



National Energy Board  
Office national de l'énergie

## AN ENERGY MARKET ASSESSMENT



# Canada's Energy Future **2016**

ENERGY SUPPLY AND DEMAND PROJECTIONS TO 2040

Executive Summary

Canada

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## **Letter from the Chair and CEO of the National Energy Board**

I am pleased to introduce the 2016 edition of the National Energy Board's *Energy Futures* series. *Canada's Energy Future 2016: Energy Supply and Demand Projections to 2040* (EF 2016) continues a long tradition of energy outlooks which the National Energy Board has been producing regularly since 1967. The only publicly available Canadian long-term energy outlook covering all energy commodities and all provinces and territories, this series provides Canadians a key reference point for discussing the country's energy future. This Report relies on the extensive energy market expertise of the Board's technical staff. In addition, energy experts from government, industry, environmental organizations and academia across Canada provided input on the preliminary assumptions and results of this report. I would personally like to thank all those who contributed.

To use "uncertain" to characterize the past 18 months in Canadian energy would be an understatement. I doubt there is a single market observer who could have foreseen the dramatic fall in the global price of crude oil, one of Canada's largest exports, from US\$110 per barrel in mid-2014 to less than US\$40 per barrel by end of December 2015 and then to less than US\$30 per barrel in January 2016. Among many other factors contributing to the lack of clarity on Canada's energy future were the unprecedented market volatility, the rapid deployment of advanced technologies for renewable and fossil fuel energy production, a historic climate agreement in Paris, the denial of the Keystone XL project in the U.S., the lifting of the U.S. oil export ban, as well as the lifting of sanctions on Iran.

Producing an energy supply and demand projection in this context is challenging, to say the least. Nonetheless, the projections in EF 2016 remain valid reference points for discussing Canada's long-term energy future amid the current global energy uncertainty. Our analysis is not a prediction of future outcomes but rather projections of what might occur given a certain set of assumptions and inputs. This report, which centers on a baseline projection, also outlines alternate projections for higher and lower energy prices, and alternate market access and energy infrastructure assumptions, and then goes on to explore the important long-term implications of these energy market uncertainties.

The alternative projections in EF 2016 strike me as particularly relevant in the current context. As recently noted by Bank of Canada Governor Stephen Poloz, the drop in crude oil prices, as well as in other commodities, has had an unambiguously negative impact on the Canadian economy. EF 2016 indicates that the development of future energy infrastructure directly impacts export prices, future production growth and the overall Canadian economy. While Canada has no influence on global commodity prices, it does have control over the ability to access new markets for our exports and receive the full value in the global market place, whatever future global prices may be.

Of course, building new infrastructure and reaching new markets will hinge on Canada's ability to develop its resources sustainably and transport them safely. And one thing that is clear amidst this uncertainty is that the link between energy and the environment is stronger than ever, and will continue to strengthen in the future. This stems from the fact that a majority of greenhouse gases (GHGs) emitted in Canada result from the combustion of fossil fuels and that those fossil fuels provide the vast majority of energy currently used to heat homes and businesses, transport goods and people, and power industrial equipment. In all of the EF 2016 projections, hydrocarbon energy use continues to increase, which implies increasing GHG emissions. This is important because it shows that high or low oil and

natural gas prices, or the number of pipelines or LNG terminals that are built, while having a modest impact on energy use, will not lead to significant overall emission reductions by themselves. As long as there is demand for energy, markets will function to provide the supply, whether from domestic or international sources, with little consequential impact on global energy use and the associated emissions.

In recent months the federal and many provincial governments in Canada have made announcements about new climate policy initiatives and the momentum is increasing, especially following the agreement at the 21<sup>st</sup> Conference of the Parties in Paris. Many of these policies are quite bold and put Canada in the position of having some of the most advanced climate change policies in the world. EF 2016 does not include these recent announcements, as it only reports on policies and programs that are law, or near law at the time of analysis, but it does highlight their significance. The insights from the report suggest to me that these policy developments will be critical factors in Canada's energy and environmental future, and the possible addition of climate policy developments beyond those just announced will represent a considerable uncertainty for long-term energy projections.

