



Part 1: The challenges we face

By Harris Naseer, thermal subsurface specialist

The Canadian heavy oil industry is at a crucial juncture in its history. Within a short span of 24 months, tens of thousands of people have lost employment, hundreds of billions of dollars in earnings and capital have evaporated, dozens of companies have failed, access to markets has been denied or withheld, and pressure to address climate change and environmental concerns has mounted.

In the face of these huge challenges, we must consider where we stand and what we can do to become willing partners in this sweeping change, rather than fighting it.

CANADA'S IMMENSE OIL RESOURCES

Canada's oil resources of 172 billion barrels are impossible to ignore in a global context, as can be seen in Figure 1.

Of all the countries possessing 100 billion barrels or more of oil reserves, only Canada is part of the Organisation for Economic

Co-operation and Development (OECD). This uniquely positions Canada as an economically strong, geopolitically stable and developed place for doing business—a place where innovation and technology blossom, attracting international investment and experienced, educated talent.

WORLD OIL SUPPLY AND DEMAND OUTLOOK

Canada has also been a production powerhouse of the world. As of year-end 2015, it produced about 4.2 million bbls/d, which equates to almost five per cent of the world's daily supply of oil. The major sources of this production are heavy oil and bitumen from oilsands.

It is clear that Japan, India, China and the U.S. each need to import three to eight million bbls/d to meet their needs. The demand from India and China will continue to grow significantly in line with their gross domestic product (GDP). Unless commercially viable alternatives are found for freight, aviation and petrochemicals, ▶

World's Top Countries by Reserves

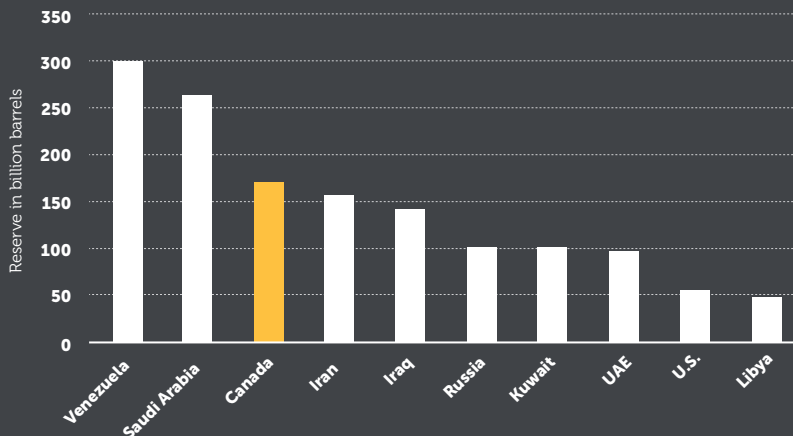


FIGURE 1 | SOURCE: BP STATISTICAL REVIEW OF WORLD ENERGY JUNE 2016

Oil Supply and Demand - Leading Players

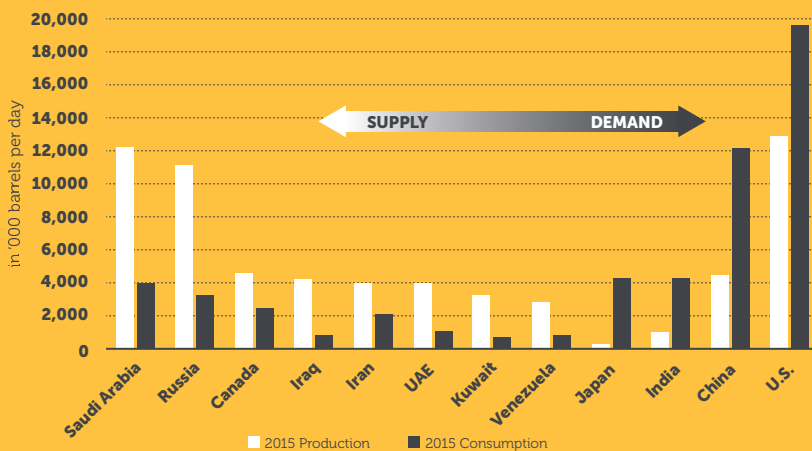


FIGURE 2 | SOURCE: BP STATISTICAL REVIEW OF WORLD ENERGY JUNE 2016

fossil fuels will continue to be a significant portion of the energy mix.

For developed economies like the OECD countries, most analysts predict that over the next 25 years oil consumption will go down significantly due to a shift to other energy sources such as natural gas and renewables, increased efficiencies in fuel consumption, widespread use of electric vehicles and increased decoupling of GDP from energy consumption.

