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The future of oil in the energy transition

Understanding global oil demand scenarios

Janetta McKenzie

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by Janetta McKenzie | December 14, 2022

Summary

For the first time, a range of oil demand scenarios — including those created by industry, international organizations, and research institutes — project that, if the current pace of climate policy action continues, global demand for oil will peak before 2030 and decline steadily afterwards.

These projections are largely based on the continued and accelerated uptake of electric vehicles, as well as environmental policies around plastic use and recycling, both of which lead to less oil being required for the transportation and petrochemical sectors (two key sources of current demand). Additionally, an increasing number of countries are committing to and developing net-zero targets and economy-wide plans to reach those targets.

Several scenarios indicate that the actions governments have already taken (or have committed to take in the short term), combined with macro-level economic trends, will likely result in a long-term decline in global demand for oil beginning before 2030. The energy transition has been gaining momentum since the adoption of the Paris Agreement in 2015, and the International Energy Agency's latest *World Energy Outlook* shows that, despite upheaval in the global energy system in 2022 caused by the Russian invasion of Ukraine, the transition is accelerating as countries realise the energy security benefits of renewables.

This growing consensus on the near future of declining oil demand provides important indicators for Canada's governments and its oil production sector. These scenarios appear to demonstrate the inherent risks involved in investing public or private capital in an industry facing demand challenges, and underscore the need for Canadian oil companies to urgently improve their emissions credentials to remain competitive in a net-zero energy world of the near future, where demand is projected to decline.

Context

As the world tackles the increasingly urgent challenge of climate change, Canada must navigate its own pathway to net-zero greenhouse gas emissions by 2050. Every sector of the Canadian economy must make deep, urgent cuts to emissions to achieve this target.

However, as the largest (and still growing) source of emissions in Canada, oil and gas production — especially the emissions-intensive production of bitumen in the oilsands — has the potential to either make or break Canada's climate commitments.

Recognizing the link between global climate action and the future of Canada's oil sector is important. More and more countries are now transitioning to clean energy — such as by scaling up renewables for power production, or implementing policies that will encourage a widespread shift from gasoline to electric vehicles (EVs). As adoption of clean technology such as EVs ramps up, prices will continue to fall — encouraging yet further adoption. It is reasonable to expect that all of this will precipitate a long-term decline in global demand for oil.

This report explores how data is beginning to back up that expectation. Several institutions, from international organizations like the International Energy Agency (IEA), oil majors like bp and Equinor, and research consultancies like Bloomberg New Energy Finance (NEF) and Rystad Energy all publish in-depth, data-driven scenarios that explore possible pathways of the global energy transition between now and 2050. All these scenarios indicate that if climate policy action, technological development, and economic momentum continues at least at the same pace as has been observed in recent years, global oil demand will begin to decline before 2030, and is not projected to recover (making this different to previous boom-and-bust cycles in the oil industry). Meanwhile, if these trends intensify in alignment with numerous countries' commitments to reaching net-zero emissions by 2050, the scenarios indicate that the decline will begin sooner and be faster.

There are two key stakeholders here. First, the oil and gas industry itself, which will need to confront a near future where there is significantly less demand for its product. Second, Canada's federal and provincial governments, which must ensure — on behalf of the public — that the oil sector reduces its emissions in line with Canada's climate commitments, while also ensuring the shift away from fossil fuels does not leave the taxpayer to pick up the cost of significant oil sector liabilities (such as cleanup of disused wells and tailings).

This has implications for Canada's energy and climate policy planning, and for public investment decisions. If we can reasonably expect a long-term decline in global oil demand starting this decade — and that competition to service the remaining demand will be driven by both emissions intensity conditions as well as cost-effectiveness — then Canada should increase its ambition regarding decarbonization of oil production. In doing so, it can seek to

keep the Canadian industry globally competitive, while also adhering to our climate obligations.

What do these scenarios tell us about oil demand?

Equinor[1], bp[2], the IEA[3], Bloomberg New Energy Finance,[4] and Rystad Energy[5] all model scenarios exploring different trajectories for global oil demand between now and 2050. These scenarios are developed using assumptions about how national policies, clean energy technology, and the global economy will change in the years ahead.

For example, some scenarios assume a similar rate of change as has been seen since the Paris Agreement in 2015 (a landmark moment, after which multiple countries began to introduce a greater volume of policies intended to curb global warming). These "evolving policy scenarios" account for factors that are either already happening or are already on a trajectory to happen — such as policies that have already been implemented or announced, the deployment of technology that is already developed, or trends in global prices already being observed. There are other scenarios that model trajectories based on existing policies only — for instance, the International Energy Agency's Stated Policies (STEPS) scenario, most of which still lead to a decline — albeit a less significant one — in oil demand by 2050.

Other scenarios assume a more rapid pace of change that would need to occur if the world were to reach net-zero greenhouse gas emissions by 2050 (as many countries have committed to), or where global warming is successfully kept below 2 degrees Celsius. These scenarios are more indicative of where we need to go, and what trends we need to accelerate, to avoid the very worst impacts of climate change.

Crucially, in all of these scenarios — evolving policy, net-zero, and 2C — global oil demand begins to decline by 2030. In this report, we have focused on scenarios that assume the world meets its current climate goals, and expands those goals to reach net-zero global emissions by 2050.

[1] Equinor, *Energy Perspectives 2021*. https://www.equinor.com/sustainability/energy-perspectives

[2] bp, *Energy Outlook 2022*. https://www.bp.com/en/global/corporate/energy-economics/energy-outlook.html

[3] IEA, *World Energy Outlook 2022*. https://www.iea.org/reports/world-energy-outlook-2022

[4] Bloomberg NEF, *New Energy Outlook 2022*. https://about.bnef.com/new-energy-outlook/;.BNEF's input data is not publicly available.

[5] Rystad Energy, *Demand Scenarios* (Accessed November 2022); Rystad's input data is not publicly available but was obtained through license.

What is a scenario?

