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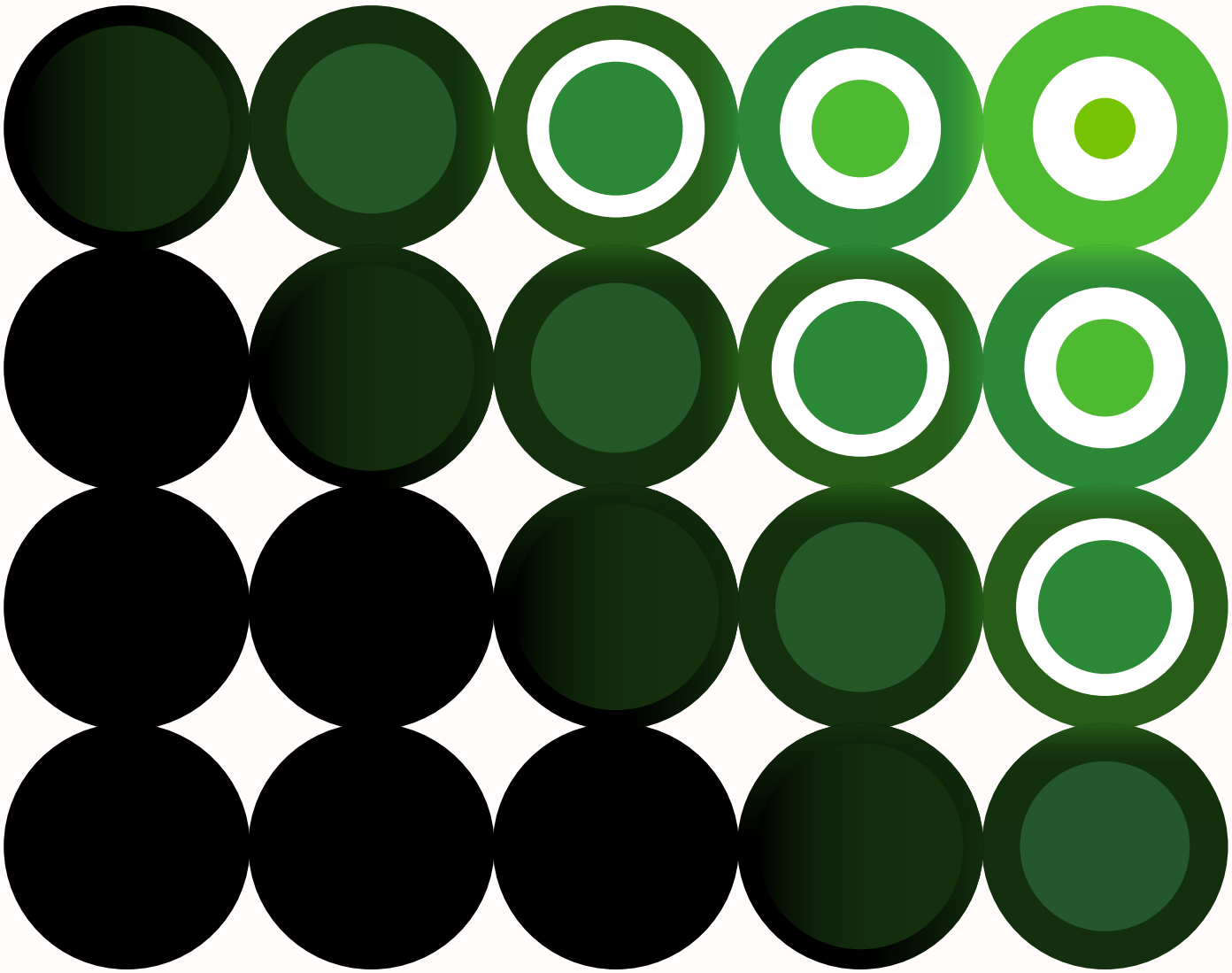
# From Coal to Clean

## Canada's progress toward phasing out coal power



2021

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# Executive summary

Worldwide, an increasing number of countries, utilities and financial institutions are putting coal in the rear-view mirror. They are driven by climate action, the demand for cleaner air and the poor economics of coal. While the health impacts of air pollution and the greenhouse gas (GHG) emissions from coal are far higher than any other power source, there are readily available, abundant, cost-effective alternatives to coal-fired generation. This makes coal-fired electricity both uniquely harmful and unnecessary. The phase-out of coal is also happening in the context of countries committing to a net-zero economy by 2050, which would require a net-zero electricity grid by 2035 in developed countries.

