

# CANADA

- *Canada's primary energy demand is projected to grow at an annual rate of 1.1 percent from 2002 until 2030.*
- *Canada is foreseen to become a net importer of natural gas by 2030. LNG is considered as an option to supply natural gas to both the domestic market and the US market via pipeline.*
- *CO<sub>2</sub> emissions from the utilisation of energy in 2010 are expected to exceed the 1990 level by 40 percent.*

## RECENT ENERGY TRENDS AND ENERGY POLICY

Canada's primary energy consumption increased from 252 Mtoe in 2000 to 261 Mtoe in 2003 at an annual rate of 1.1 percent over the same period. The increase in consumption is mainly due to the increased consumption of oil in the transport sector and natural gas for electricity generation.

Canada has abundant energy resources of oil, natural gas and coal mainly located in the western provinces.

The economy is a net energy exporter. Energy exports more than doubled from 59.7 Mtoe in 1990 to 128.7 Mtoe in 2003, with the economy exporting about 90 percent to the US. In 2003, natural gas accounted for about 59 percent of total net exports, followed by crude oil (31 percent), petroleum products (7 percent), and coal (3 percent).

The crude oil export ratio<sup>20</sup> has grown from 13 percent in 1990 to 38 percent in 2003, as a result of increasing offshore and oil-sands production offsetting the declining conventional oil production from the Western Canadian Sedimentary Basin. Crude oil production – both conventional and non-conventional oil – reached 144 Mtoe in 2003 from 94 Mtoe in 1990.

Net export ratio of natural gas has declined from a peak of 119 percent in 2001 to 95 percent in 2003, as a result of flat natural gas production combined with an increase in domestic consumption. Between 2003 and 2004, spurred by rising natural gas prices, the number of wells drilled increased by 11 percent, however production only increased by 1 percent during the same period. Due to the expected increase in demand for natural gas for electricity generation, petrochemical industry, mining, and oil and gas extraction, the net export ratio is expected to continue declining in the future.

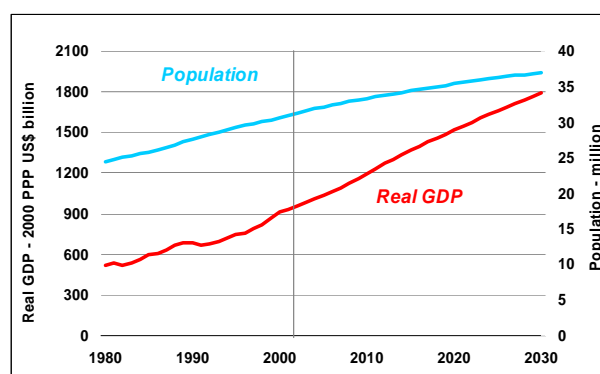
Meeting the Kyoto target poses a great challenge to the economy as it relies heavily on energy-intensive industries. In 2002, Canada ratified the Kyoto Protocol and is committed to reduce CO<sub>2</sub> emissions to 6.0 percent below the 1990 level. However in 2003, Canada's CO<sub>2</sub> emissions from energy consumption have surpassed the 1990 level by 29 percent. To meet the target, Canada released "The Climate Change Plan for Canada" in 2002. Following the release of the Plan, Canada has launched several climate change programmes including among others, the R&D for a hydrogen economy and the provision for financial incentive for energy efficiency retrofits of houses.

## ENERGY DEMAND DRIVERS

Canada's economy is expected to grow at an annual rate of 2.3 percent over the outlook period. In the near term (2002-2015), increased productivity through technological innovation will result in faster GDP growth of 2.8 per cent per year. However, slower GDP growth is expected over the longer term at 1.8 percent from 2015 through 2030.

Population is projected to grow at an annual rate of 0.6 percent from 31 million in 2002 to 37 million in 2030. Despite the declining birth rate, continued immigration is expected to ensure the growth in population.