Scenarios are **modelled trajectories** that highlight key trends, uncertainties, and potential outcomes, but are **not precise predictions** of how the next few decades will unfold. Scenarios can help governments and businesses make decisions and navigate the uncertainty of the global energy transition, while maintaining the necessary flexibility to adapt to events in real time.

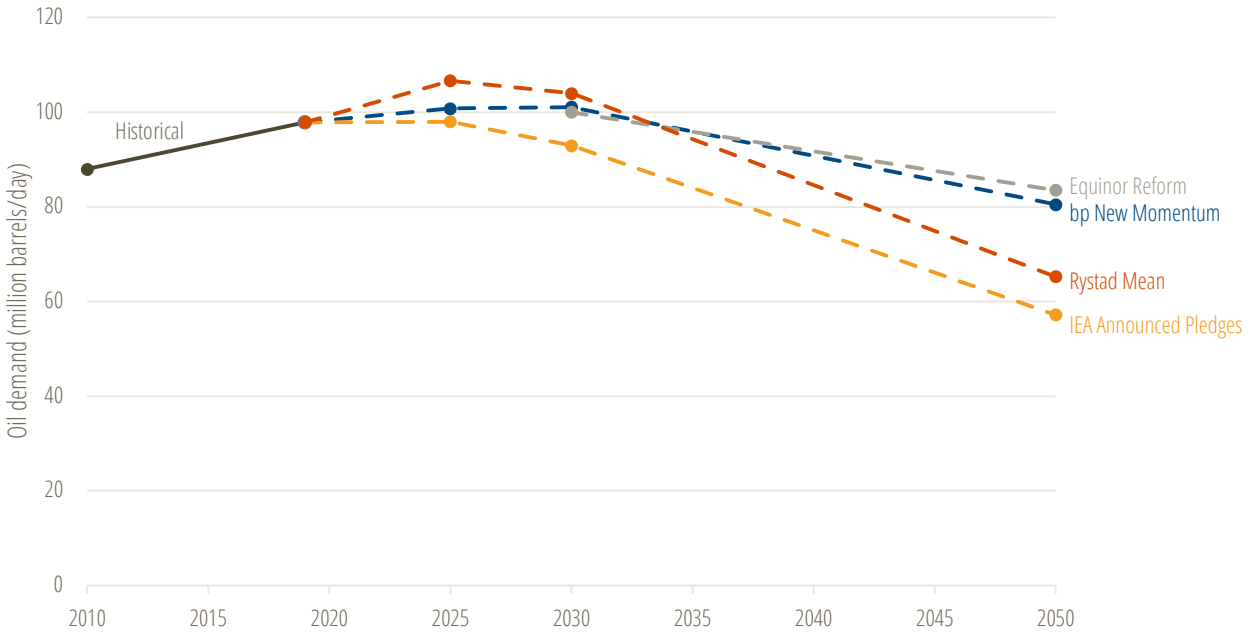

Figure 1. Oil demand under current policy and economic trajectories (evolving policy scenarios)

Data sources: various[6]

Key insight: Under all four evolving policy scenarios (Figure 1), oil demand begins long-term decline by the 2030s. These scenarios broadly assume that the current pace of technological and economic change continues, and that all goals are met. These scenarios model **a range of decline in demand of 17%-41% from 2019 levels by 2050**. The IEA and Rystad scenarios assume that climate targets are met, while Equinor and bp assume a less ambitious but still accelerated pace of change compared to today. **Meanwhile, under net-zero scenarios, a decline of 53%-84% from 2019 levels is modelled** (Figure 2).

[6] IEA, *World Energy Outlook 2022;* bp, *Energy Outlook 2022*; Equinor, *Energy Perspectives 2021*, Rystad Energy, *Demand Scenarios* (Accessed November 2022).

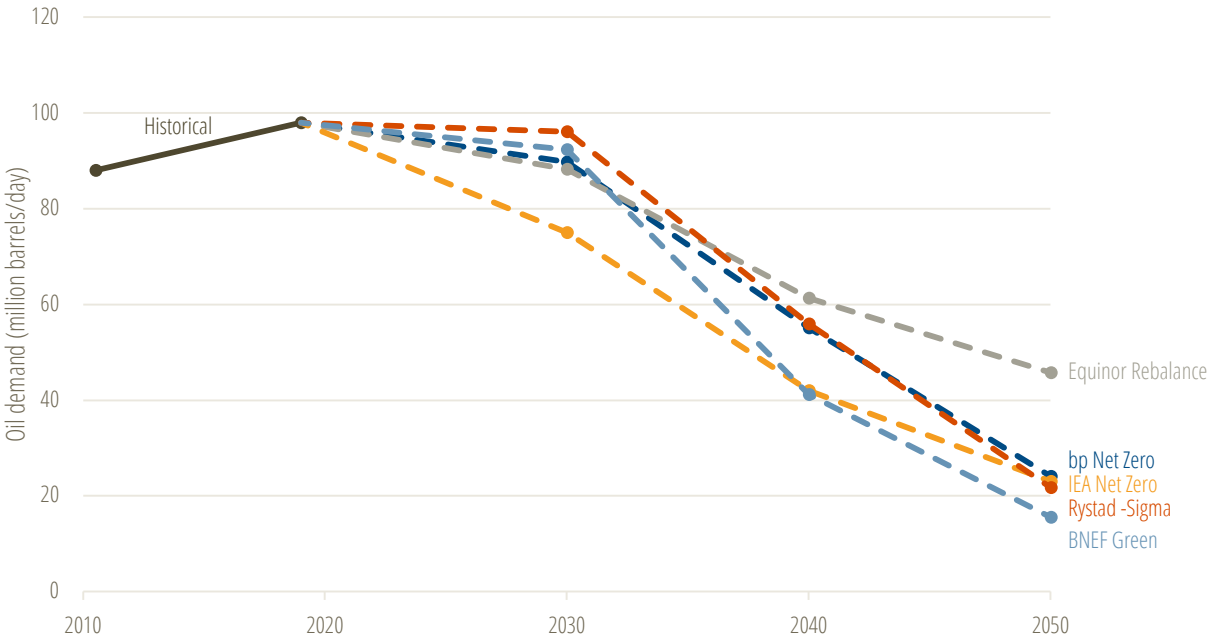

Figure 2. Oil demand if countries reach net-zero by 2050, or global warming is limited to 2 degrees Celsius