Canada's energy future will not be determined by a single force, but rather by the interaction of many. Energy prices, economic growth, policies and regulation, market access and infrastructure development, and the development and use of new technologies will all play an important role. It is our goal to help Canadians understand these complex interactions through our analysis, reports, and statistics. The long-term projections in our *Energy Futures* series are an important part of that, along with the topical market analysis found in publications such as the *Canadian Energy Dynamics* annual review, and the weekly Market Snapshots. However, as climate policy and energy markets rapidly and continuously evolve, the type of analysis we undertake and the way by which we share that analysis with Canadians must evolve as well. In response, the Board will complete an update to EF 2016 this coming autumn to incorporate recent developments. Just as EF 2016 includes groundbreaking analysis on the long-term impacts of market access and transportation infrastructure, future work may focus on the implications of future climate policy developments.

Not only will we increase the frequency and depth of our *Energy Futures* projections, we will also implement some new and exciting ways of engaging with Canadians on energy, and look forward to hearing from them on issues that matter the most in these uncertain times.

A handwritten signature in black ink, appearing to read 'C. Peter Watson', written in a cursive style.

C. Peter Watson, P. Eng. FCAE  
Chair and CEO

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## EXECUTIVE SUMMARY

*Canada's Energy Future 2016: Energy Supply and Demand Projections to 2040* (EF 2016) is a continuation of the National Energy Board's (NEB) Energy Futures series. The Board released the last full report, *Canada's Energy Future 2013* (EF 2013), in November 2013.

In developing EF 2016, the NEB met with various energy experts and interested stakeholders, including representatives from industry and industry associations, government, non-governmental organizations, and academia to gather input and feedback on the preliminary projections. The information obtained from these consultations helped shape the key assumptions and final projections.

It is important to note that the projections presented in EF 2016 are a baseline for discussing Canada's energy future today and **do not** represent the Board's predictions of what will take place in the future. The projections in EF 2016 are based on assumptions which allow for analysis of possible outcomes. Any assumptions made about current or future energy infrastructure or market developments are strictly theoretical and have no bearing on the regulatory proceedings that are or will be before the Board.

### Key Findings

The key findings of EF 2016 are outlined below and then summarized in the following pages:

- 1. Recent developments have highlighted numerous uncertainties for Canada's long-term energy outlook.**
- 2. In the Reference Case, energy production grows faster than energy use and net exports of energy increase.**
- 3. The levels of future oil and natural gas production are highly dependent on future prices, which are subject to considerable uncertainty.**
- 4. Without development of additional oil pipeline infrastructure, crude oil production grows less quickly but continues to grow at a moderate pace over the projection period.**
- 5. The volume of liquefied natural gas exports is an important driver of Canadian natural gas production growth.**
- 6. Total energy use in Canada, which includes energy use in the energy production sector, grows at similar rates in all EF 2016 cases, and GHG emissions related to that energy use will follow similar trends.**

**1. Recent developments have highlighted numerous uncertainties for Canada’s long-term energy outlook.**

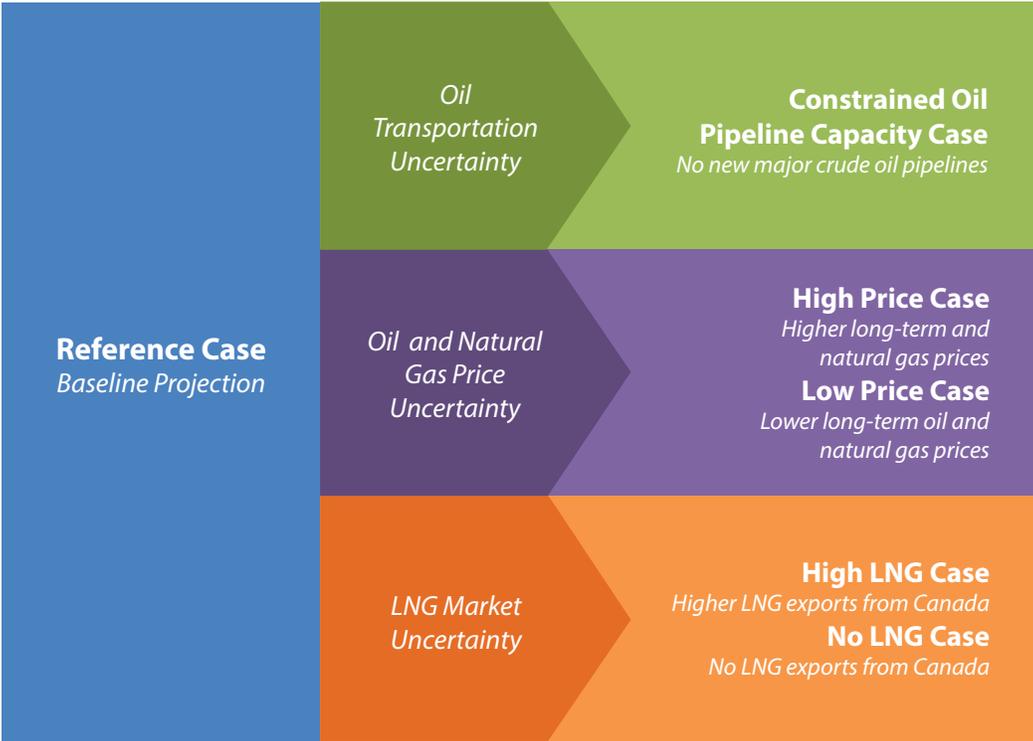
In recent years, energy prices, technology, external markets and societal factors have all undergone substantial shifts over a short period of time. As the energy system continues to adjust and new trends emerge, there are considerable uncertainties in Canada’s long-term energy outlook.