The structural transition away from coal power generation is most advanced in economies that are part of the Organization for Economic Co-operation and Development (OECD), where power plants have tended to be older, electricity demand is often relatively flat compared to developing economies, and climate policies or carbon pricing have been introduced. The lessons learned from this experience will need to be proactively shared internationally, particularly as non-OECD countries complete their pivot away from adding new coal power capacity and begin planning their own phase-out pathways. The energy crunch experienced in China, India, Europe and elsewhere in October 2021 reinforces that policy-makers will need to develop approaches that are both robust in the face of potential short-term imbalances in supply and demand and capable of providing a longer-term framework that can consistently drive investment in clean generation.

*From Coal to Clean* focuses on Canada's progress in phasing out coal since the height of coal-fired power in Canada at the turn of the century — through the pioneering Ontario coal phase-out completed in 2014 and the 2030 phase-outs announced in 2015 and 2016 — and up to the dramatically accelerated Alberta phase-out that will see coal power eliminated in that province by the end of 2023, nearly 40 years ahead of the schedule in place at the start of 2015. It also takes stock of the current plans in the remaining three coal-burning provinces, acknowledges recent progress in policies and plans, and identifies opportunities for improvement. It shows that, **with the exception of New Brunswick, Canada is on track to phasing out coal by 2030.**

## Canada's progress on coal phase-out

Canada's policies, plans and actions to transition away from coal in this century have not been linear in momentum nor uniform across the country. The timelines for the transition have shifted forward in fits and starts and inconsistently from province to province. But this survey of Canada's route to ending coal-fired generation finds:

- While Canada's progress on coal phase-out started slowly in the early 2010s, **Ontario's pioneering action** laid a marker for the world as the single largest climate measure of its time in North America.
- The **40-year acceleration of the coal phase-out in Alberta** (from an original forecast of 2061 to the current 2023), demonstrates the power of coal phase-out commitments and effective carbon pricing design.
- Key opportunities remain for further accelerating the coal phase-out:

- Saskatchewan is already taking advantage of its strong portfolio of lower-emitting generation to achieve reductions in advance of its 2030 phase-out and has opportunities remaining to accelerate and deepen its progress.
- Nova Scotia — after initially insisting that coal must be in use beyond 2030, and receiving such exemption from the federal government — has accepted the feasibility of the 2030 phase-out and must now lock in its implementation plan.
- New Brunswick is pursuing leeway to continue using coal well past 2030, which would single the province out as a clear laggard on coal emissions and undermine Canada's global leadership in phasing out coal.

- To **build towards a net-zero grid by 2035, provinces should replace coal with non-emitting generation options** instead of new unabated gas-fired generation, to avoid losing about half of the GHG reductions from coal phase out.

## Canada’s path forward to fully phase out coal and decarbonize the grid

Learnings gained from achievements and failings over the last six years of rapid policy development have charted a path for phasing out coal reliably, equitably and cost effectively**.** To support the urgent complete transition of Canada’s grid from coal to clean, the following actions are needed:

- The federal and provincial governments should set clear targets for a **net-zero grid by 2035**.
- Provinces should transition to **effective sector-wide carbon pricing** benchmarks.
- The federal government should develop **more stringent protocols for protecting federal coal regulations** against weakening via equivalency agreements.
- The federal government should support provincial investment in **infrastructure and modernization of regulations** to facilitate the integration of non-emitting electricity.
- We need greater **data transparency and accessibility** to accurately understand and project the impact of policies on electricity emissions.
- All levels of government, industry, and the financial sector should implement meaningful measures for an **equitable transition**.