Data source: various[7]

Examples of assumptions underlying different scenarios

All the scenarios shown in Figures 1 and 2 indicate promising trends in zero-emission vehicle uptake (and concurrent shift away from gasoline engines), with an associated increase in renewable energy capacity that is largely driven by advanced economies (including Canada) and China. The IEA's *Net-Zero* scenario — the trajectory for which is shown in Figure 2 — shows a rapid acceleration of these trends across geographies, along with increased public funding of key technologies like direct air capture, battery storage, and low-carbon fuels.

These scenarios also show a shift in oil consumption from transport to petrochemicals; bp's New Momentum scenario expects almost 30% of oil demand in 2050 will be for chemical feedstocks, driven mainly by demand for plastics, compared to 18% in 2019.[8] The IEA's Net-Zero scenario attributes more than half of global oil demand in 2050 to the chemicals sector.

All scenarios shown also assume energy efficiency improvements in buildings and appliances (for instance, improving insulation or using LED lights), a substantial increase of renewable

[7] IEA, *World Energy Outlook 2022*; bp, *Energy Outlook 2022*; Equinor, *Energy Perspectives 2021*; Bloomberg NEF *New Energy Outlook 2021;* Rystad Energy, *Demand Scenarios* (November 2022).

[8] bp World Energy Outlook 2022.

energy capacity globally, and end-use electrification (like installing heat pumps) to chart the path forward.

Why will oil demand decline?

The reasons for oil demand decline are complex and interact with each other, but the uptake of electric vehicles, the acceleration of global climate action, and persistent use of oil for petrochemicals are crucial to understand long-term oil demand scenarios. As climate policy around the world is brought in and strengthened, new economic opportunities are created, which in turn affect implementation of further climate policy. Changing geopolitical dynamics also affect short-term oil demand, highlighting the sensitivity of a global commodity like oil to price and demand shocks. This in turn may accelerate the long-term decline in demand, as nations seek to diversify their energy supplies in pursuit of energy security. For instance, in response to the Russian invasion of Ukraine, Germany has accelerated plans for renewable energy, increasing subsidies and streamlining the regulatory process.[9]

1. Uptake of EVs

- In 2021, transportation was responsible for almost half of crude oil demand. In 2019, road transportation alone accounted for more than 40% of oil demand.[10] Therefore, the pace of substitution of combustion engines with electric vehicles is a leading indicator of oil demand and general emissions trends.
- In all three scenarios in the IEA's *World Energy Outlook,* oil demand for road transport declines. Under the Announced Pledges scenario, which assumes all EV sales targets and efficiency goals are met on time and in full, oil demand for road transport peaks in the mid-2020's and falls by almost half by 2050.

[9] European Commission, "State aid: Commission approves additional German measures to support electricity production from renewable energy sources", September 27, 2022. https://ec.europa.eu/commission/presscorner/detail/en/ip_22_5811

[10] Bloomberg NEF, "Oil Demand from Road Transport: Covid-19 and Beyond," June 11, 2022. https://about.bnef.com/blog/oil-demand-from-road-transport-covid-19-and-beyond/

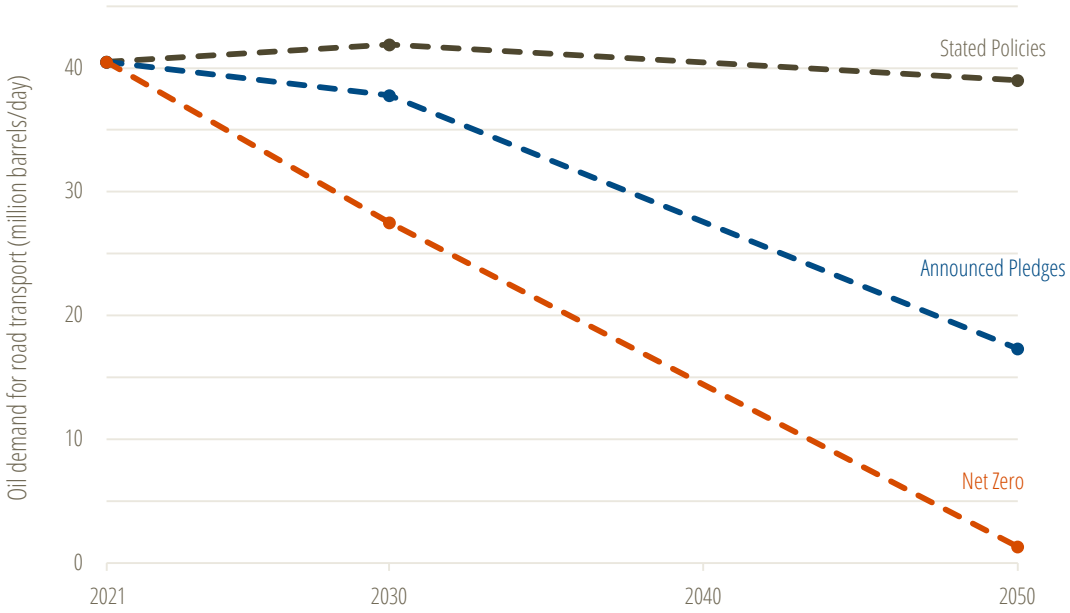

Figure 3. Oil demand for road transport across three scenarios in the IEA *World Energy Outlook*

Data source: IEA[11]

Key insight: In all scenarios, **changes in road transport account for much of the decline in oil demand to 2050**, underscoring the significance of government policies — such as Canada's sales targets — that incentivize electric vehicle uptake.

