

# Canada's Energy Future: Energy Supply and Demand Projections to 2035 - Emerging Fuels and Energy Efficiency Highlights



National Energy Board  
Office national de l'énergie

## Fact Sheet

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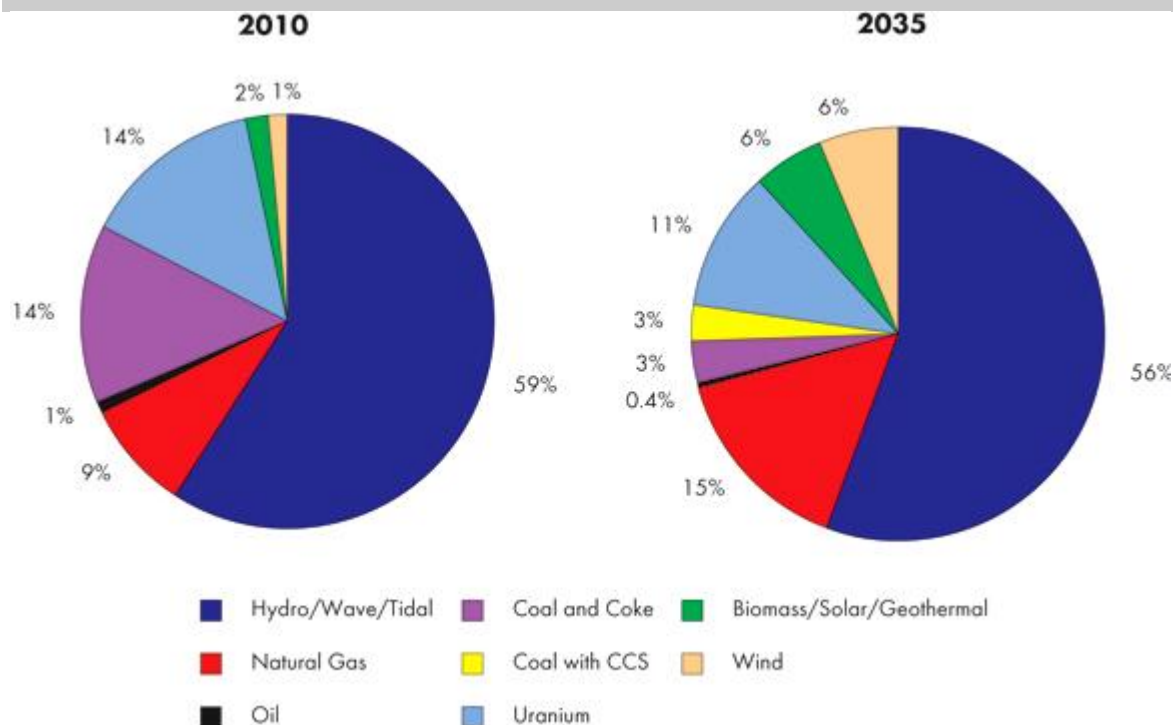
### Canada's Energy Future: Energy Supply and Demand Projections to 2035 – Emerging Fuels and Energy Efficiency Highlights

Canada's Energy Future: Energy Supply and Demand Projections to 2035 provides a "most likely" Reference Case and four sensitivity cases (based on high and low prices, and fast and slow economic growth) to 2035. The highlights below are based on the Reference Case and were selected from various sections of the report.

#### Canadian electricity supply becomes cleaner

- The projected changes in generation mix (see figure below) reflect government and industry efforts to curb energy-related green house gas (GHG) emissions and take into account announced provincial energy strategies, utility expansion plans, and the relative economics of generation options.
- Canadian electricity supply becomes cleaner over the projection period, as the share of non-CO<sub>2</sub>-emitting generation sources (such as nuclear, renewable and plants with carbon capture and storage technology) increases from 76 per cent in 2010 to 79 per cent in 2035. The share of renewable-based generation increases from 62 per cent in 2010 to 68 per cent in 2035.