THE BIG GLOBAL ISSUES: POPULATION, ECONOMY AND CLIMATE CHANGE

As shown in Figure 3, from 2014 to 2040 the entire 1.7 billion projected population growth in non-OECD countries will be in urban areas. With increased urbanization and current development trends, it is foreseen that GDP growth will far outstrip population growth.

Besides urbanization, GDP growth correlates to energy consumption through three factors: industrialization, economic diversification and

income distribution. In most developed countries, industrialization has reached maturation with the processes offering marginal efficiencies. Developed economies are more service-based than goods-based, and the distribution of income follows a bell curve with a strong middle class; therefore, GDP growth is slow and energy consumption per capita is decreasing.

In contrast, most growth in rapidly developing economies comes from manufacturing and other industries that require energy, the infrastructure and processes are not yet fully efficient, and huge swaths of population are poor—some below the poverty line. Therefore, GDP growth in developing countries inevitably results in increased energy consumption.

CLIMATE CHANGE, EMISSIONS AND CARBON PRICING

Water vapour, CO₂, methane and ozone are considered the primary greenhouse gases (GHGs). Although methane's global warming potential is 72 times that of CO₂ over a 20-year period, it also leaves the atmosphere within a decade; therefore, anthropogenic (human-caused) CO₂ is considered the chief concern to long-term climate change. Carbon dioxide concentrations in the atmosphere, measured by various observatories, have been rising constantly over the last several decades at the rate of two to three parts per million every year and exceeded 400 parts per million in 2014, as seen in Figure 4.

The rise in atmospheric CO₂ concentration is directly attributed to increased CO₂ emissions worldwide, which have risen by almost 50 per cent over the last 25 years.

GHG EMISSION LEVELS FOR SELECTED COUNTRIES FROM 1990 TO 2012

Canada's GHG emissions are 1.6 per cent (0.7 gigatonnes in 2014 compared to a world total of around 49 gigatonnes). This will likely go down in percentage as China, India, Brazil, Indonesia and others continue fast economic growth. Nevertheless, as a responsible global nation, Canada is a signatory to the Paris Agreement that came into force on Nov. 4, 2016.

Article 2 of the Paris Agreement describes its goals:

- Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change;
- Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production;
- Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development.

The goals are ambitious though the mechanisms are non-binding. The longest global surface temperature data set available shows the observed change between the period 1850-1900 and the Intergovernmental Panel on Climate Change's *Fifth Assessment Report's* reference period (1986-2005) is 0.61 °C¹. To achieve the Paris Agreement's goals, serious curtailment of CO₂ and other GHG emissions will be required of everyone but particularly the main emitters: the U.S., China, India and the European Union (which collectively accounts for 55 per cent of the world's emissions).

It is helpful to examine the main sources of GHG emissions, especially CO₂.

The classification and percentage of contribution may vary from one analysis and world region to another, but the fact remains that fossil fuel uses—besides Agricultural, Forestry and Other Land Use (AFOLU)—are one of the biggest contributors to GHGs whether directly (in extraction and flaring) or indirectly.

CARBON TAX AND DE-INCENTIVIZING FOSSIL FUELS

The response of most international governments and world organizations to inhibit use of fossil fuels is to introduce disincentives, such as a carbon tax, cap and trade schemes, and other regulatory and trade hurdles. Additionally, governments subsidize alternative and renewable energy sources and their consumers, such as subsidies to ethanol in some countries and a tax credit for electric vehicles in the U.S.

For non-governmental opponents of fossil fuels, the response spectrum is broad and can encompass lobbying; legal challenges; political pressure; media influence; partnering with aboriginal communities; enlisting local and international groups, academia, scientists and celebrities; and protests including sit-ins and blockades.

CARBON PRICING REGIME IN SELECT COUNTRIES

In Alberta, the Specified Gas Emitter Regulation levy on large industrial emitters stands at \$20/tonne (T) as of Jan. 1, 2017, which will change to \$30/T starting in 2018. The emissions intensity, conservatively² expressed in kilograms of CO₂ equivalent per barrel (CO₂e/bbl), is 80 kilograms of CO₂e/bbl for in situ oilsands and 50 kilograms of CO₂e/bbl for oilsands mining operations. Thus, for in situ projects, which account for more than 50 per cent of the total oilsands production, this \$20/T levy would amount to \$1.60/bbl. This levy, in addition to the existing royalties, is significant given the prevailing WTI prices and the differential of WCS to WTI prices. A \$50/T carbon tax in 2022 would be equivalent to \$4/bbl for in situ oilsands projects.