- Sales of electric vehicles increased globally and in Canada during the pandemic and keep pace with IEA projections of what is needed to reach a net-zero transportation sector by 2050 (Figure 4).
- Also according to data from the IEA, EVs represented just over 2% of light vehicle sales globally in 2019; by the end of 2021, market share had risen to 9%. Early figures from 2022 indicate that this trend continues, despite supply chain challenges that have affected the entire auto industry, including gasoline-powered vehicles.
- All net-zero or 2-degree scenarios assume a fundamental shift towards electric vehicles in the next twenty years in order to get the reductions in oil consumption needed to reach those targets. The IEA, whose long-term projections start in 2025, show that while electric vehicle uptake is increasing, we need the rate of change to accelerate further (Figure 4). That is why policies designed to prioritize EV sales, like Canada's target for 100% of light-duty vehicle sales to be zero-emission by 2035, matter. Canada

[11] IEA, *World Energy Outlook 2022.*

has also set zero-emissions vehicle (ZEV) adoption targets for 35% of new on-road medium and heavy-duty vehicles (MHDVs) by 2030, and 100% by 2040. However, Canada has not yet announced binding mandates for electric vehicle sales.

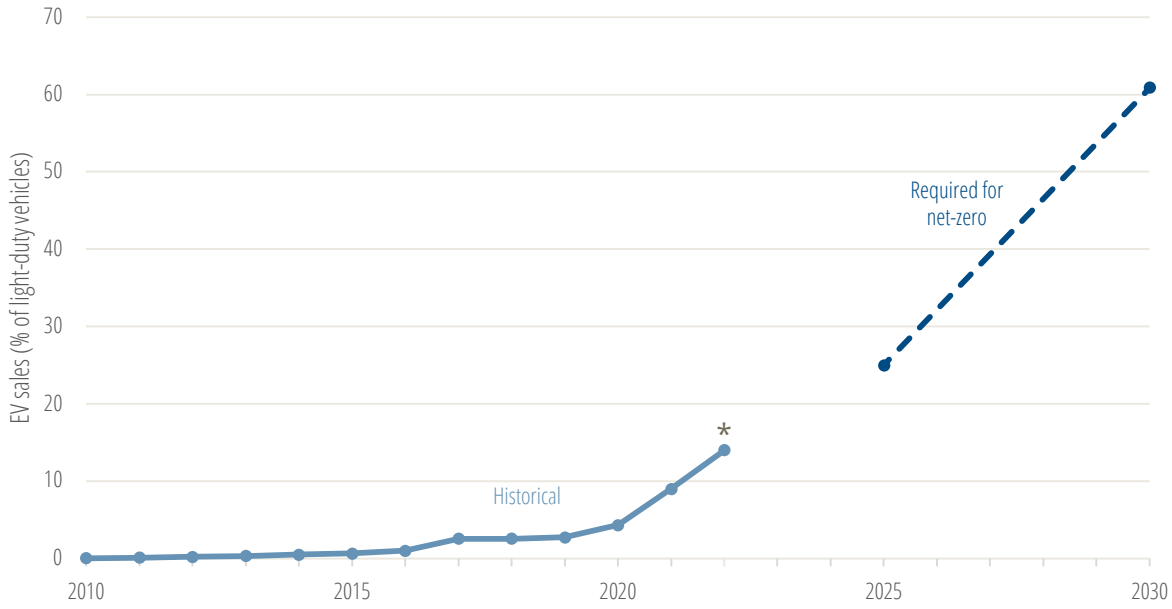

Figure 4. Share of light EV sales needed by 2030 on the road to net-zero

* Projected value

Data sources: Hastings-Simon, [12] IEA[13]

- Europe and China are leading the charge on EV uptake. In Europe, 17% of all vehicle sales were electric in 2021. In 2021, sales of EVs in China more than doubled from 2020, to 16% of all vehicle sales.[14]
- In Canada, the increase in EV adoption has been led by B.C., Ontario, and Quebec. In 2021, almost 43% of new zero-emissions vehicles registered in Canada were in Quebec.[15] B.C. and Quebec are the only two provinces with provincial sales mandates for passenger/light-duty EVs — 90% of sales by 2030 in B.C, and 65% by 2030 in Quebec.[16]

[12] Sara Hastings-Simon, *The Accelerating Pace of Electric Vehicle Adoption* (University of Calgary School of Public Policy, 2022). https://www.policyschool.ca/wp-content/uploads/2022/03/EPT-Electric-Vehicles-March.pdf

[13] IEA long-term scenarios include projections from 2025 onward, and are based on the publicly available data. IEA *Net-zero by 2050: A Roadmap for the Global Energy Sector.* https://www.iea.org/reports/net-zero-by-2050

[14] IEA, *Global EV Outlook 2022* (2022). https://iea.blob.core.windows.net/assets/ad8fb04c-4f75-42fc-973a-6e54c8a4449a/GlobalElectricVehicleOutlook2022.pdf

[15] Statistics Canada, "Vehicle registrations, 2021." https://www150.statcan.gc.ca/n1/daily-quotidien/221201/dq221201c-eng.htm

[16] Clean Energy Canada and Electric Mobility Canada, *How Canada can design a truly effective zero-emission vehicle mandate* (2022). https://cleanenergycanada.org/wp-content/uploads/2022/08/ZEV-Standard-Best-Practices-EN.pdf

- The federal government, six provinces and two territories have purchasing incentives for zero-emission passenger vehicles. B.C. and Quebec also have incentives for zero-emission MHDVs.
- The global bus fleet is already 44% electrified, due to clean public procurement policies around the world.[17] Meanwhile, global sales of lighter-duty electric trucks and vans more than doubled in 2021,[18] and the electrification of urban delivery vehicles is expected grow exponentially over the next decade.[19] However, to align with the IEA's Announced Pledges scenario, sales of MHDVs need to accelerate significantly to 10% of the sales share by 2030.[20]
- Today's high gasoline and diesel prices may help speed up this transition to EVs. First, EVs offer consumers the opportunity to end their reliance on unpredictable gasoline prices. Second, as gasoline prices increase further, consumers are more likely to seek alternative, lower-carbon modes of transportation — and while still more expensive to purchase than combustion vehicles, EVs are already cheaper than conventional vehicles on a total cost of ownership basis.[21]
- The cost of EVs is expected to decrease as vehicle manufacturers invest more in development to meet forecasted demand. While forecasts for these price reductions vary, due to supply chain and logistical variables, Bloomberg New Energy Finance estimates that electric vehicles may be cheaper to buy than combustion vehicles as early as 2026 in most countries.[22]

[17] Bloomberg NEF, *New Energy Outlook 2022*.

