of the investment was involved to the retrofitting of buildings. According to the next part of the program it was decided to invest more than \$78 million between the year 2011 and 2013

## 5.2 Carbon Capture and Storage

Carbon Capture and Storage is a priority issue for the scientists and all the government of the countries. Western Canada in particular represents a world-class opportunity to advance CCS, with a concentration of large final emitters in close proximity to excellent storage sites. Depleted oil and gas reservoirs in this region, whose location and geology are well researched, are the most promising storage sites, with an estimated capacity of 3800 Mt CO<sub>2</sub>-eq. The Weyburn-Midale CO<sub>2</sub> Enhanced Oil Recovery (EOR) project in Saskatchewan is one of the largest CCS projects in the world. It is also the site of the world's first measuring, monitoring and verification initiative, which is supported by industry and governments and endorsed by the International Energy Agency's GHG Research and Development Program.

## 5.3 ecoENERGY for industry program

To improve industrial energy efficiency and reduction in energy related industrial greenhouse gases a program named "ecoENERGY for industry" was designed. It was desired to achieve energy savings equivalent to the energy used by between 65000 and 146000 households.

## 5.4 Energy Policy

There are several energy policies adopted by the Canadian Government. They are described below:

- *Market Orientation:* Markets are the most efficient means of determining supply, demand, prices and trade while ensuring an efficient, competitive and innovative energy system that is responsive to Canada's energy needs.
- *Respect for the jurisdictional authority and the role of the provinces:* Provincial governments are the direct managers of most of Canada's resources and have responsibility for resource management within their borders.
- *Where necessary, targeted intervention in the market process to achieve specific policy objectives through regulation or other means:* These policy objective include issues of health and safety and environmental sustainability.

*Energy Sustainability Index:* Canada shares a highly integrated electricity transmission network with the United States. According to the Energy Sustainability Index Canada is in the 4<sup>th</sup> position among the leading countries grouped by economics. In accordance with the index Canada has more than 33,500

USD GDP per capita.

## 6 TRENDS

### 6.1 Energy Consumption Trends: High Energy Consumption Per Capita

Canada has almost 6 percent higher energy consumption per capita than in the US and 72 percent higher than the OECD average. The amount is 7.6 toes in 2010. The percentage of Energy consumption fluctuates from 2000 to 2008, 2009 and 2010. Over the period of 2000 - 2008 total energy consumption increased by 0.8 percent per year. But in the year 2009 the percentage faces downward movement by 5 percent. Again in the year 2010 the percentage recovered slightly by 1.2 percent. Canada is having the highest rate of electricity consumption per capita and the value is around 15,000kWh in 2010 which is more than twice as high as the OECD average and about 20 percent higher than the United States. About 22 percent of the final energy consumption is represented by Electricity.

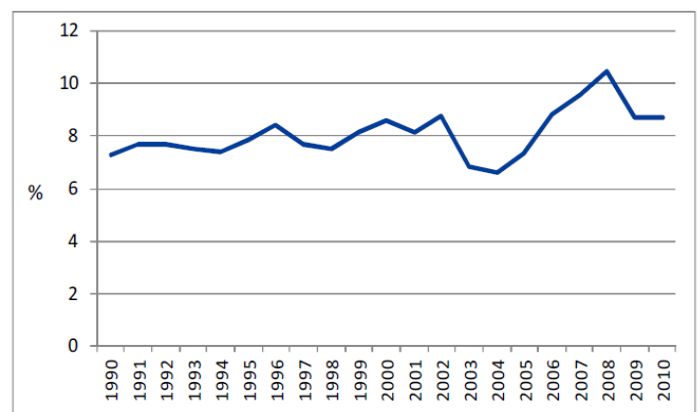
### 6.2 Trends in Energy Efficiency

There is noticeable energy efficiency improvement been observed between 1990 - 2000. PEI (total energy consumption per unit of GDP), measured at purchasing power parity is almost 40 percent higher than the OECD average and 24 percent higher than in the US. PEI decreased by 1.7 percent/year between 1990 and 2010.

### 6.3 Energy Efficiency in Power Generation

The energy efficiency percentage of power generation is found to be steady from the year 1990 to 2005. The rate was 58 percent. It has increased in the year 2010 by 60 percent. This high energy efficiency is very much close to the OECD average. The rate of T&D losses in the Canadian Grid is above 8 percent of the distributed volumes. These losses are irregular but trend to increase.

Figure: Energy Efficiency in power generation



## 7 CONCLUSION

To conclude with the study and analysis above it is quite clear that Canada has very much strong and probable future in the

future energy demand and supply sector. Utilizing the available resources properly in Canada it is possible to export power and energy to the world energy market meeting its demand successfully.

## ACKNOWLEDGMENT

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## APPENDIX

SOEP : STABLE OFFSHORE ENERGY PROJECT  
SEOP : STABLE ENERGY OFFSHORE PROJECT  
TEPS : TOTAL ENERGY POWER SUPPLY  
BCM : BILLION CUBIC METER  
WCBS : WESTERN CANADA SEDIMENTARY BASIN  
CCS: CARBON CAPTURE AND STORAGE  
EOR: ENHANCED OIL RECOVERY

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