#### Canadian Generation Mix in 2010 and 2035, Reference Case



#### Use of renewable resources to grow

## Renewable resources

- Canada has significant non-hydro renewable resources for electricity generation, including wind, biomass, solar, tidal and wave power. These technologies have grown in the last few years, despite challenges relating to availability and cost. Policy and incentives have helped their growth, such as Ontario's feed-in tariff.
- Wind power has experienced strong growth in recent years. Over the projection period, it makes the largest contribution to non-hydro renewable growth. The availability of large hydro storage capacity in Canada facilitates the development of wind power as hydro may be used as a back-up source of power when intermittent wind resources are not available.

## Hydro electricity

- Canada is a world leader in hydroelectricity generation. Hydroelectricity will remain a dominant source of electricity supply in Canada over the projection period. It has the advantages of being a flexible, low-cost source of non-CO<sub>2</sub> emitting base load electricity, which contributes to maintaining stable electricity prices.<sup>[1]</sup>

[1] Hydro power is flexible in the sense that the output from hydro generating stations can be adjusted quickly with variations in demand. This is often referred to as the load-following characteristic of hydro power. Hydro power can contribute to maintaining price stability because it is not subject to volatility of fuel costs.

## Declining use of coal

- A key feature of the electricity supply outlook is the declining role of coal used in power generation. This trend reflects various government and industry initiatives to limit GHGs, including stricter regulation of GHG emissions from large industrial polluters such as coal-fired power plants and the planned complete phase-out of coal in power generation in Ontario. In addition to renewable and hydro generation capacity, natural gas-fired plants are expected to replace retired coal-fired power plants.

## Canadians strive for energy efficiency

### Vehicle energy efficiency

- In late 2010, the federal government finalized regulations for light duty vehicle emissions. The *Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations* set progressively more stringent limitations on tailpipe emissions for new vehicles in the 2012 to 2016 timeframe.
- The regulation is based on manufacturers' fleet make-up from 2011. It is expected that a large portion of the emissions reductions will coincide with an improvement in fuel economy, which will put downward pressure on vehicle energy demand.

### Energy efficiency in buildings

- An extensively revised National Energy Code for Buildings (NECB) was finalized in the spring of 2011. This companion to the National Building Code puts a greater emphasis on energy performance in buildings than in the past. The code change is expected to improve energy performance in new commercial, institutional, and multi-unit residential complexes by 25 per cent over the previous code (1997).
- Demand management programs and policies contribute to the low energy demand growth in the residential sector. Federal programs, such as the ecoEnergy Retrofit-Homes program, have been employed with various provincial programs. Space heating energy efficiency will benefit from new federal regulations for furnaces and boilers. In 2009 and 2010, amendments to the federal *Energy Efficiency Act* have increased minimum energy performance standards for more than a dozen home devices. There has also been a renewed commitment for utility-based demand side management (DSM) programs.
- All provinces and territories have voluntary programs encouraging greater energy efficiency in new homes and equipment. Many of these programs offer incentives to consumers such as rebates, low-interest loans, and education and awareness campaigns. Also, several provinces have recently moved forward with building codes that include more stringent minimum energy performance standards.

# Canada's Energy Future: Energy Supply and Demand Projections to 2035 – Energy Demand Highlights



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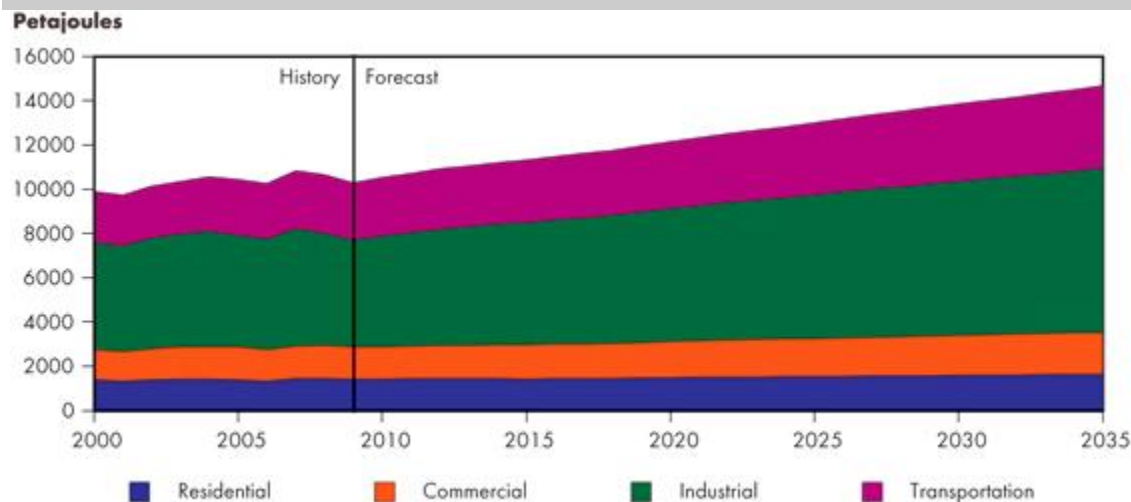
### Canada's Energy Future: Energy Supply and Demand Projections to 2035 – Energy Demand Highlights