[18] Bloomberg NEF, *New Energy Outlook 2022*.

[19] Colton Kasteel, Sarah McBain, Chandan Bhardwaj, *Laying the Groundwork: Exploring the challenges and opportunities in the transition to zero-emission medium- and heavy- duty vehicles* (Pembina Institute, 2022). https://www.pembina.org/reports/laying-the-groundwork-mhdvs.pdf

[20] IEA, *Global EV Outlook*.

[21] Clean Energy Canada, *The True Cost* (2022). https://cleanenergycanada.org/wp-content/uploads/2022/03/Report_TheTrueCost.pdf

[22] Colin McKerracher, "The EV Price Gap Narrows," *Bloomberg NEF,* June 25, 2021. https://about.bnef.com/blog/the-ev-price-gap-narrows/

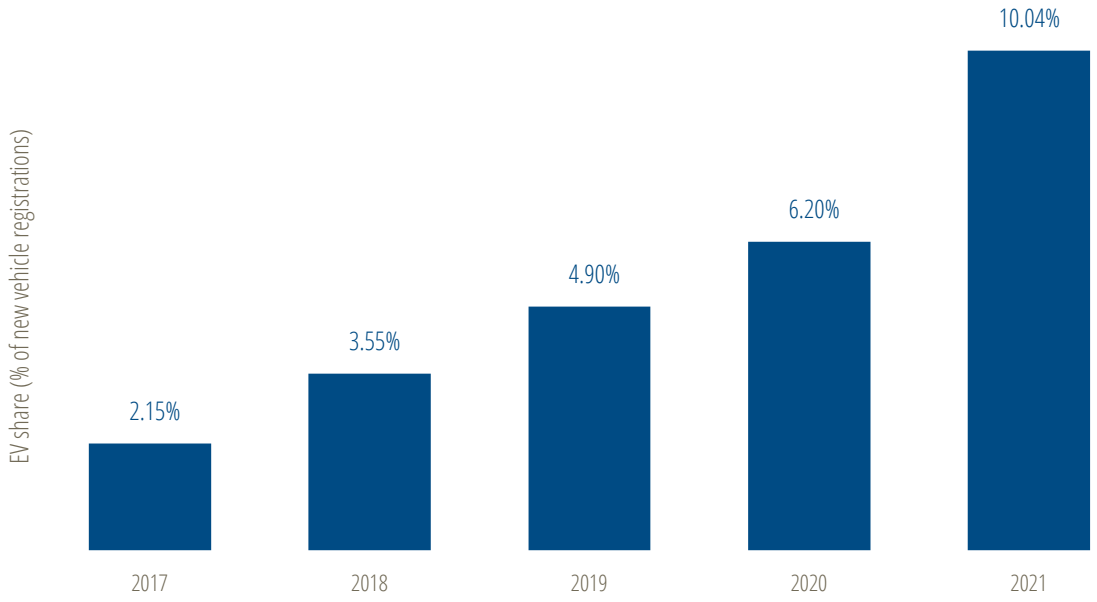

Figure 5. EV (hybrid and battery) percentage of new vehicle registrations in Canada

Data source: Statistics Canada[23]

2. Global climate action

- Aside from transportation policy, the pace at which countries introduce and implement other regulations specifically designed to reduce emissions across their economies will also impact oil demand. However, it should be noted from the outset that even under the IEA's Announced Pledges Scenario — which includes national policies that have been **either announced or already implemented** — oil demand still peaks before 2030.
- While globally, Nationally Determined Contributions (NDCs; emissions reductions that countries commit to internationally) still fall short of what is required to keep warming below 2 degrees Celsius, the most recently submitted NDCs are more ambitious than ever, with absolute emissions reductions of almost 4 Gt CO_2eq (gigatonnes of carbon dioxide equivalent) by 2030 forecasted.[24]
- As of September 2022, 16 countries have enshrined a net-zero target into legislation, including Canada. Another 34 countries have developed net-zero policies which are not

[23] Statistics Canada, "Table 20-10-0021-01: New motor vehicle registrations." https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2010002101

[24] Michel G. J. den Elzen et al., "Updated Nationally Determined Contributions Collectively Raise Ambition Levels but Need Strengthening Further to Keep Paris Goals within Reach," *Mitigation and Adaptation Strategies for Global Change* 27, no. 2022): 33, https://doi.org/10.1007/s11027-022-10008-7.

legally binding, and 138 countries have declared an intention to work towards net-zero, if not yet formally integrated into policy.