*Figure 13 GDP and Population*



Source: Global Insights (2005)

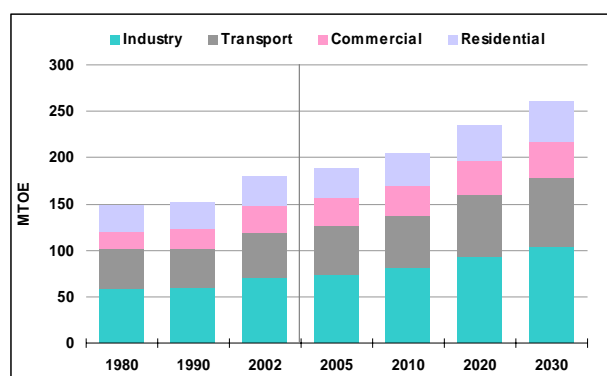
<sup>20</sup> Net export ratio is calculated based on the following. Net export ratio = (Import + Export)/Total Primary Energy Demand.

## OUTLOOK

### FINAL ENERGY DEMAND

Over the outlook period, final energy demand is projected to grow at 1.3 percent per year, from 180 Mtoe in 2002 to 260 Mtoe in 2030, faster than the average annual growth in the previous two decades at 0.9 percent. The industry sector is expected to account for the largest share at 40 percent, followed by transport (29 percent), residential (16 percent), and commercial (15 percent) in 2030.

*Figure 14 Final Energy Demand*



Source: APERC Analysis (2006)

### Industry

Energy demand in the industrial sector is projected to grow at an average annual rate of 1.4 percent until 2030, faster than the average annual growth of 0.8 percent over the past two decades. The higher growth in industrial value-added at 2.2 percent per year over the outlook period will lead to the faster projected energy demand growth in the sector.<sup>21</sup> The energy-intensive and non-energy-intensive industrial sub-sectors are expected to grow at about the same pace; therefore the structure of the industrial sector is not expected to change significantly. Strong growth in the resource extraction industries, notably oil sands development<sup>22</sup>, will also contribute to the faster growth in energy demand. Energy intensity<sup>23</sup> in the industrial sector is expected to improve from 250 toe per US\$ in 2002 to 196 toe per US\$ in 2030 declining at an average annual rate of 0.9 percent,

slightly slower than the decline of 1.1 percent over the past two decades.<sup>24</sup>

Natural gas, which accounted for 32 percent of industrial energy consumption in 2002, is projected to maintain the largest share of total industrial energy demand throughout the outlook period. Utilised as a feedstock to produce methanol and ammonia, and a fuel for manufacturing, natural gas is expected to grow at 1.1 percent per year. The share of electricity, the second-largest energy source in the industrial sector, is projected to increase from 26 percent in 2002 to 29 percent in 2030. This will be driven by robust increase in the use of electricity-specific processes in manufacturing such as mechanical pulping techniques in the pulp industry and electric arc furnaces in the steel industry. By contrast, the share of petroleum products is expected to decrease from 26 percent in 2002 to 24 percent in 2030. However, demand for ethane will grow robustly at an annual growth rate of 1.8 percent as a result of expansion in the ethylene manufacturing industry.<sup>25</sup> Coal demand is projected to decline at 0.1 percent per year as industrial production shifts from integrated steel mills to electric arc furnaces, and the demand for coking coal is reduced. The demand for renewable energy is expected to grow at the fastest rate of 1.9 percent per year, with the share increasing from 11 percent in 2002 to 13 percent in 2030, due mainly to the increasing demand for pulping liquor and hog fuel, by-products of the paper and pulp industry, which account for almost all of the demand for renewables.

### Transport

Transport energy demand is dominated by the road transport sub-sector, representing around 90 percent of total transport energy consumption in 2002. The low population density and high living standards have translated into the substantial requirements for gasoline in passenger vehicles. The economy's integration within the North American market and the production of high value added manufacturing goods have resulted in the increased utilisation of diesel-powered heavy trucks as the main mode of freight transport. With the economy's heavy reliance on road transport, Canada's per capita transport energy consumption accounted for the

<sup>21</sup> Between 1980 and 2002, value-added of Canada's industrial sector has grown at 1.9 percent per year.

<sup>22</sup> Oil sands production is expected to increase by three times the 2002 level by 2030.

<sup>23</sup> The amount of energy needed to produce a dollar's worth of industrial sector's value added.

<sup>24</sup> This could be explained by the fact that mining (which includes oil and gas) and forestry (logging) industries will likely require exploitation of more remote and difficult to access resources, thus limiting energy intensity improvement.