# 1. Introduction

An increasing number of countries across the world are transitioning away coal power. This transition is now an inexorable product of:

- Climate action: Coal, the highest-emitting major electricity source with readily available and economically feasible alternatives, is an accessible way for governments to make progress toward climate targets.
- Demand for cleaner air: Citizens and health advocates demand reductions in coal power's health-harming air pollutants such as nitrogen oxides, sulphur dioxide, and particulate matter.
- Poor economics: While coal power's costs have risen with increasing environmental requirements, cleaner sources of energy have become more efficient and cost-effective, so that even existing coal power is now more expensive than cleaner sources in a growing number of electricity markets and systems, and this trend is expected to continue.
- Global financial markets addressing climate risk: Institutional investors are pulling equity and debt from coal-fired assets, while major global corporations are seeking lower-emitting grids for power-intensive operations to address indirect emissions in their operations.

Canada has abundant clean energy resources to help it compete effectively in the global net-zero future. While much of the country is well-served with very low-emitting electricity supply and has been for decades, there are some regions that are more reliant on fossil fuels, and coal in particular.

Within the last two decades, Ontario eliminated its near-30-percent reliance on coal generation, reducing electricity emissions by nearly 40 million tonnes (megatonnes; Mt) per year in the process. It was the largest climate measure successfully completed in North America to date. This left Alberta, Saskatchewan, Nova Scotia and — to a lesser extent — New Brunswick with far and away the most carbon-intensive electricity grids in the country because of their heavy reliance on coal power.

But as Ontario has demonstrated, change is possible. Though it started its transition over a decade later, an even faster phase-out is underway in Alberta, and once completed in 2023, the magnitude of emissions reductions in that province could match Ontario's continent-leading result.

There has been a profound shift over the last half-decade. This report begins with a review of the status quo before the recent spate of new climate action, where we thought coal power in Canada was headed back in early 2015. That was a crucial year of international commitments to climate action, and it set governments on a firmer course to deal with the coal power pollution problem. The policy decisions that came out of that era and began implementation in the intervening years are now clearly effecting change faster than anyone originally expected.

The first key steps in this era of action toward coal phase-out were taken by the government of Alberta. They included a medium-range (approximately 15-year) coal power phase-out by 2030. While this provoked loud argument around feasibility from certain corners at the time of the announcement, that timeline has since been cut in half. Coal power owner/operators have accelerated the transition, with plans to complete phase-out by 2023. They are motivated by coal's poor competitive positioning against cleaner alternatives, sector-wide carbon pricing, and new corporate imperatives to address climate risk and carbon liability.

The Alberta experience can serve as an instructive example for accelerating coal phase-out in other provinces. This report reviews the recent history of coal power in Canada's coal-burning provinces, their current plans for transition away from it, and the potential they have to grasp the opportunities of grid decarbonization by accelerating the transition. It does so in part by estimating the greenhouse gas (GHG) emissions from coal power over the 2020s and 2030s as forecast through key policy moments from the last decade, considering the government and utility policies and plans in place during those moments:

- Status quo as of 2015 — the outlook from the start of 2015, before considerable new federal and provincial policy commitments were made in that year leading up to the Paris Agreement. The central policy feature of this scenario is the 2012 federal coal-fired GHG regulations introduced by the Conservative government of then-Prime Minister Stephen Harper.
- 2030 phase-out — developed through new policies announced in 2015 that set the phase-out deadline at 2030, that were largely implemented by 2018, including equivalency agreements that weakened the phase-out schedule in certain provinces.
- Current situation — the current outlook that includes recent government policy announcements and utility plans, which have accelerated the phase-out since 2018. In some provinces, these recent accelerations were born out of the realities of operating coal under sector-wide carbon pricing regimes implemented in or since 2018, both provincially and federally, as well as increasing urgency for

bolder climate action. The exception is New Brunswick, where the government is pursuing equivalency to extend coal power operations.

Finally, in addition to the time-marker scenarios above, this analysis also assesses the possibility of reducing GHG emissions further by accelerating the phase-out beyond current plans.