Apart from the above, the Alberta government's Climate Leadership Plan calls for a

	Population (million)		Urbanization		Urban Population (million)	
	2014	2040	2014	2040	2014	2040
OECD	1,272	1,394	80%	85%	1,018	1,185
Americas	496	592	81%	86%	402	509
United States	323	377	82%	86%	265	324
Europe	570	599	76%	82%	433	491
Asia Oceania	206	203	90%	93%	185	189
Japan	127	114	93%	97%	118	111
Non-OECD	5,983	7,757	48%	59%	2,872	4,577
E. Europe/Eurasia	343	335	63%	68%	216	228
Russia	144	133	74%	79%	107	105
Asia	3,779	4,459	43%	57%	1,625	2,542
China	1,372	1,398	55%	73%	755	1,021
India	1,295	1,634	32%	45%	414	735
Southeast Asia	623	763	47%	60%	293	458
Middle East	224	323	70%	75%	157	242
Africa	1,156	2,062	40%	51%	462	1,052
Latin America	481	578	79%	85%	380	491
Brazil	206	236	85%	90%	175	212
World	7,255	9,151	53%	63%	3,845	5,765

FIGURE 3 | SOURCE: IEA WORLD ENERGY OUTLOOK 2016

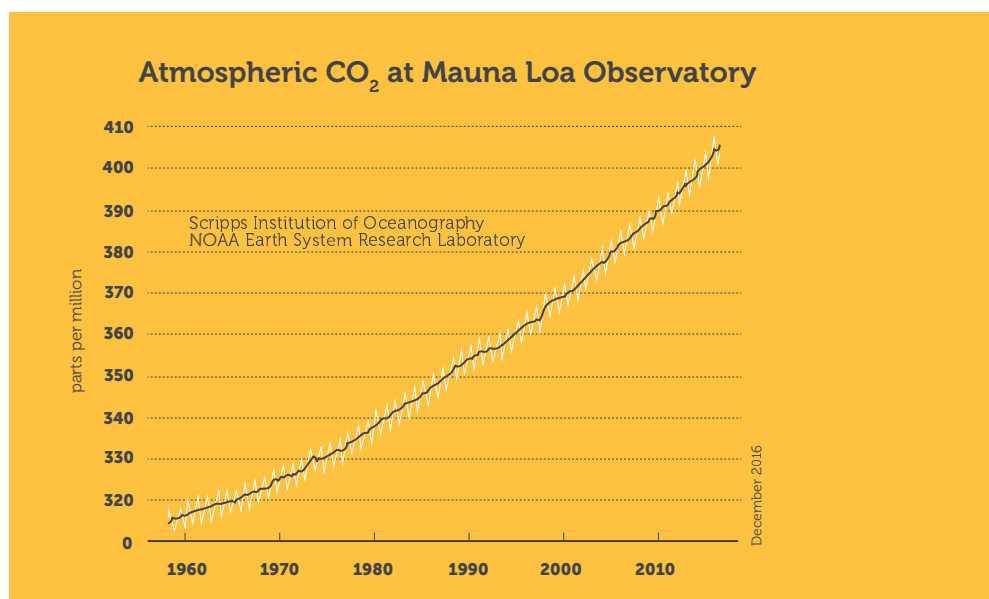


FIGURE 4 | SOURCE: NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION; SCRIPPS INSTITUTION OF OCEANOGRAPHY

carbon levy on all fuels emitting GHGs when combusted. This levy will be \$20/T starting on Jan. 1, 2017, and \$30/T from 2018, which will result in an increase of 8.03 cents per litre in the price of diesel, 6.73 cents per litre for gasoline and \$1.52/GJ for natural gas³. It remains to be seen how the increase in fuel prices will impact the end-user in terms of increased prices for all commodities owing to higher transportation costs and increased heating costs.

IS ACCESS TO MARKETS IMPROVING?