*Canada's Energy Future: Energy Supply and Demand Projections to 2035* provides a "most likely" Reference Case and four sensitivity cases (based on high and low prices, and fast and slow economic growth) to 2035. The highlights below are based on the Reference Case. For detailed information, please see page 7 of the report.

#### Energy demand growth slows from its historical pace

- In the Reference Case, total end-use energy demand increases by an average of 1.3 per cent per year. This growth is led by the industrial sector, which grows at an annual average rate of 1.6 per cent, followed by transportation at 1.4 per cent. Residential and commercial energy demand grow at an average annual rate of 0.6 and 1.0 per cent, respectively.

#### Canadian Energy Demand by Sector, Reference Case



- Overall, energy demand growth slows modestly compared to historical trends. Demand grew at an average of 1.4 per cent per year from 1990 to 2008.
- Despite this modest slowing in aggregate demand growth, the detailed results indicate a marked slowdown in many of the energy demand drivers. These drivers include slowing population growth, higher energy prices, lower than historical economic growth, and enhanced efficiency and conservation programs. Compared to historical growth rates, energy demand growth in the commercial and transportation sectors slows considerably. In the commercial sector, average annual growth falls from 2.0 per cent historically to 1.0 per cent in the projection, while transportation growth falls from 1.9 per cent to 1.4 per cent. Demand growth in the residential sector falls from 0.7 per cent per year over the 1990 to 2008 period to 0.6 per cent from 2010 to 2035.
- Offsetting this slowdown is demand growth in the industrial sector, which made up nearly half of Canadian energy demand in 2010. Robust growth in a number of industries outweighs the declines in energy intensity exhibited by this sector over the outlook period. Industrial energy demand grows at 1.6 per cent per year over the projection period, compared to 1.2 per cent over the 1990 to 2008 period.

- Total energy intensity, measured as energy use per dollar of real Canadian GDP, decreases by an average annual rate of 1.1 per cent over the projection period. This continues the historical trend where energy intensity declined by an average of 1.2 per cent per year from 1990 to 2008.

***The report outlines projected demand changes for various sectors including:***

**Residential sector** - Residential is the slowest-growing sector, and its share of total energy demand drops to 11 per cent by 2035 from 14 per cent in 2009.

**Commercial sector** - By 2035, the commercial sector's share of total demand decreases to 13 per cent down from 14 per cent in 2009.

**Industrial sector** - The industrial sector makes up the largest share of Canadian end-use energy demand. In the Reference Case, its share of total demand increases to 51 per cent in 2035 from 47 per cent in 2009.

**Transportation sector** - The transportation sector accounted for 25 per cent of total end-use demand in 2009. Its share of total energy demand remains at 25 per cent throughout the outlook period.