While the path to grid decarbonization has many elements, this report focuses on coal-fired emissions. This is not a blind spot. Coal has been responsible for the largest and most consequential electricity emissions: in 2014, coal produced 72.0% of Canada's electricity GHG emissions, while producing only 10.7% of the country's power. Moreover, it is especially important to target coal for two key reasons:

- The air pollution produced by coal generation harms human health. Even the "cleanest" coal power facilities built in Canada are far more polluting than any alternative electricity source, and when coal emissions are curbed, air quality and human health improves.
- Thermal coal is a particularly carbon-intensive emissions source, with readily available, abundant, cost-effective alternatives. The world has a limited carbon budget, and any further coal removed from the ground and combusted into the atmosphere would unnecessarily draw from that budget and jeopardize our chances of maintaining a safe climate.[1]

Combined, these two factors make clear that emissions from burning coal for electricity are uniquely unnecessary and harmful.

No wonder, then, that coal power emissions have become such a focus of global efforts to reduce climate pollution, with ever-more-focused attention on countries that continue to use unabated coal power (i.e. coal plants that do not capture their GHG emissions), particularly in the developed world. Beyond national borders, Canada's action on this file over the coming decade will make or break its role as a model for the global transition away from coal power.

Nevertheless, to secure all the grid decarbonization benefits of phasing out coal, the transitioning provinces must keep a keen focus on avoiding locking in new investment into long-lived emitting assets, such as unabated gas-fired generation. They can take key measures to ensure that we maximize investment in non-emitting or net-zero-

[1] Carbon Brief, "Analysis: Why coal use must plummet this decade to keep global warming below 1.5C," February 6, 2020. https://www.carbonbrief.org/analysis-why-coal-use-must-plummet-this-decade-to-keep-global-warming-below-1-5c

ready technologies. This is the only way to future-proof our electricity supply against future carbon liabilities and to fully enable the potential for wider electrification in our economy.

While this report focuses on coal emissions reductions and decarbonization, transitioning off coal power results in significant impacts to coal workers and communities that must not be ignored. As we follow the coal phase-out timeline, we also provide brief snapshots of just transition efforts. For climate policies such as coal phase-out to be truly successful, it is critical that they enable an equitable transition to a clean economy.

# 2. Canada's coal phase-out within a global context

Canada's transition away from coal power is taking place within a global trend away from coal-fired electricity. The future for coal is more uncertain than ever, driven by a combination of increasing climate action and the poor economics of coal. To meet Paris Agreement targets, coal-fired power must be phased out in developed countries by 2030 and globally by 2040,[2] as shown in Figure 1 from the International Energy Agency. This rapid phase-out of coal is needed to achieve zero electricity sector emissions in advanced economies by 2035, which will help ensure a global net-zero economy by 2050.