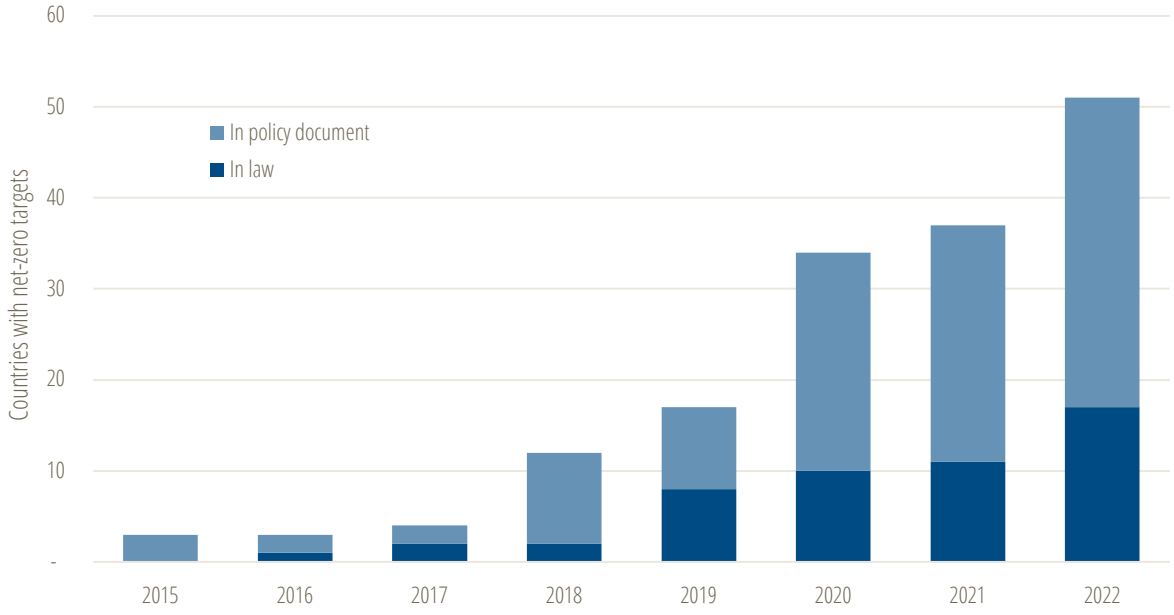

Figure 6. National net-zero targets announced and in legislation

Data source: Net Zero Tracker[25]

Key insight: Political will to implement the energy transition **is building**. Policy implementation, technology development, and global economic trends **will likely accelerate further** in the coming years.

- Policy momentum is building across the world.
  - The Global Methane Pledge, signed by over 150 countries as of COP27, aims to reduce global methane emissions by at least 30% from 2020 levels by 2030. Canada has pledged to reduce oil and gas methane emissions 75% from 2012 levels by 2030.
  - Canada's *2030 Emissions Reduction Plan* outlines an economy-wide pathway to our target of reducing emissions by at least 40% below 2005 levels by 2030, and achieving net-zero emissions by 2050.
  - China, the largest emitter of GHGs (although 28th in 2019 per capita emissions), is on track to meet its goal of peaking CO_2 emissions before 2030.[26]

[25] Net Zero Tracker, "Net zero stocktake 2022." https://zerotracker.net/analysis/net-zero-stocktake-2022

[26] Swithin Lui, "Why China is set to significantly overachieve its 2030 climate goals," *CarbonBrief,* May 19, 2022. https://www.carbonbrief.org/guest-post-why-china-is-set-to-significantly-overachieve-its-2030-climate-goals/

- The United States (the second largest global emitter) will implement the historic *Inflation Reduction Act*, which commits US$369 billion over the next ten years to climate measures and clean energy development.
- 68 carbon pricing initiatives have been implemented across the world — including in Canada — covering 23% of global emissions in 2022.[27]

3. Demand for plastics

- Oil is also used as a feedstock for the petrochemicals industry, which uses it to produce plastic.
- Oil companies are betting big on plastics, planning to invest more than US$400 billion in new petrochemical supply by 2026.[28] Both bp and the IEA see petrochemicals as the largest driver of future oil demand.
- In both evolving policy and net-zero scenarios, the *amount* of oil used for petrochemicals changes slightly from now to 2050, but the *share* of oil consumption increases, because overall oil demand is declining. For instance, in bp's least ambitious New Momentum scenario, petrochemicals make up 28% of global oil demand in 2050; they make up 50% of demand in bp's Net Zero scenario.[29]
- In the IEA's Announced Pledges scenario, oil demand for plastics rises by about 1 mb/d to 2050 — one of the only areas in this scenario where oil demand stays about the same (Figure 7). In the IEA's Net Zero scenario, oil demand falls by about 20% in the chemical sector by 2050, although this is a much slower decline than other sectors. And to achieve this decline, a massive and rapid increase in the global average recycling rate is required; increasing from 17% in 2021, to 26% in 2030 and 54% in 2050.
- While petrochemicals are a non-combustion use for oil, there are still emissions and other environmental effects associated with production, transport, and disposal. There are signs that plastics demand is now front of mind for some governments for limiting oil use and reducing emissions, as countries implement circular economy policies in their efforts to hit climate targets and conserve their natural ecosystems. For example, the European Union implemented an €0.80 per kilogram tax on non-recycled plastic in 2021.[30] China has implemented a ban on certain types of plastics, and in 2018 stopped importing and processing plastic waste from other countries.

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[27] The World Bank, "Carbon Pricing Dashboard." https://carbonpricingdashboard.worldbank.org/

[28] Carbon Tracker, "Oil industry betting future on shaky plastics as world battles waste", September 4, 2020. https://carbontracker.org/oil-industry-betting-future-on-shaky-plastics-as-world-battles-waste/

[29] bp, *Energy Outlook 2022,*49.

[30] European Commission, "Plastics own resource." https://ec.europa.eu/info/strategy/eu-budget/long-term-eu-budget/2021-2027/revenue/own-resources/plastics-own-resource_en

- Demand for plastics is already no longer increasing in OECD markets — which in 2021 made up nearly half of all plastics demand.[31]
- We see then that global climate action is likely to also impact demand for plastics, which will have a knock-on effect on demand for oil. Via a combination of demand reduction — through design innovation, substitution with more sustainable products (like swapping plastic straws for paper or reusable materials) and increased recycling — the demand for plastics will likely decline as well.
- Further, Carbon Tracker (a financial think tank) has identified plenty of low-cost actions for plastics that are available for less than $87/ton, including eliminating plastic use where possible, re-using plastic, and improvements in mechanical recycling processes (including improving recycling infrastructure and setting binding recycling targets).[32]
- Policies to reduce plastic use are generally popular, as plastics impose not only a significant climate cost, but also threaten biodiversity and increase local pollution — making such measures more naturally appealing to governments than some other climate initiatives.