# Canada's Energy Future: Energy Supply and Demand Projections to 2035 - Crude Oil and Bitumen Highlights



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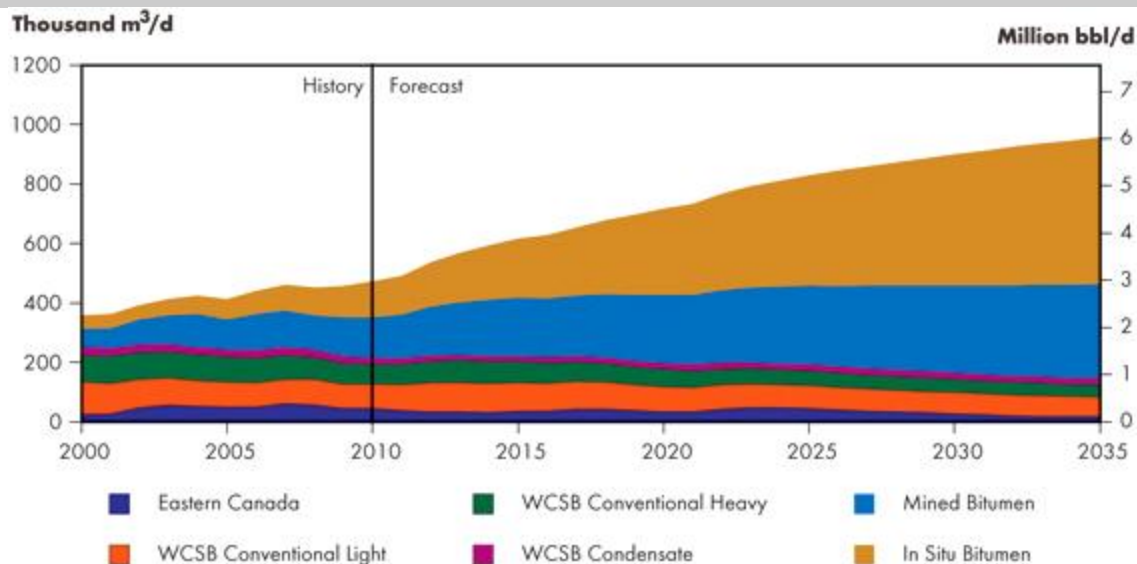
### Canada's Energy Future: Energy Supply and Demand Projections to 2035 - Crude Oil and Bitumen Highlights

*Canada's Energy Future: Energy Supply and Demand Projections to 2035* provides a "most likely" Reference Case and four sensitivity cases (based on high and low prices, and fast and slow economic growth) to 2035. The highlights below are based on the Reference Case. For detailed information, please see page 16 of the report.

#### **By 2035, Canada almost doubles 2010 crude oil production rates**

- By 2035, Canadian crude oil production in the Reference Case reaches 958 thousand m<sup>3</sup>/d (6.0 million bbl/d), or about double 2010 production rates.
- In 2035, oil sands account for nearly 85 per cent of production, compared to 54 per cent in 2010.

#### **Total Canadian Oil Production, Reference Case**



#### **Production Highlights:**

- **Oil sands** - By 2035, in the Reference Case, oil sands bitumen production is projected to reach 811 thousand m<sup>3</sup>/d (5.1 million bbl/d), three times the production for 2010. The majority of the growth occurs in the in situ category. In situ projects tend to be smaller and less expensive to build. Also, 80 per cent of the oil sands reserves are considered well suited to in situ extraction, versus 20 per cent for mining methods.<sup>[1]</sup>

[1] Energy Resources Conservation Board, ERCB ST-98 2011, Alberta's Energy Reserves 2010 and Supply / Demand Outlook 2011-2020, June 2011.

- **Oil sands upgrading** - Both mining and in situ operations provide bitumen feedstock to upgraders. In 2010, essentially all mined production and about 11 per cent of in situ production was upgraded.<sup>[2]</sup> In the Reference Case projection, upgraded bitumen volumes roughly double to 302 thousand m<sup>3</sup>/d (1.9 million bbl/d) by 2035, but do not keep pace with the overall increase in bitumen production. The share of total bitumen production that is upgraded declines from 49 per cent in 2010 to 37 per cent in 2035.

[2] [Energy Resources Conservation Board](#), *ERCB ST-98 2011, Alberta's Energy Reserves 2010 and Supply / Demand Outlook 2011-2020*, June 2011.

- **Eastern Canada** - The Newfoundland and Labrador offshore fields are the primary source of production in Eastern Canada. Production in this area has been declining, but this decline will moderate with the addition of two large fields. The Hebron Field is scheduled to begin production in 2017. In the Reference Case, an additional field is assumed to be discovered and commences operation by 2022.
- **Western Canada Sedimentary Basin (WCSB)** - Conventional crude oil in the WCSB has reversed its long-standing declining trend. Production is ramping up based on the successful application of horizontal drilling and multi-stage hydraulic fracturing methods to tight oil<sup>[3]</sup> reservoirs. Because this technology is in its infancy and the full impact on future production levels unclear, the incremental production volumes assumed in the projection are limited. Decline resumes in the 2015 to 2016 timeframe.