Access to markets has been a long-standing and profound concern for Canadian producers of heavy oil and oilsands bitumen. The federal government has recently announced the approval of two pipelines: the Trans Mountain Expansion, which would increase the capacity of Kinder Morgan's existing pipeline to the West Coast by 590,000 bbls/d, and Enbridge's Line 3 replacement program, which will restore capacity to the system from Alberta ►

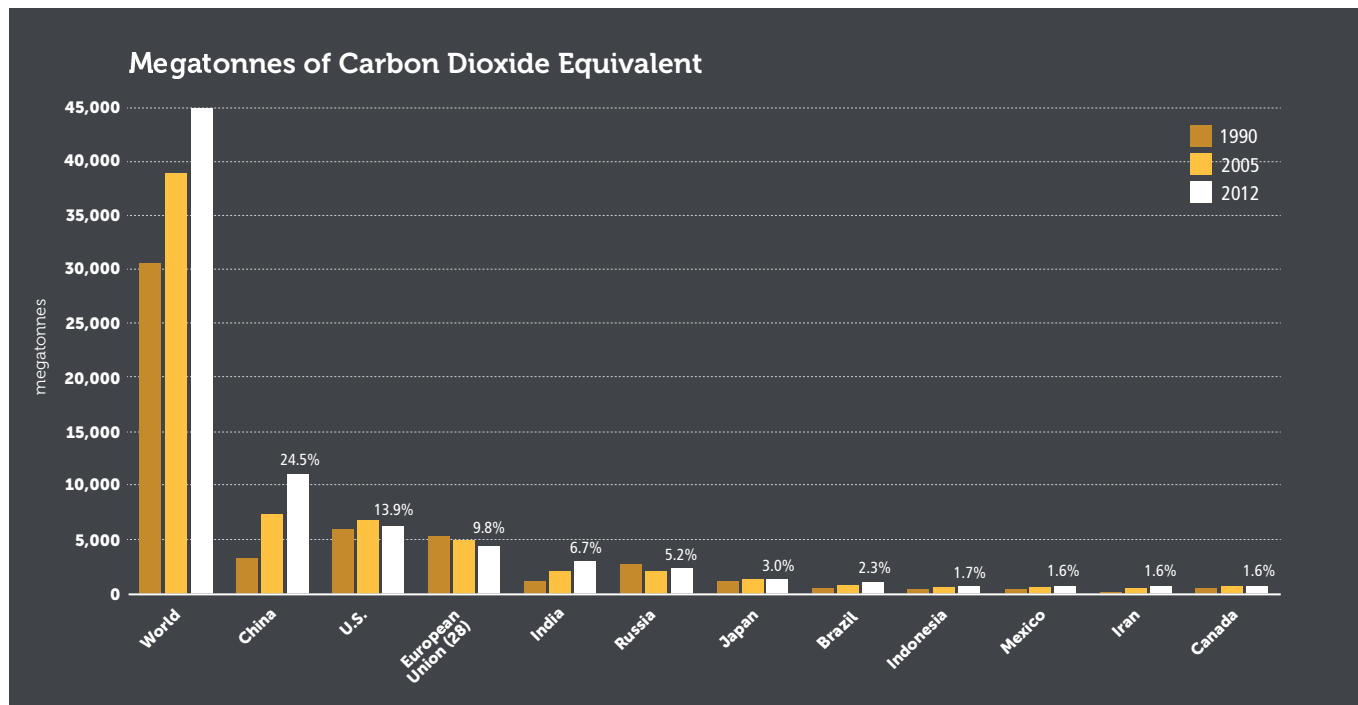


FIGURE 5 | SOURCE: ENVIRONMENT AND CLIMATE CHANGE CANADA (2016) CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS: GLOBAL GREENHOUSE GAS EMISSIONS.