The projections in EF 2016 include a Reference Case, two price sensitivity cases and three supplemental sensitivity cases:

- The Reference Case provides a baseline outlook, based on a moderate view of future energy prices and economic growth.
- Two price cases, with higher and lower oil and natural gas prices, capture some of the uncertainty related to future energy prices.
- EF 2016 also addresses uncertainties related to future oil export infrastructure by considering a case where no new major oil pipelines are built over the projection period.
- The uncertainty related to eventual volumes of liquefied natural gas (LNG) exports is explored in two additional cases.

**FIGURE ES.1**

Overview of Cases in EF 2016



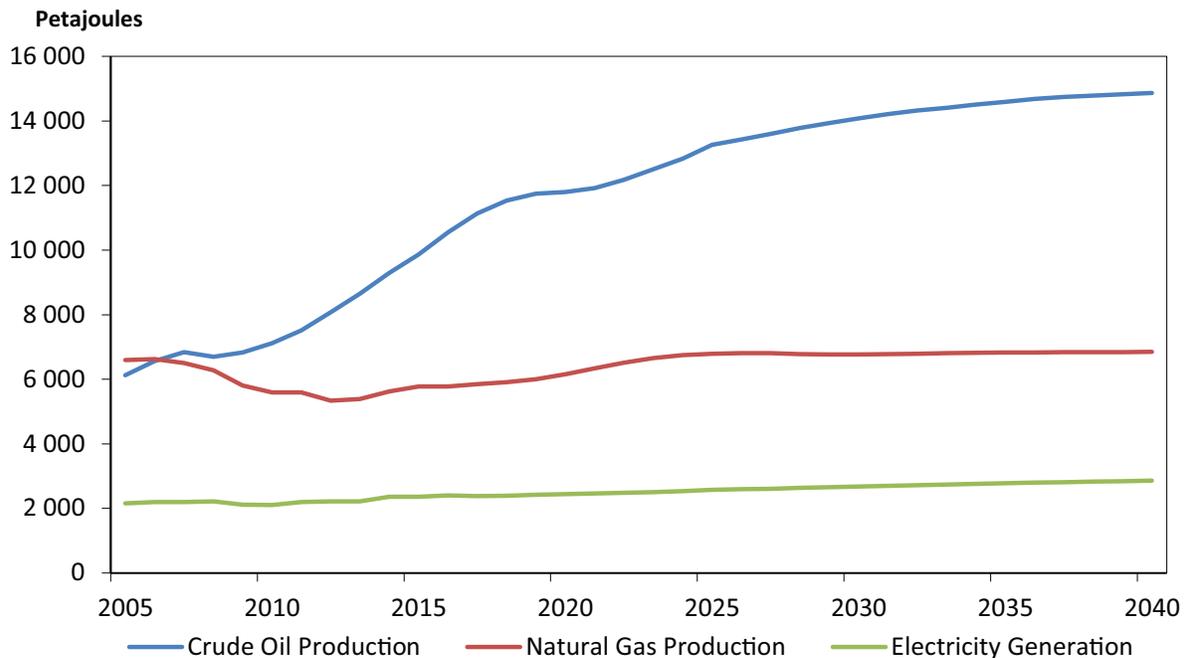
## 2. In the Reference Case, energy production grows faster than energy use and net exports of energy increase.