[3] Tight oil refers to oil produced from organic-rich shales or from low permeability sandstone, siltstone, limestone or dolostone reservoirs. Tight oil reservoirs typically require the combination of horizontal drilling and multi-stage hydraulic fracturing to establish sufficient fluid flow to achieve economic rates of recovery.

### **Crude Oil Reserves:**

- Canada has abundant reserves of crude oil, with remaining reserves of 27.5 billion cubic metres (173 billion barrels). Of this, oil sands bitumen accounts for 98 per cent and conventional crude oil makes up 2 per cent. According to the *Oil & Gas Journal*, Canada ranks third in the world in terms of oil reserves, behind Saudi Arabia and Venezuela.

# Canada's Energy Future: Energy Supply and Demand Projections to 2035 - Electricity Outlook Highlights



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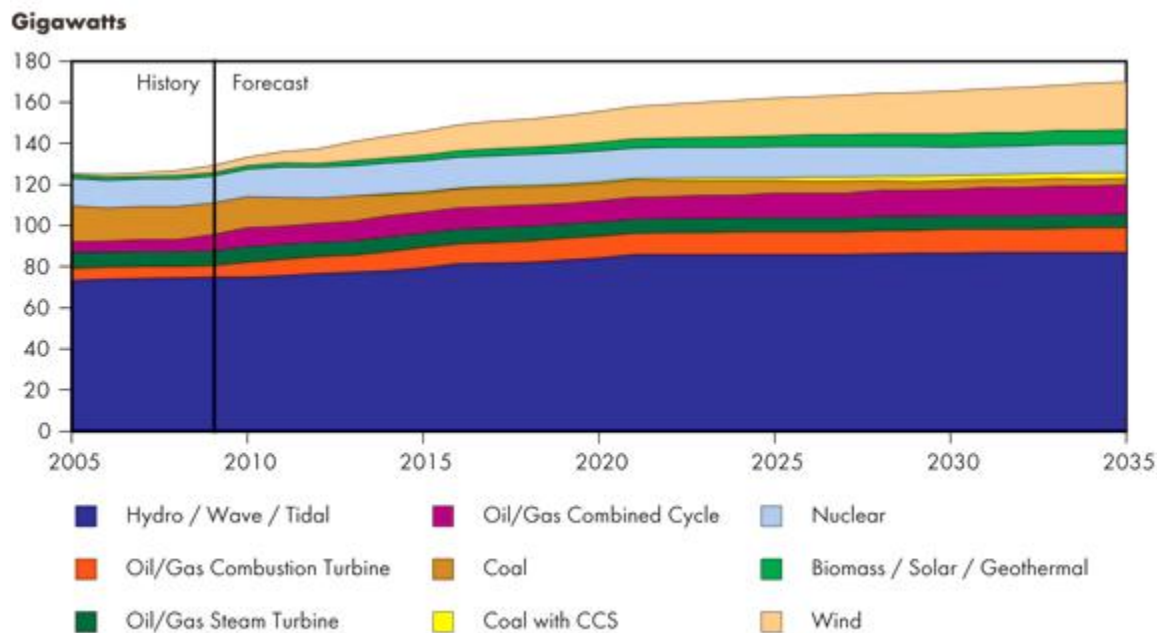
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### Canada's Energy Future: Energy Supply and Demand Projections to 2035 - Electricity Outlook Highlights

*Canada's Energy Future: Energy Supply and Demand Projections to 2035* provides a "most likely" Reference Case and four sensitivity cases (based on high and low prices, and fast and slow economic growth) to 2035. The highlights below are based on the Reference Case. For detailed information, please see page 41 of the report.