Greenhouse Gas Emissions by Economic Sector

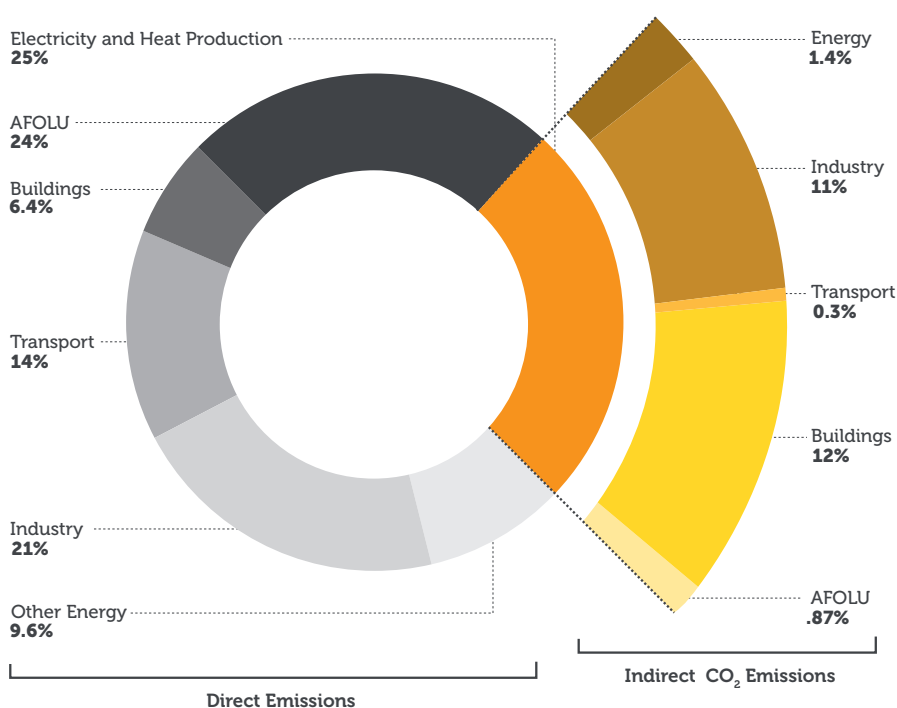


FIGURE 6 | SOURCE: FIFTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

to Wisconsin to 760,000 bbls/d (an increase of about 370,000 bbls/d from 2016 operating capacity).

Once completed, these two projects would provide a total of 960,000 bbls/d of additional capacity. More significantly, the Trans Mountain Expansion would provide the first meaningful open access to Asian markets from the Pacific seaboard, thus reducing the U.S.'s influence as the most important buyer of Canadian crude.

In the U.S., major political change is afoot. With new president Donald Trump taking office, as anticipated the previous administration's decision to deny permission for the Keystone XL pipeline to cross into the U.S. has been reversed. Once Keystone XL finally gets constructed, it will add another 830,000 bbls/d of capacity and will improve access to PADD III refineries on the U.S. Gulf Coast. Meanwhile, Enbridge's proposed Energy East pipeline to the East Coast is under intense debate and scrutiny. The regulatory review of the project, which has the potential to add 1.1 million bbls/d of capacity, was stalled in September, and it is unclear when it will resume.

If all four of these pipeline projects come to fruition, it will increase export capacity by almost 2.9 million bbls/d. A portion of this capacity is currently served by rail and some is taken up by movement of oil in the opposite direction, such as through Canada's import of about 600,000 bbls/d, which is used in eastern and central provinces.

CAP ON CARBON EMISSIONS AND PROJECTIONS

In November 2016, the Alberta government introduced Bill 25: Oil Sands Emissions Limit Act into the legislature. If enacted, Alberta will have an annual legislated 100 megatonne cap on GHG emissions from oilsands projects including mining, in situ and upgrading facilities. Alberta's oilsands GHG emissions were about 66 megatonnes in 2014, which is about 24 per cent of Alberta's emissions and nine per cent of Canada's emissions⁴.

In 2015, oilsands produced around 1.3 million bbls/d from in situ projects and one million bbls/d from mining projects. Assuming the same mix of the future projects, total oilsands production will be limited to around 3.5 million bbls/d if this cap is fully enforced. However, there are some caveats to this projection, which will be explored when discussing mitigation efforts in Part 2 of this series.

CONCLUSIONS

While it is true that the challenges are numerous and serious, a lot can be done to address them. The foremost thing to do is to keep ourselves informed of all the changes happening around us locally and globally and make sure that we don't miss out on the big opportunities.

Part 2 of this article will focus on mitigation to the major challenges the Canadian heavy oil industry is facing. Many of the mitigation suggestions are likely already being implemented by the industry in some form, and some hardened industry veterans may not look favourably upon the ideas. However, this author sincerely believes these suggestions will provide food for thought and can stimulate healthy discussion with an aim to make a better, cleaner world with energy for everyone. ■

¹Fifth Assessment Report of the Intergovernmental Panel on Climate Change

²Pembina Institute; Measuring Oilsands carbon emissions intensity, August 2016

³Table 1. Alberta Government's Climate Leadership Plan, <https://www.alberta.ca/climate-carbon-pricing.aspx>

⁴Norton Rose Fulbright: Legal update, Alberta law to cap oil sands emissions, November 2016



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he has been actively engaged in heavy oil and oilsands and is considered one of the leading sub-surface specialists in thermal operations. Harris currently runs his own consulting business in Calgary. He is a member of the CHOA editorial committee.