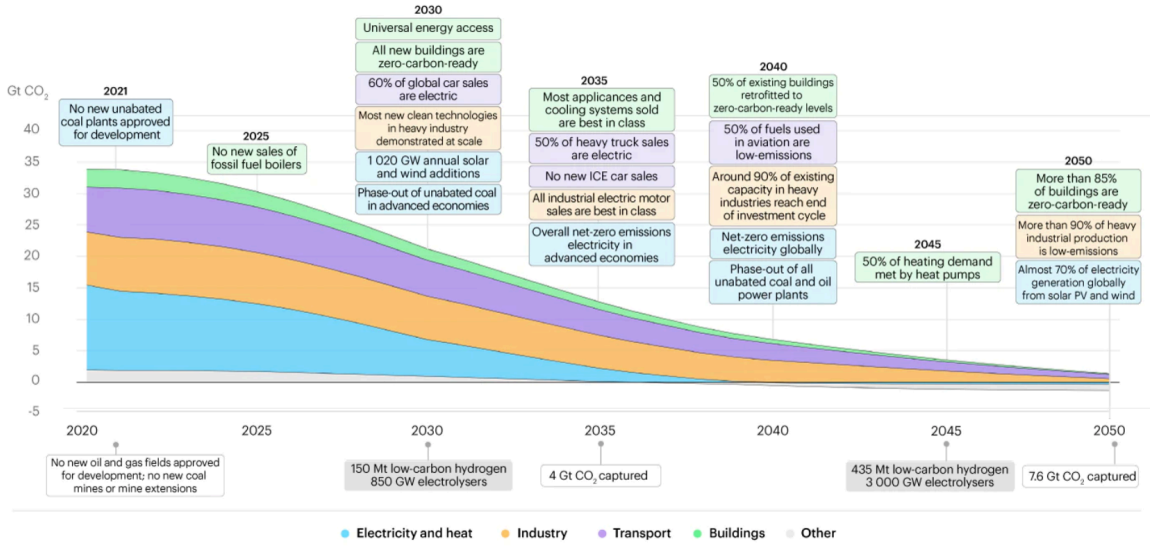


Figure 1. IEA key milestones on the pathway to net-zero

Source: International Energy Agency[3]

Globally, more than 60% of coal plants now have higher operating costs than the all-in costs of electricity from new renewables — and by 2030, new renewables will be cheaper

[2] Paola A. Yanguas Parra et al., *Global and regional coal phase-out requirements of the Paris Agreement: Insights from the IPCC Special Report on 1.5°C* (Climate Analytics, 2019), 14. https://climateanalytics.org/media/report_coal_phase_out_2019.pdf

[3] International Energy Agency, *Net Zero by 2050: A Roadmap for the Global Energy Sector* (2021). https://www.iea.org/reports/net-zero-by-2050

than existing coal power in all markets.[4] The UN Secretary General António Guterres has said, "[Coal] spells stranded assets and makes no commercial sense — the coal business is going up in smoke."[5]

In response to economic and climate pressures, the pipeline for new coal has been shrinking, and the number of coal retirements has been increasing, as mapped by E3G in Figure 2. The new coal plants that are being constructed are facing severe opposition at the local level from residents and civil society due to impacts on land, water, and air quality.

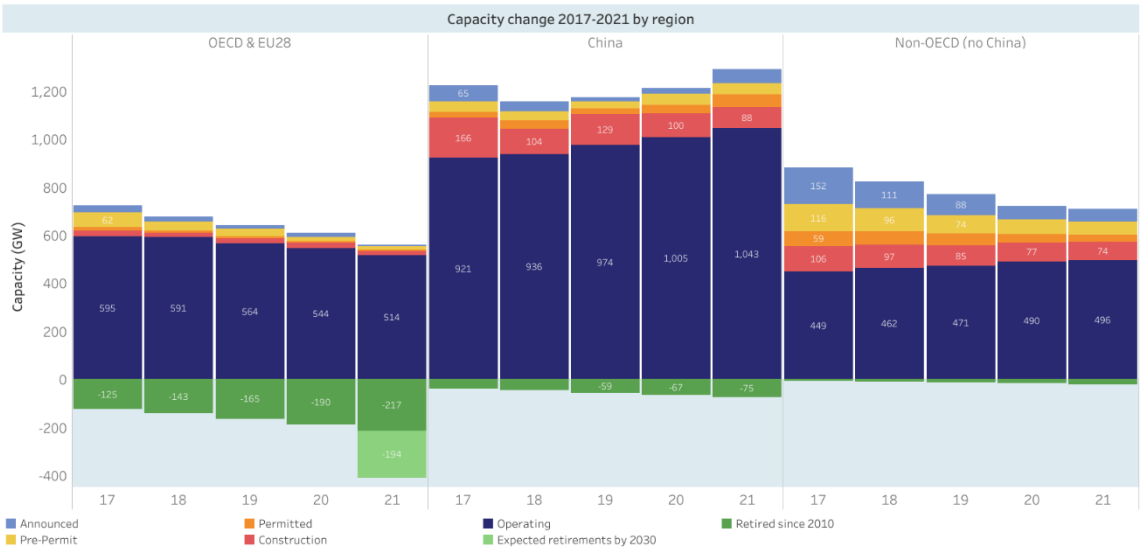


Figure 2. Regional coal capacity change, 2017-2021

Source: E3G[6]

Across the top coal-power countries, there is a general shift toward decreasing coal capacity and a transition to a cleaner grid. The structural transition away from coal power generation is most advanced in OECD economies where power plants have tended to be older, electricity demand is relatively flat (especially compared to rapidly developing countries), and climate policies or carbon pricing have been introduced.