***Electricity supply increases to record levels as new generating capacity is built to meet steadily increasing demand.***

#### Electricity Generating Capacity, Reference Case



- The electricity supply mix varies significantly among the provinces and territories. The electricity supply projections are driven by the demand projections, as well as provincial and utility electricity system plans.
- Total generation capacity is projected to increase by 27 per cent over the projection period, with natural gas-fired and renewable-based capacity showing the largest increases.
- Total installed capacity is projected to increase from 133 GW in 2010 to 170 GW in 2035. The capacity increases occur in all provinces and territories, with most increases in the larger electricity markets of Quebec, Ontario, British Columbia and Alberta.
- A number of federal and provincial policies and regulations result in a cleaner electricity supply mix in Canada. The addition of more renewable-based capacity, such as wind, hydro and biomass, as well as the application of carbon capture and storage (CCS) technology, reduce the emissions intensity of the electricity sector.
- Hydroelectricity remains a dominant source of Canadian electricity supply over the projection period. As a result of projected hydro-based capacity expansion, annual hydroelectricity production increases from 346 TW.h in 2010 to 430 TW.h in 2035. The

share of wind-based generation triples from less than two per cent of total generation currently to six per cent in 2035. Biomass, solar and geothermal in total account for nearly four per cent of total capacity by 2035.

- Canadian electricity generation increased at an average annual rate of 1.0 per cent over the projection period, with faster growth in the 2010 to 2020 timeframe.
- In the Reference Case, net electricity available for export has the potential to increase significantly.

#### **Electricity projections include:**

- **Hydro** - Hydroelectricity remains a dominant source of Canadian electricity supply over the projection period. As a result of new capacity expansion, hydro-based generation capacity increases from 75 GW in 2010 to 87 GW in 2035.
- **Nuclear** - As a result of higher growth in other types of generation, such as wind and gas-fired, the share of nuclear in total electricity generation declines to 12 per cent by 2035, compared to 14 per cent in 2010.
- **Coal-fired** - Within Canada, over 9,000 MW of coal-fired capacity will be retired over the 2010 to 2035 period, or about two-thirds of the total coal-fired capacity in 2010. Natural gas-fired - The share of gas-fired generation increases from nine per cent in 2010 to 15 per cent in 2035.
- **Natural gas-fired** - The share of gas-fired generation increases from nine per cent in 2010 to 15 per cent in 2035.
- **Oil-fired** - Oil-fired generation accounts for about one per cent of total generation and is expected to maintain a very small share over the projection period.

# Canada's Energy Future: Energy Supply and Demand Projections to 2035 - **Natural Gas Production Outlook Highlights**



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### Canada's Energy Future: Energy Supply and Demand Projections to 2035 - Natural Gas Production Outlook Highlights

*Canada's Energy Future: Energy Supply and Demand Projections to 2035* provides a "most likely" Reference Case and four sensitivity cases (based on high and low prices, and fast and slow economic growth) to 2035. The highlights below are based on the Reference Case. For detailed information, please see page 27 of the report.