<sup>25</sup> Ethylene production is expected to increase from 4.7 million tonnes in 2002 to 5.6 million tonnes by 2010, then to 7.1 million tonnes in 2030.

second highest in the APEC region after the US, at 1.6 toe per person in 2002.

Over the outlook period, transportation energy demand is expected to grow at 1.6 percent per year, from 49 Mtoe in 2002 to 76 Mtoe in 2030. In 2030, road transport will represent the largest share at 92 percent, followed by rail (3 percent), marine (2.4 percent) and air (2.3 percent). With steady demand growth, per capita transport energy demand is projected to reach 2.0 toe in 2030.

By fuel type, gasoline, the main fuel for road transport, is expected to steadily increase at 1.5 percent per year. The popularity of light trucks, including minivans and sport utility vehicles (SUVs) is expected to continue in the future, resulting in the increase in gasoline demand.<sup>26</sup> The expected growth in export and further need for just-in-time delivery is expected to boost diesel demand for heavy trucks.

#### Residential and Commercial

Along with income and population growth, energy demand in the residential sector is expected to grow annually at 1.1 percent from 31 Mtoe in 2002 to 42 Mtoe in 2030, growing faster than the average annual growth rate of 0.5 percent between 1971 and 2002. Due mainly to the long and extremely cold winter, the energy demand for space and water heating in this sector and is projected to account for 80 percent of total energy demand in 2030. Most households in Canada are expected to continue using gas for heating thereby increasing the demand for natural gas at an annual rate of 1.5 percent. Subsequently, as coal and petroleum products are replaced by natural gas, the share of natural gas in total residential energy demand is expected to increase from 45 percent in 2002 to 50 percent in 2030. Electricity is projected to take the second largest share of total residential energy demand at 40 percent in 2030, growing at an annual rate of 1.2 percent per year, slower than the previous two decades.<sup>27</sup>

As in the residential sector, space and water heating accounted for 60 percent of total energy demand in the commercial sector in 2002. During the outlook period, energy demand in the sector is projected to grow at 1.0 percent per year, driven by

growth in the services sector.<sup>28</sup> Natural gas is projected to grow at 1.3 percent per year, increasing the share of total commercial energy demand from 38 percent in 2002 to 42 percent in 2030. Electricity demand is projected to increase from 11 Mtoe in 2002 to 14 Mtoe in 2030 and grow at an annual rate of 0.9 percent.<sup>29</sup> The projected growth is driven by the increase in demand for lighting, and the increasing diffusion of electric equipment in commercial buildings. The demand for petroleum products, particularly LPG in remote areas, is projected to grow at 0.7 percent per year, accounting for 22 percent of total commercial energy demand in 2030.

#### PRIMARY ENERGY DEMAND

Canada's primary energy demand is projected to grow at an annual rate of 1.1 percent over the outlook period. Among the fossil fuels, natural gas is expected to grow at the fastest rate of 1.7 percent per year, followed by oil at 1.2 percent per year. Coal is however projected to decline annually at 1.2 percent through 2030.

Natural gas will increase across all sectors, with electricity generation accounting for the largest incremental demand growth at 46 percent, followed by residential and commercial (26 percent), industry (17 percent) and other (10 percent). Given the declining trend of natural gas production and the continued domestic demand growth, Canada is expected to become a net importer of natural gas by 2030. LNG is considered as an option to supply gas to both the domestic and US markets through pipelines. To secure the future supply of natural gas, seven LNG receiving terminals have been proposed, however as of 2006, only Irving Oil and Anadarko Petroleum Corporation have received federal and provincial environmental approval.

Oil demand will be driven mainly by the transportation sector accounting for 77 percent of the oil demand growth, followed by industry at 20 percent. Most of the demand will be met by domestic production which is projected to increase from 133 Mtoe in 2002 to 236 Mtoe in 2030. Much of the increase in crude oil production is expected to come from oil sands, the output of which is projected to triple over the outlook period if the necessary infrastructure for production and transportation are developed.