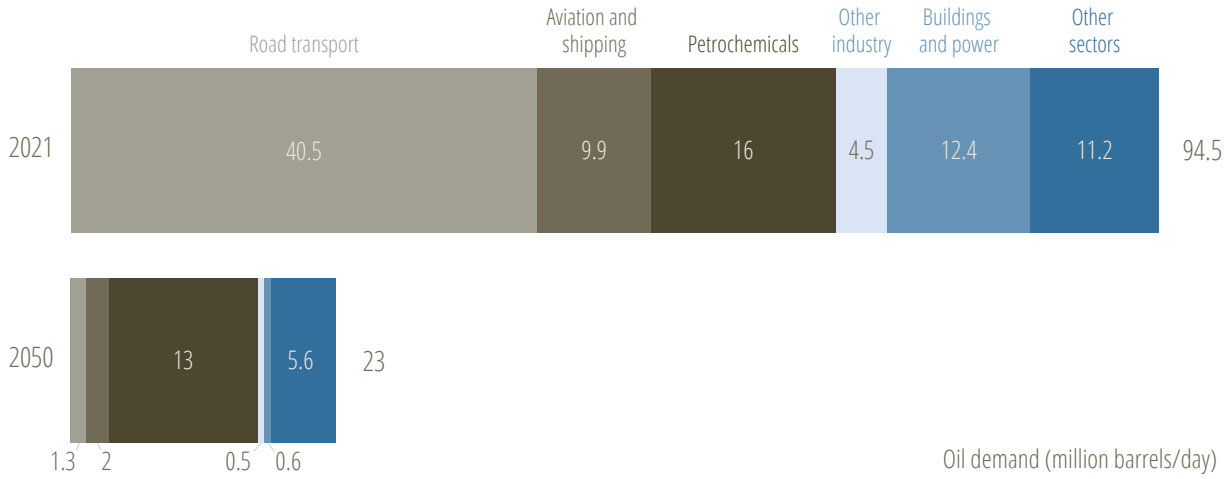

Figure 7. End-use of oil by sector in 2021 and 2050, under the IEA's pathway to net-zero by 2050

Note: Oil use as a chemical feedstock makes up about 90% of the petrochemicals sector oil demand today. The remainder is used for process energy. Other sectors include agriculture, fishing, etc.

Data source: IEA[33]

[31] Carbon Tracker, *The future's not in plastics: Why plastics demand won't rescue the oil sector* (2021). https://carbontracker.org/reports/the-futures-not-in-plastics/

[32] *The future's not in plastics.*

[33] IEA, *World Energy Outlook 2022,* Chapter 7.

What do these scenarios mean for Canada?

These different scenarios show that, with each passing year between now and 2050, momentum accelerates both in climate action and adoption of clean technology. Even most conservative scenarios about rate of change show a plateau and decline in demand — the question is only the speed of that decline.

Most scenarios that assume all existing climate pledges are met indicate that oil demand will start to decline before 2030. This includes scenarios published by oil majors like bp and Equinor. While the clean energy transition may not be linear, and we will have to navigate temporary obstacles like the current energy supply crisis, this nonetheless indicates that a fundamental shift is already underway. We will still need an abundance of energy to power our economies in 2050 and beyond, but attitudes on what type of energy that should be appear to have changed, and this is being reflected in government policies. The tide is turning towards lower-carbon and renewable energies, and Canada should recognize that continuing to rely on the fossil fuel sector to the extent that it has in decades past will leave its economy vulnerable to global socio-economic forces that are driving long-term decline in oil demand. The IEA's *World Energy Outlook 2022* emphasizes these trends, and includes a projection of overall Canadian oil production and oilsands production in particular (Figure 8).

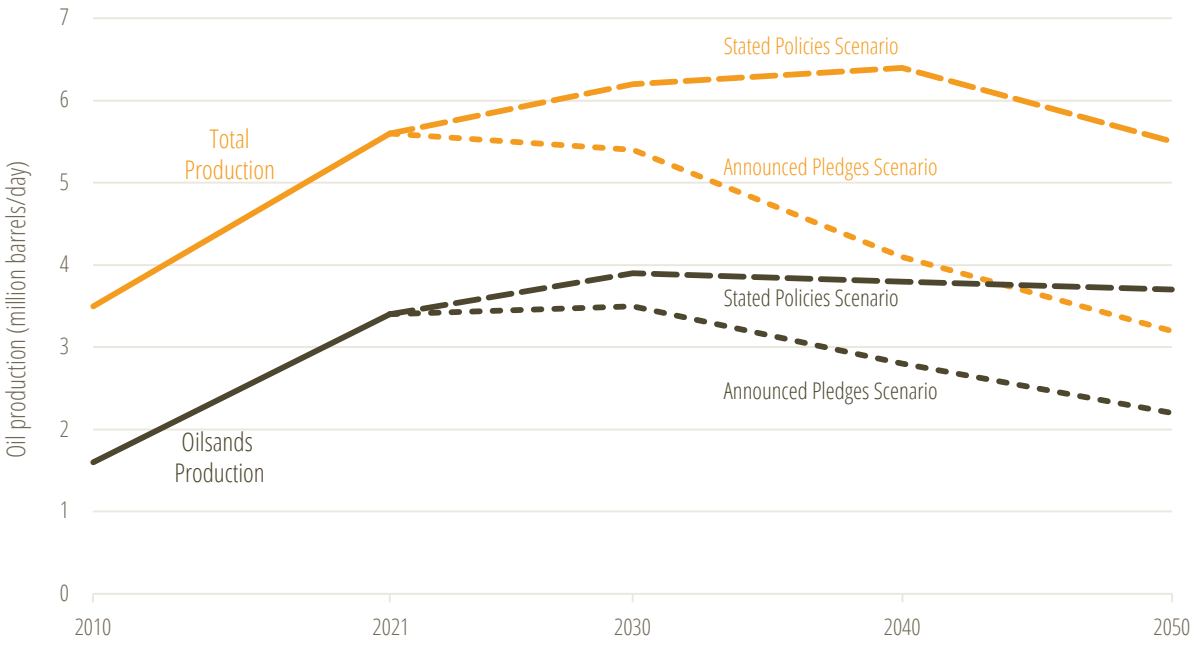

Figure 8. Canadian oil production in the IEA's *World Energy Outlook 2022*

Data source: IEA[34]

[34] IEA, World Energy Outlook 2022.