#### ***Drilling and production gradually climb, and the focus on tight and shale gas continues***

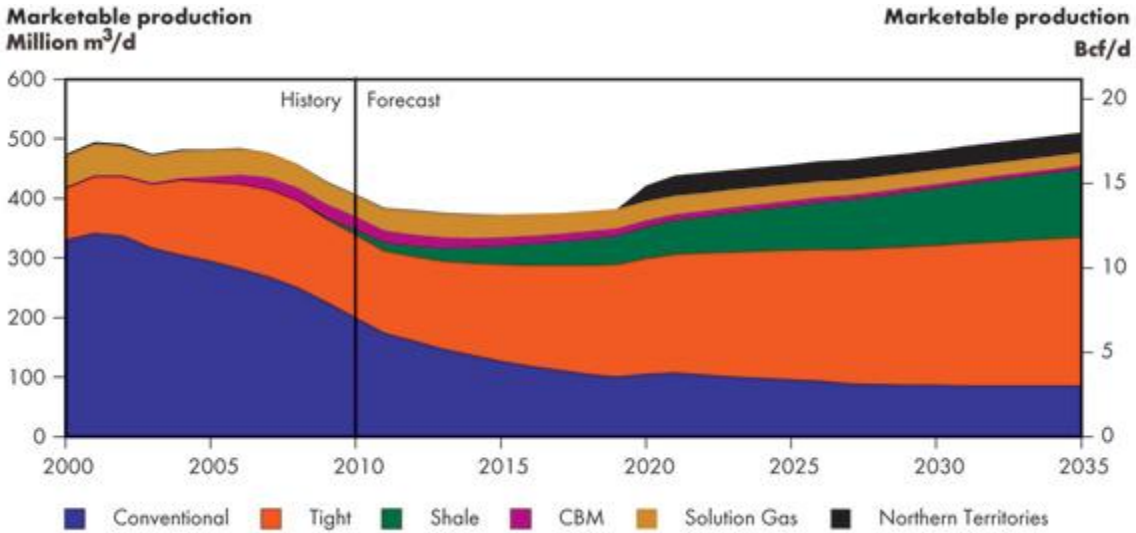
- Natural gas prices gradually climb in the Reference Case projection. This leads to increased drilling activity, especially for the more economic resources like deeper tight gas and shale gas. However, gas wells drilled per year remain about one-fifth of the peaks seen in 2005 through 2008.
- Strong production rates from the deeper wells lead to increased production in the latter half of the projection, as additions of new gas outpace production declines from older wells. This would lead to increased revenues available to fund additional drilling, and thus more gas wells and more gas production.
- Canadian natural gas production has dropped 15 per cent since 2008, a direct result of a downturn in drilling activity due to gas price declines. Activity in the last few years has increasingly focused on deeper conventional, tight, and shale gas resources as technological advancements in horizontal drilling and/or multi-stage hydraulic fracturing have lowered their supply costs.<sup>[1]</sup> Shallow gas resources largely remain unprofitable throughout the projection period.

[1] National Energy Board, *Natural Gas Supply Costs in Western Canada in 2009*, November 2010.

#### **Production**

- Canadian marketable natural gas production in the Reference Case declines slightly until 2015, from 383 million m<sup>3</sup>/d (13.5 Bcf/d) in 2011 to 372 million m<sup>3</sup>/d (13.1 /d) in 2015. Production then starts to increase, reaching 510 million m<sup>3</sup>/d (18.0 Bcf/d) in 2035 (see graph below).
- Natural gas from the deeper and more productive conventional, tight, and shale wells more than compensates for production declines from older wells and less gas being added from shallower areas. With higher-productivity wells, it takes fewer wells to maintain overall production than it did before.

#### **Natural Gas Production by Type, Reference Case**



- Recently, companies have been focusing on tight and shale resources. These include the Montney tight gas play in northeast British Columbia and western Alberta, the Horn River shale gas resource in northeastern British Columbia, and the Cretaceous tight gas zones in the Deep Basin in western Alberta. This focus is expected to continue throughout the projection period as these resources have some of the best economics in Western Canada.
- Coalbed methane production declines over the projection period, as investment is drawn to other resources.
- Production of solution gas (gas produced from oil wells) increases slightly through 2014 along with conventional oil production. As conventional and tight oil production decreases over the projection period after 2014, so does the production of solution gas.
- Given the price assumptions, Mackenzie gas is assumed to begin flowing in 2020 in the Reference Case. Mackenzie marketable production in the first year is projected to average 27 million m<sup>3</sup>/d (953 MMcf/d) and 34 million m<sup>3</sup>/d (1.2 Bcf/d) over the remainder of the projection period.

# Canada's Energy Future: Energy Supply and Demand Projections to 2035 - Natural Gas Liquids Outlook Highlights



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### Canada's Energy Future: Energy Supply and Demand Projections to 2035 - Natural Gas Liquids Outlook Highlights

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#### **Total NGL production expected to decline**