In the baseline projection of EF 2016 (the Reference Case), total Canadian energy production grows substantially over the projection period:

- Oil production leads this growth, with production reaching  $963 \times 10^3 \text{ m}^3/\text{d}$  (6.1 MMb/d) by 2040, a 56 per cent increase from 2014. Much of this growth takes place in the oil sands.
- Natural gas production increases 22 per cent from 2014 levels to  $506 \times 10^6 \text{ m}^3/\text{d}$  (17.9 Bcf/d), and LNG exports are a key driver of production growth.
- Electricity generation grows steadily over the projection period, with considerable additions of natural gas and renewable capacity while coal capacity declines.

### FIGURE ES.2

Energy Production in Canada, on an Energy Equivalent Basis, Reference Case



While production grows steadily, energy use in Canada increases less quickly than in the past. Total end-use energy demand increases at an average annual rate of 0.7 per cent from 2014 to 2040, almost half the rate of increase from 1990 to 2013.

Combined, net exports of energy increase over the projection period, led by increasing heavy crude oil exports.

### 3. The levels of future oil and natural gas production are highly dependent on future prices, which are subject to considerable uncertainty.

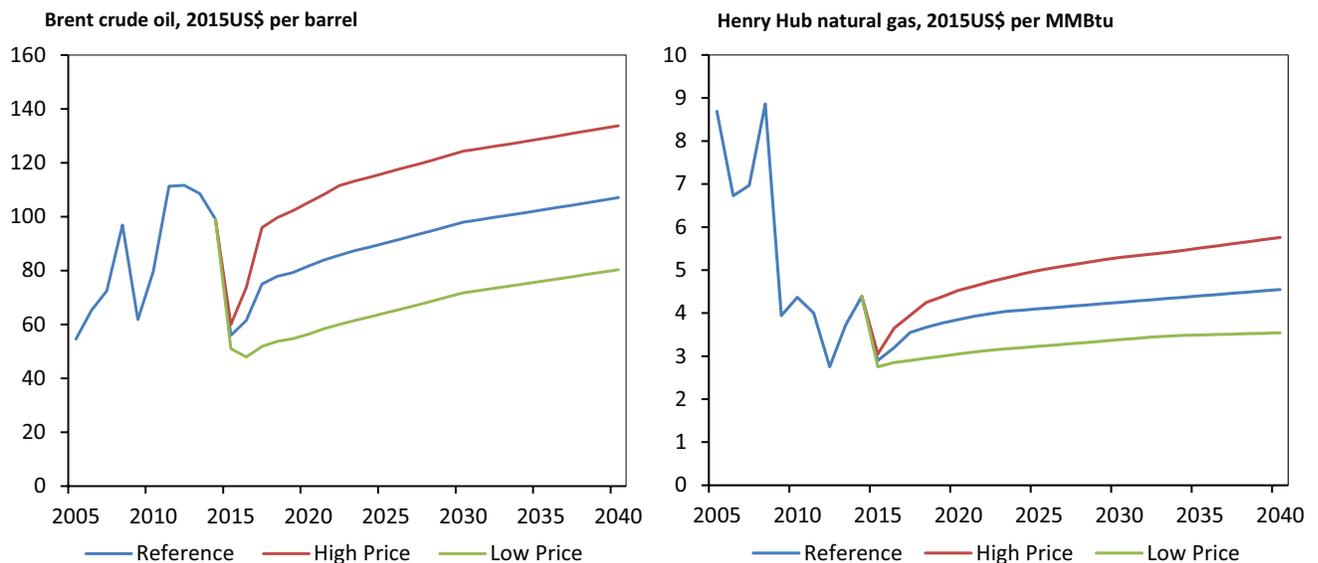
Over the last decade, both crude oil and natural gas prices have been volatile. The EF 2016 High and Low price cases consider the impacts of different price trends on Canada’s energy outlook. Crude oil and natural gas prices can exhibit substantial variation in the short term, and could be outside of the ranges assumed in EF 2016 at a given point in time.

Production of crude oil in all three EF 2016 price cases is similar from 2015 to 2020, as oil sands projects already under construction are likely to be developed. In the High Price Case, total oil production continues to grow robustly, reaching 1103 10<sup>3</sup>m<sup>3</sup>/d (6.9 MMb/d) by 2040, 15 per cent higher than the Reference Case. In the Low Price Case, total oil production grows little after 2020, reaching 770 10<sup>3</sup>m<sup>3</sup>/d (4.8 MMb/d) by 2040, or 20 per cent less than the Reference Case.