In particular, instead of driving long-term demand for oil, the 2022 energy price crisis spurred by Russia's invasion of Ukraine has highlighted that the long-term solution to energy security is for countries to reduce their reliance on fossil fuels. The IEA notes that those regions with more access to renewable energies were most shielded from price spikes in oil and gas this year.[35]

As such, the soaring oil prices we have witnessed in 2022 do not constitute a fundamental paradigm shift in favour of oil. The sector has always been volatile, and geopolitics exacerbate that volatility. For instance, the 2008 recession led to significant job losses across Alberta and western Canada, while the U.S. shale boom of the 2010s made the U.S. the top producer of oil but later precipitated the sector's downturn in 2014, when cheaper shale oil flooded the market. The price crisis of 2022 is perhaps unusual in that it has taken place in the crossroads of significantly heightened international rhetoric on the apparently conflicting issues of energy security and the climate crisis, and unpredictable geopolitical dynamics will likely continue to result in shorter periods of supply and demand imbalance. However, there is now clear evidence that the energy transition is gaining momentum at both a policy and business level, and so longer-term trends for oil demand are more indicative of the future for Canada's sector.

Firms and investors alike are therefore increasingly likely to identify a risk of stranded assets in the oil sector; a risk which will increase as oil demand plateaus and begins to decline.[36] Given that almost all demand forecasts see a decline in oil post-2030 (including the IEA's 2022 Stated Policies scenario, its least ambitious), the uncertainty of demand for plastics, and increasingly stringent climate policies, the willingness to back expensive, long-term oil projects is waning.

Canada needs its own scenario that charts a pathway to a net-zero by 2050. The Canada Energy Regulator has been tasked with developing such a scenario for the next iteration of its landmark Energy Futures report, due to be published in spring 2023. One important assumption that should underlie this scenario is that Canada's oil and gas sector aligns with the federal 2030 Emissions Reduction Plan target of a 40-45% reduction in emissions from 2005 levels by 2030.

Overall, these scenarios demonstrate that the energy transition is gaining momentum, and that progress is encouraging. Nevertheless, the current global emissions trajectory remains far in excess of net-zero scenarios. We will need further, urgent policy ambition and support for critical technologies to meet our net-zero goals and keep global warming below 2 degrees Celsius.

[35] IEA, *World Energy Outlook 2022,* 20.

[36] Gregor Semieniuk et al., "Stranded fossil-fuel assets translate to major losses for investors in advanced economies," *Nature Climate Change* 12, (2022). https://doi.org/10.1038/s41558-022-01356-y

Table 1: Scenario assumptions[37]

Scenario	Key Assumptions
2022 IEA Announced Pledges	Assumes that all climate commitments made by governments around the world, including Nationally Determined Contributions (NDCs) and longer-term net-zero targets, are met in full and on time.
2022 bp New Momentum	Captures the broad trajectory along which the global energy system is currently progressing. It places weight both on the marked increase in global ambition for decarbonization seen in recent years and the likelihood that those aims and ambitions will be achieved, and in the manner and speed of progress seen over the recent past.
2021 Equinor Reform	Builds on current trends in markets, technology, and policy, expecting them to continue to unfold at a similar pace. It assumes that climate policies continue to tighten, but that not all stated policy targets are met. Momentum is largely driven by industrialized countries. Limited deployment of CCUS and hydrogen is assumed, due to high cost.
2022 Rystad Mean Scenario	Assumes that EV adoption develops according to current EV manufacturers' targets. Plastics recycling increases to 75% for some plastic types, while green hydrogen accounts for 30% of feedstock for some plastic types. The substitution of oil with renewable and lower-carbon fuels continues in line with current policies, and accelerates in the power, agriculture, and maritime sectors.
2021 Equinor Rebalance	Assumes widespread, systematic changes addressing wealth inequality and excessive consumption with low (but positive) rates of economic growth globally. This scenario is a pathway to keeping global warming below 2C.
2022 bp Net Zero	Explores how different elements of the energy system might change to achieve a substantial reduction in carbon emissions. These changes are conditioned on the assumption that there is a significant tightening of climate policies leading to a pronounced and sustained fall in emissions. The fall in emissions is aided by a shift in societal behaviour and preferences which further supports gains in energy efficiency and the adoption of low-carbon energy sources.
2022 Rystad Sigma	Assumes that EV adoption follows EV manufacturers' current targets. EV constraints (infrastructure, power supply, etc.) are assumed to be solved and short-distance vehicle transport reduced (replaced by public transit). Plastics recycling is up to 90% for some plastic types, while green hydrogen accounts for 70% of feedstock for some plastic types.

[37] Most of these scenarios were published in early 2022, largely before the Russian invasion of Ukraine and subsequent energy supply crisis in Europe. The IEA scenarios, however, were published in October 2022 and include the impacts of the Russian invasion.

	The substitution of oil with renewable energies and lower-carbon fuels accelerates significantly compared to current trajectories.
2022 IEA Net Zero	Lays out a pathway for transition to a net-zero energy system by 2050 while ensuring stable and affordable energy supplies, providing universal energy access, and enabling robust economic growth.
2021 Bloomberg NEF Green	One of Bloomberg NEF's three net-zero scenarios, the Green scenario describes a pathway where greater use of clean electricity in the end-use economy is complemented by "green hydrogen", produced from water, using electrolyzers powered by wind and solar. Biofuels and recycling also play minor roles.