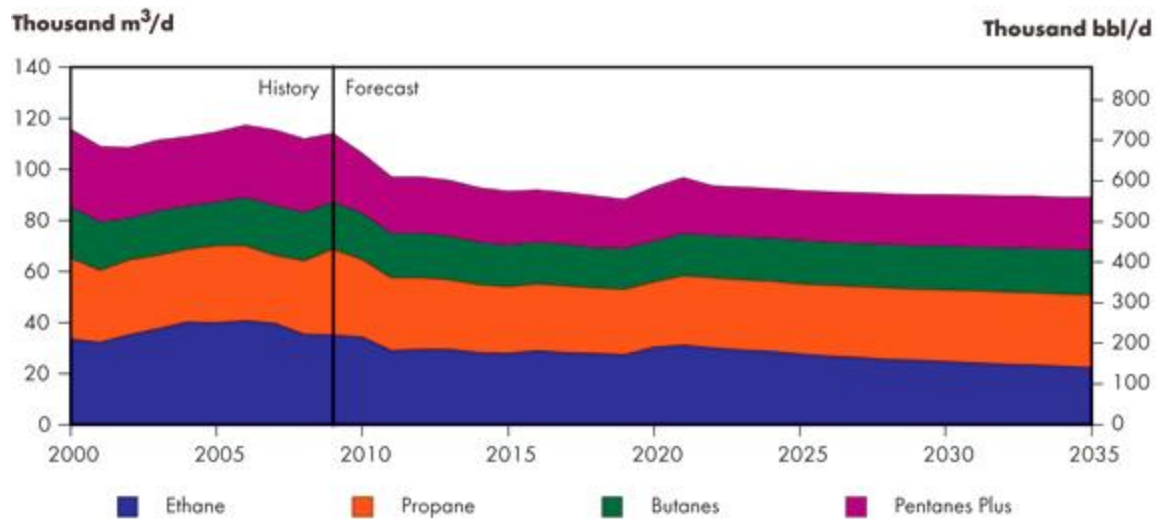
- Raw natural gas as it comes from the wellhead is mostly composed of methane, but also contains various heavier hydrocarbons as well as some contaminants.<sup>[1]</sup> These heavier hydrocarbons, which consist of ethane, propane, butanes and pentanes plus,<sup>[2]</sup> are called natural gas liquids or NGLs.

[1] Common contaminants are water, carbon dioxide, and hydrogen sulphide.

[2] Pentanes plus, or condensate, is a gaseous mixture comprised of pentane and heavier hydrocarbons.

- In the Reference Case, total Canadian NGL production is expected to decline. A fall in ethane production is the biggest contributor to the declining trend in total NGL production. In general, production of propane, butanes and pentanes plus is expected to decline in the near term but stabilize after 2015, as shown in the figure below.
- In the Reference Case, propane supply declines in the near term due to falling non-tight conventional natural gas production. It starts a slow recovery in 2014 when new natural gas production from Montney and increased off-gas processing increases supply. Domestic demand for propane is projected to grow 0.3 per cent per year over the projection period. Propane available for export is expected to decrease early in the projection period, but stabilize from 2015 onwards.
- Production of butanes in the Reference Case behaves similarly to propane. Production is expected to decline from 2010 to 2015, and then stabilize until a mild recovery in 2021. Butanes demand is expected to grow at 1.7 per cent per year over the projection period, as use of butanes as diluents in oil sands production continues. The combination of growing demand and the decline in butane supply makes Canada a net importer of butanes after 2013.
- Pentanes plus supply is expected to decline early in the Reference Case projection period, and then stabilize from 2020 onwards. Growth in oil sands production will be the main driver of condensate demand. Although some synthetic crude oil could be used for bitumen dilution in the future, bitumen diluent demand is expected to grow at an average rate of 5.7 per cent per year over the projection period, outstripping available domestic supplies. Imports of condensate increase at an average rate of 10 per cent per year over the projection period, reaching 106 thousand m<sup>3</sup>/d (668 thousand bbl/d) by 2035.

#### **Natural Gas Liquids Production, Reference Case**



- Despite the growing availability of ethane in raw gas in the Reference Case, ethane production is expected to decline in the projection. This occurs because gas production growth is largely occurring in British Columbia where ethane extraction capacity is minimal. In Alberta, non-tight conventional production is falling while gas demand is rising. These factors combine to reduce the amount of gas reaching the major ethane extraction facilities located near Alberta's borders.
- Alberta's ethane demand is mostly concentrated in the petrochemical sector. Ethane demand in Alberta has become supply-constrained as ethane supplies have fallen in recent years below the petrochemical capacity. In the absence of other sources such as imports or new indigenous supply, ethane consumption is expected to continue to decline.