In the High Price Case, natural gas production grows quickly, reaching 665 10<sup>6</sup>m<sup>3</sup>/d (24 Bcf/d) by 2040, 31 per cent higher than in the Reference Case. In the Low Price Case, total gas production is relatively flat until 2019. Production begins to increase in conjunction with assumed LNG exports and then declines gradually starting in 2026, reaching 440 10<sup>6</sup>m<sup>3</sup>/d (16 Bcf/d) by 2040, or 13 per cent less than in the Reference Case.

#### FIGURE 3

EF 2016 Crude Oil and Natural Gas Price Assumptions



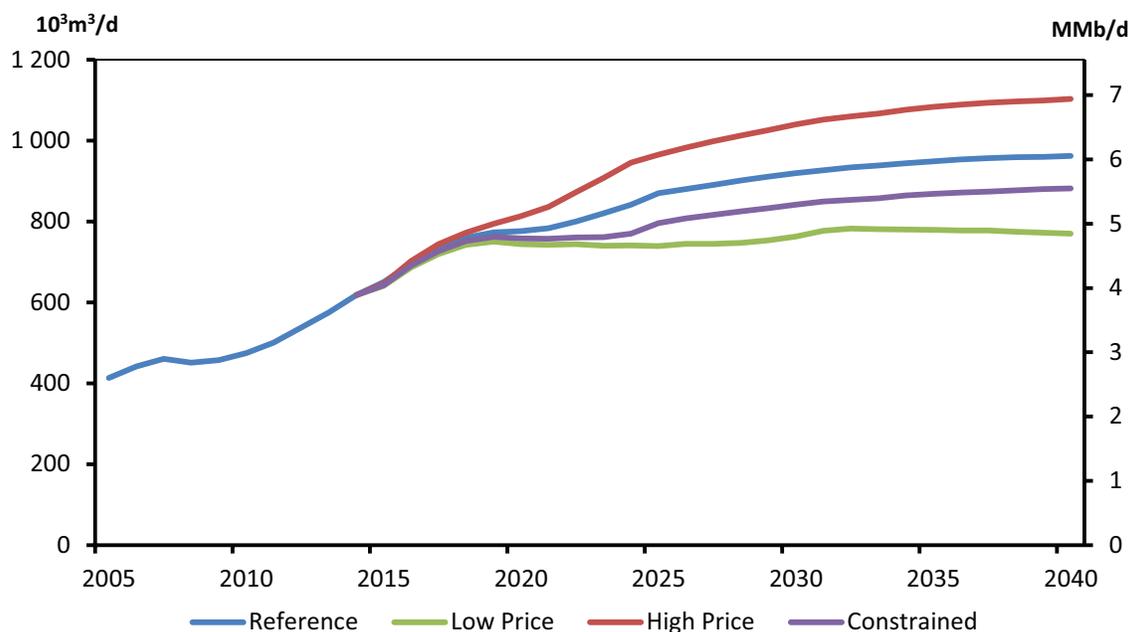
#### 4. Without development of additional oil pipeline infrastructure, crude oil production grows less quickly but continues to grow at a moderate pace over the projection period.

The Reference Case assumes that energy infrastructure is built as needed. However, the pace of development of oil pipeline infrastructure is a notable uncertainty for the Canadian energy system. The Constrained Oil Pipeline Capacity Case (Constrained Case) considers the impact on the Canadian energy system if no new major oil export pipelines are built over the projection period, including the Keystone XL, Northern Gateway, Trans Mountain Expansion and Energy East pipeline proposals.

In this case, the increased use of rail, a more expensive shipping mode, leads to lower prices received by Canadian producers, net of transportation costs. Despite somewhat lower prices compared to the Reference Case, crude oil production continues to grow as many projects remain profitable. Oil production in the Constrained Case reaches 882 10<sup>3</sup>m<sup>3</sup>/d (5.6 MMb/d) by 2040, eight per cent lower than the Reference Case. Crude oil shipped by rail grows substantially over the projection, reaching 187 10<sup>3</sup>m<sup>3</sup>/d (1.2 MMb/d) by 2040.