Carbon Pricing in Select Countries

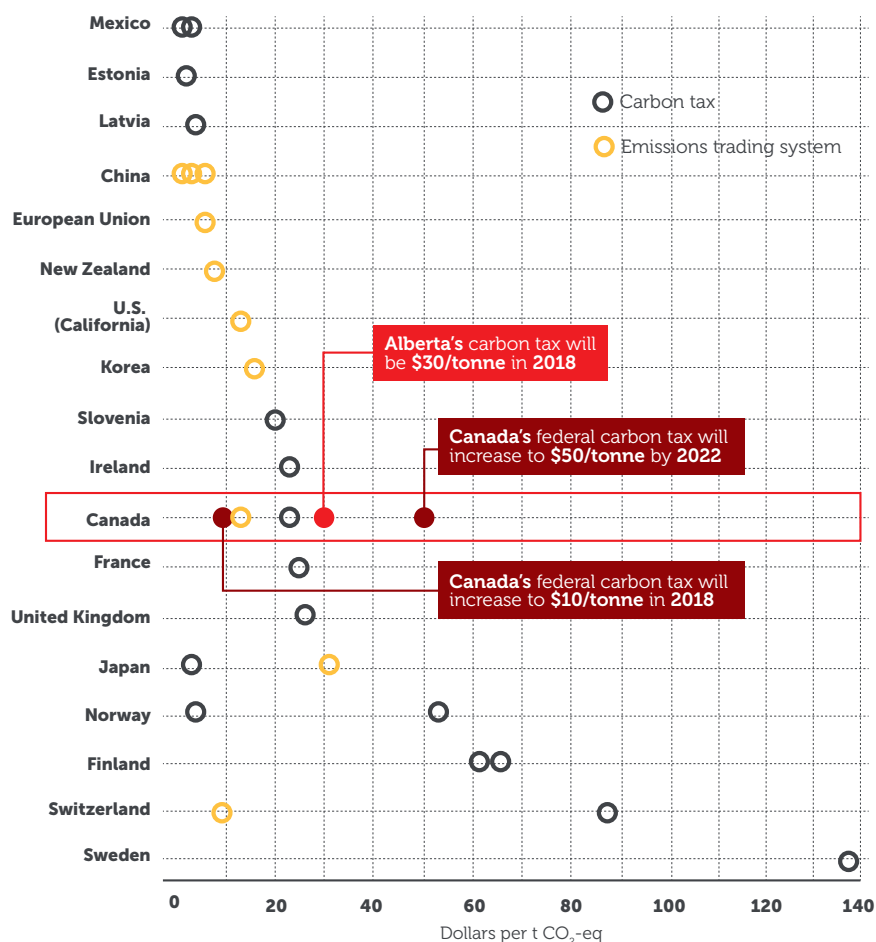


FIGURE 7 | SOURCE: IEA WORLD ENERGY OUTLOOK 2016

Oilsands Emissions Growth Projections

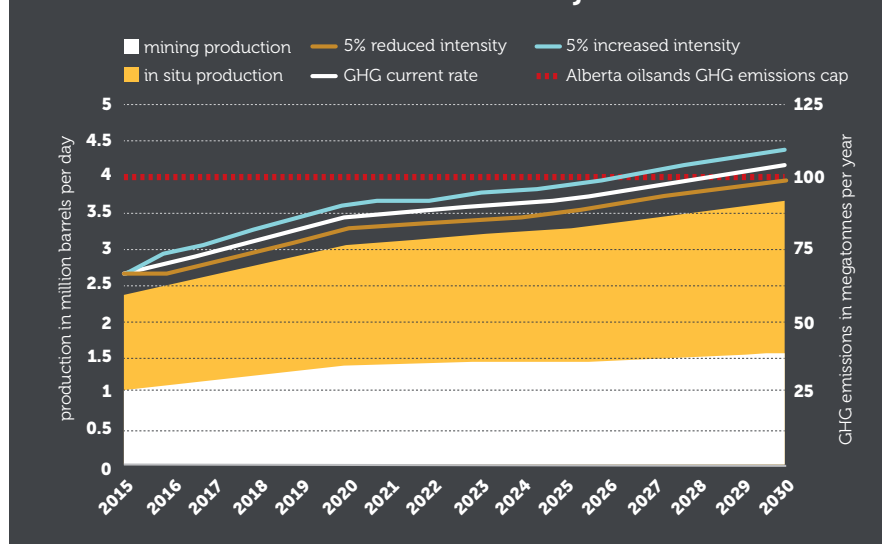


FIGURE 8 | SOURCE: CAPP, ENVIRONMENT CANADA, HARRIS NASEER