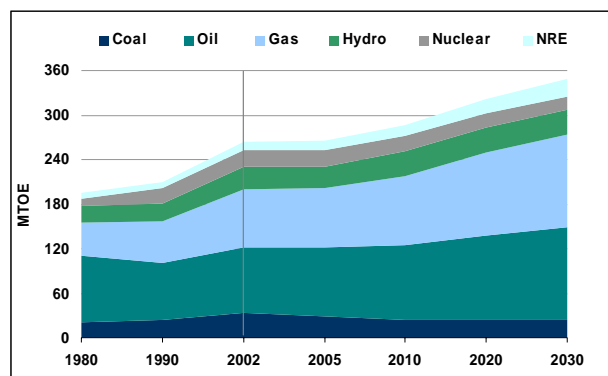
<sup>26</sup> From 1990 to 2002, the stock of light trucks increased by an annual rate of 2.5 percent, with the share increasing from 25 percent in 1990 to 31 percent in 2002. All other type of passenger vehicles has however declined at 0.4 percent per year, over the same period.

<sup>27</sup> Households in Canada have a high ownership level of electric appliances. In 2002, the diffusion ratio of refrigerators was 1.2, while that of China was 0.5, and Japan was 1.2 in 2002.

<sup>28</sup> The value added for the services sector is projected to grow at 2.6 percent per year.

<sup>29</sup> By 2030, electricity will account for 37 percent of the total commercial energy demand.

Figure 15 Primary Energy Demand



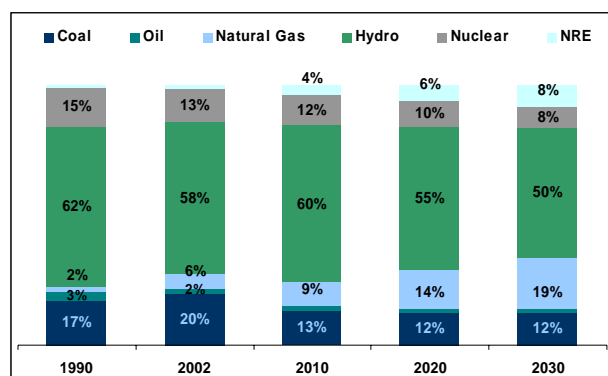
Source: APERC Analysis (2006)

Due to environmental concerns, coal demand is projected to decline sharply at a rate of 4.5 percent per year until 2010 and thereafter maintain sustained positive growth of 0.2 percent per year to the end of the outlook period. The province of Ontario's electricity generation mix will undergo a major change, replacing some coal-fired electricity generation plants by other types. This will result in the sudden decline in coal demand by 2010.

**ELECTRICITY**

Electricity demand is expected to grow annually at 1.4 percent through 2030. Electricity demand for the industry sector is expected to grow at the fastest rate of 1.8 percent per year, followed by the residential sector at 1.2 percent per year, and the commercial sector at 0.9 percent per year.

Figure 16 Electricity Generation Mix



Source: APERC Analysis (2006)

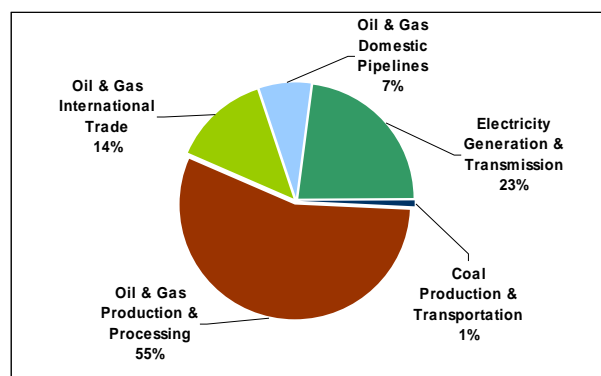
By fuel, hydro will continue to be the main source of electricity generation, but the share in the electricity generation mix will decline from 58 percent in 2002 to 50 percent in 2030. Nuclear electricity generation will decline at an annual rate of 0.5 percent per year – leading to a decline in the share from 13 percent in 2002 to 8 percent in 2030. Although two nuclear units at the Bruce A nuclear power station restarted operation in 2005, over the

outlook period construction of new nuclear capacity is likely to face strong public opposition. The share of coal in the electricity generation mix will decrease from 20 percent in 2002 to 12 percent in 2030, due mainly to the decision by Ontario to phase out coal-fired electricity generation. The reduced share of coal and nuclear in the generation mix will however be offset by an increase in the share of natural gas from 6 percent in 2002 to 19 percent in 2030.