**FIGURE ES.4**

*Total Oil Production, Reference, High Price, Low Price and Constrained Cases*



Total Canadian production in the Constrained Case grows quicker than in the Low Price Case, and production is 15 per cent higher than the Low Price Case by 2040. This suggests that although pipeline infrastructure may impact Canadian oil production, it is one of many factors that may do so. The High and Low Price cases suggest that crude oil prices, driven by global supply and demand dynamics, are also an important – perhaps the most important – determinant of Canadian production growth.

## 5. The volume of liquefied natural gas exports is an important driver of Canadian natural gas production growth.

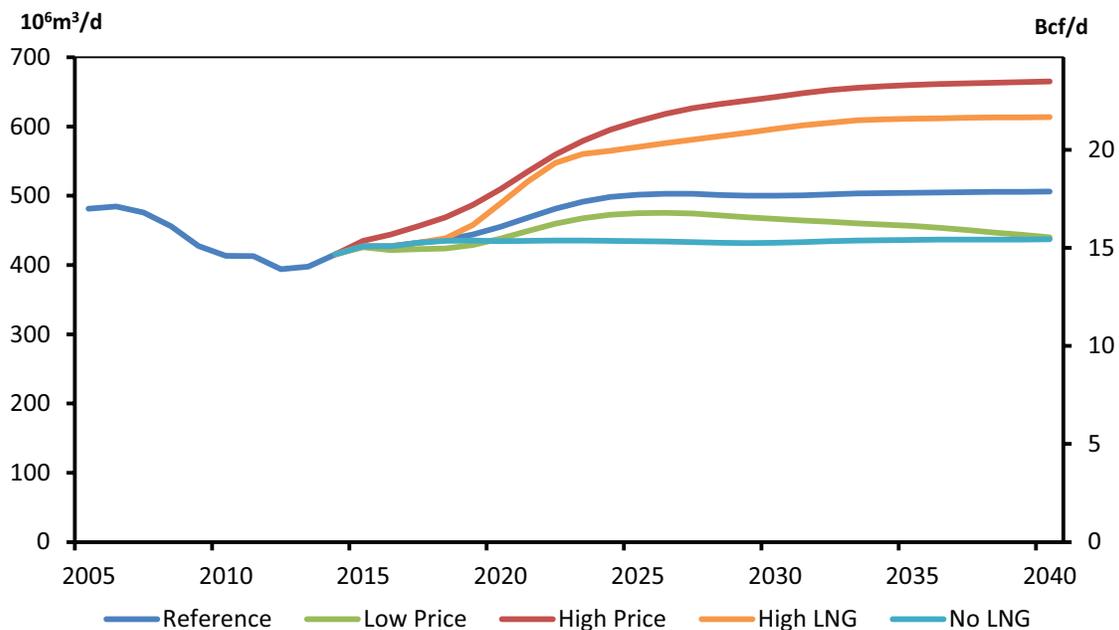
The Reference Case assumes that LNG exports begin in 2019 at 14 10<sup>6</sup>m<sup>3</sup>/d (0.5 Bcf/d) and increase to 71 10<sup>6</sup>m<sup>3</sup>/d (2.5 Bcf/d) by 2023. This is an assumption, as there is considerable uncertainty regarding the volume of LNG that Canada might export globally. Two EF 2016 cases, the High and No LNG cases, analyze this uncertainty.

The High LNG Case assumes higher LNG exports than the Reference Case, with exports reaching 170 10<sup>6</sup>m<sup>3</sup>/d (6 Bcf/d) by 2030. The No LNG Case assumes that no LNG exports occur by 2040.

Exports of LNG could be a significant driver of future Canadian natural gas production growth. In the High LNG Case, total natural gas production reaches 614 10<sup>6</sup>m<sup>3</sup>/d (22 Bcf/d) by 2040, 21 per cent higher than in the Reference Case. In the No LNG Case, total production is 437 10<sup>6</sup>m<sup>3</sup>/d (15 Bcf/d) by 2040 or 14 per cent lower than the Reference Case.

### FIGURE 5.5

Total Natural Gas Production, Reference, Price, and LNG Cases



**6. Total energy use in Canada, which includes energy use in the energy production sector, grows at similar rates in all EF 2016 cases, and GHG emissions related to that energy use will follow similar trends.**

The outcomes of the sensitivity cases in EF 2016 have implications for Canadian energy use. Numerous dynamics are at play but overall, the total differences in energy consumption across the cases are relatively small.

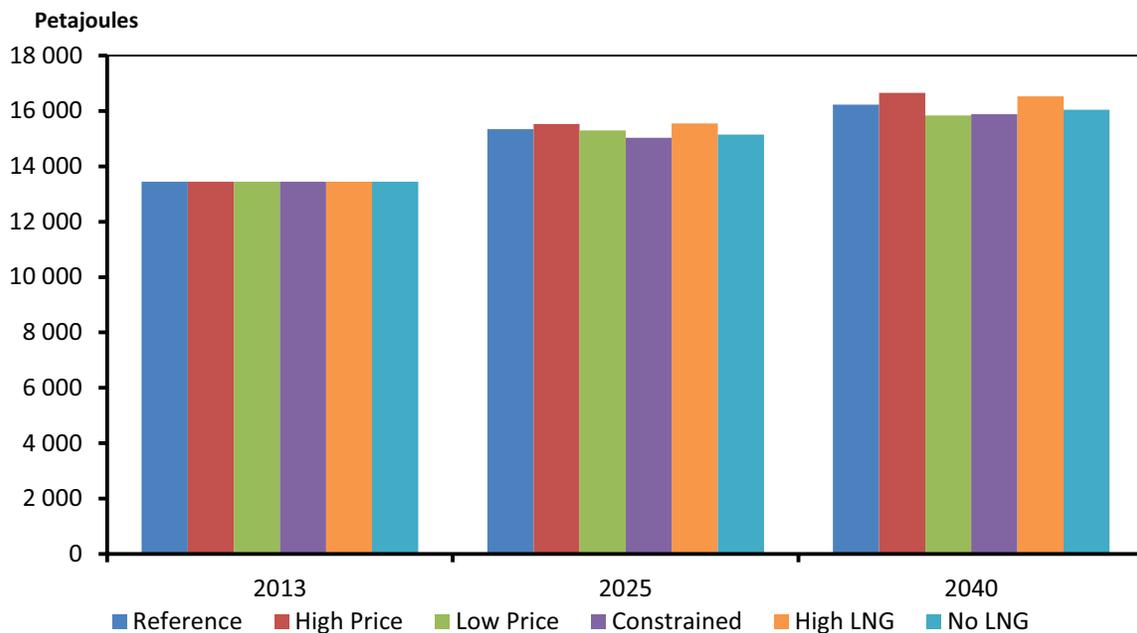
In the Reference Case, total energy use grows from 13 444 petajoules (PJ) in 2013 to 16 233 PJ in 2040. The energy intensity of the Canadian economy, measured in energy use per unit of economic activity, continues its declining trend and falls by an average of one per cent per year from 2013 to 2040.

Given the policy and technology assumptions of this analysis, fossil fuels remain the primary source of energy in Canada over the projection period. This increase in fossil fuel consumption implies that GHG emissions will increase over the projection period, consistent with the most recent GHG emission projections from Environment and Climate Change Canada.

Higher and lower energy prices impact energy use across the economy in different ways. Canada is a major producer of energy and this tends to influence its role as a consumer of energy. Energy use is highest in the High Price Case, reaching 16 659 PJ by 2040. Slightly higher economic growth and more demand in the oil and natural gas producing sector outweigh the downward impact of higher prices on consumption. The impact is reversed in the Low Price Case, which has the lowest energy use of the cases at 15 840 PJ in 2040, despite higher consumption outside of the oil and natural gas sector.

**FIGURE 6**

Canadian Energy Use, All Cases



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Energy use in the Constrained Case falls between the Reference and Low Price Case projections, at 15 887 PJ by 2040. The primary reason for lower total demand is lower energy use for oil production. Slightly slower economic growth also has a minor impact.

Canadian energy use in the High LNG Case reaches 16 531 PJ by 2040, slightly above the Reference Case. The impact is reversed in the No LNG Case, with energy use reaching 16 042 PJ by 2040, just below the Reference Case.

The relatively small impact on energy use in the sensitivity cases suggests that factors other than energy prices, oil pipeline development and LNG exports could have a more significant impact on future energy use and GHG emission trends in Canada. Economic growth trends are also important and can have a very large impact on Canadian energy use and emissions. For example, the 2008-2009 global economic downturn contributed to the nearly eight per cent drop in Canadian energy use from 2007 to 2009. Similarly, technological developments beyond those considered in this report could result in markedly different outcomes. Finally, the EF 2016 cases only include existing laws, policies and programs, and future laws, policies and programs could strongly influence long term energy use and GHG emissions.



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