**INVESTMENT REQUIREMENTS**

Canada's continued growth in domestic energy demand, including projected growth in energy exports will require new investment particularly in oil and gas production and processing reaching between US\$175-257 billion and accounting for the largest share in the economy's estimated total energy investment requirements of between US\$335-464 billion by 2030.

Figure 17 Investment Requirements

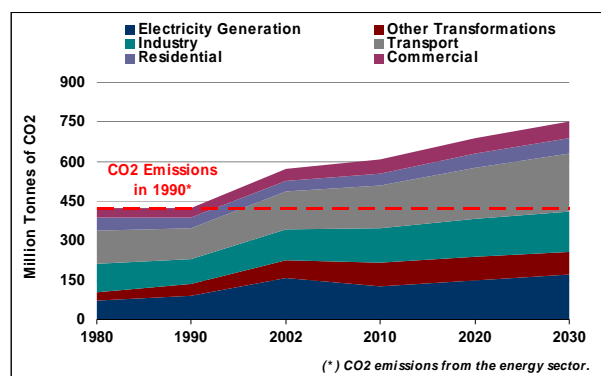


Source: APERC Analysis (2006)

**CO<sub>2</sub> EMISSIONS**

Despite the declining use of coal for electricity generation, the economy's total CO<sub>2</sub> emissions from the energy sector are expected to increase from 574 million tonnes of CO<sub>2</sub> in 2002 to 751 million tonnes of CO<sub>2</sub> in 2030.

Figure 18 CO<sub>2</sub> Emissions by Sector



Source: APERC Analysis (2006)

## MAJOR ISSUES

### MEETING THE KYOTO TARGET

Canada is committed to reduce CO<sub>2</sub> emissions to 6 percent below the 1990 level during the first commitment period between 2008 and 2012. However meeting the target poses difficult challenges for the economy. In 2010, CO<sub>2</sub> emissions from the energy sector are projected to exceed that of the 1990 CO<sub>2</sub> emission level by as much as 40 percent.

To reduce GHG emissions and ensure clean air, water, land and energy, the government is committed to develop a “made-in Canada programme”. Canada’s 2006 Budget has allocated CAN\$2 billion over the next five years for the aforementioned climate change programme. The Budget also proposes a tax credit on the purchase of public transit passes and allocates CAN\$900 million for provinces and territories through a Public Transit Capital Trust. The Budgets Fiscal Balance document indicates that the federal government is committed to work with the provinces and territories to harmonise the current differences in legislation and regulation on energy and environment among all levels of government in formulating a national climate change policy.

## IMPLICATIONS

Due to the economy’s geographical proximity to the US, Canada is expected to continue to serve as an important energy supplier to the US market. In enhancing energy supply security of North America, Canada may need to ensure the timely investment of needed energy supply infrastructure. This will include investment in pipeline for oil sands, LNG receiving terminals and enhancement of electricity transmission systems.

Meeting the Kyoto target poses a great challenge to the economy as it relies heavily on energy intensive industry, including oil and natural gas production. Although each level of government has the right to formulate their own environmental legislations and regulations, there is a need to harmonise all the differences and changes in legislation/regulations to cope with climate change issues. This effort marks an important step for Canada to establish a coherent energy policy towards the enhancement of energy security and sustainable development.

## REFERENCES

- APERC (2005). *APEC Energy Overview 2005*. Tokyo.
- EDMC (2006). *APEC Energy Database*. Energy Data and Modelling Centre, Institute of Energy Economics, Japan. Website: [www.ieej.or.jp/apec](http://www.ieej.or.jp/apec).
- National Energy Board (2003). *Canada’s Energy Future, Scenario for Supply and Demand to 2025*.
- National Resources Canada, Office of Energy Efficiency (2005). *Energy Efficiency Trends in Canada 1990 to 2003: An Update*.
- National Resources Canada, Office of Energy Efficiency (2005). *Energy Use Data Handbook, 1990 and 1997 to 2003*.
- National Resources Canada, Energy Policy Sector (2005). *Canadian Liquefied Natural Gas (LNG) Import Projects: September 2005 Update*.