[4] Matt Gray and Sriya Sundaresan, *How to waste over half a trillion dollars: The economic implications of deflationary renewable energy for coal power investments* (Carbon Tracker, 2020), 9. https://carbontracker.org/reports/how-to-waste-over-half-a-trillion-dollars/

[5] Fiona Harvey, "UN secretary general urges India to swiftly turn away from coal," August 28, 2020. https://www.theguardian.com/world/2020/aug/28/un-secretary-general-urges-india-to-swiftly-turn-away-from-coal

[6] Chris Littlecott and Leo Roberts, "The rise and fall of coal: 2020 transition trends," *E3G,* March 1, 2021. https://www.e3g.org/news/2020-hastens-the-coal-exit/

- In the United States since 2010, 63% of coal plants have been retired or will be retired by 2030,[7] and coal-fired generation has fallen over 60% since its peak in the late 2000s.[8] Whereas coal was the top fuel source for electricity in the United States as recently as 2016, it has now fallen to third place behind gas and renewables, barely edging out nuclear.[9] The United States has also committed to a zero-carbon electricity grid by 2035, and it has already started investing in the grid to enable decarbonization.[10]
- In 2015, the United Kingdom became the first national government to commit to phasing out coal, announcing that they would complete phase-out by 2025. The country also announced in 2009 that no new coal power plants could be built unless they were equipped with carbon capture and storage technology.[11] In 2017, the U.K. partnered with Canada to launch the Powering Past Coal Alliance to support governments, businesses, and financial institutions to transition away from coal generation.[12] The U.K. is also committing to decarbonize its electricity system by 2035.[13]
- The transition to a low-carbon electricity system is a key element in China's plan to become a net-zero economy by 2060.[14] Though China has seen an increase in coal-power generation,[15] its government plans to peak its coal consumption by

[7] John Romankiewicz, Cara Bottorff, and Leah C. Stokes, *The Dirty Truth about Utility Climate Pledges* (Sierra Club, 2020), 4. https://coal.sierraclub.org/the-problem/dirty-truth-greenwashing-utilities

[8] S&P Global, "Renewables surpasses coal to become second most used fuel source in 2020: EIA", July 28, 2021. https://www.spglobal.com/platts/en/market-insights/latest-news/coal/072821-renewables-surpasses-coal-to-become-second-most-used-fuel-source-in-2020-eia

[9] Ibid.

[10] The White House, "FACT SHEET: President Biden Sets 2030 Greenhouse Gas Pollution Reduction Target Aimed at Creating Good-Paying Union Jobs and Securing U.S. Leadership on Clean Energy Technologies," media release, April 22, 2021. https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-president-biden-sets-2030-greenhouse-gas-pollution-reduction-target-aimed-at-creating-good-paying-union-jobs-and-securing-u-s-leadership-on-clean-energy-technologies/

[11] Powering Past Coal Alliance, "United Kingdom Coal Phase-out," December 9, 2018. https://www.poweringpastcoal.org/members/united-kingdom

[12] Powering Past Coal Alliance, "Who we are." https://www.poweringpastcoal.org/about/who-we-are

[13] Department for Business, Energy & Industrial Strategy, "Plans unveiled to decarbonise UK power system by 2035," October 7, 2021. https://www.gov.uk/government/news/plans-unveiled-to-decarbonise-uk-power-system-by-2035

[14] Xi Jinping, "Statement by H.E. Xi Jinping President of the People's Republic of China At the General Debate of the 75th Session of The United Nations General Assembly," speech, September 22, 2020. https://www.fmprc.gov.cn/mfa_eng/zxxx_662805/t1817098.shtml

[15] Aditya Lolla, Xunpeng Shi, and Muyi Yang, *Global Electricity Review 2021 G20 Profile: China* (Ember, 2021). https://ember-climate.org/global-electricity-review-2021/g20-profiles/china/

2025,[16] then decline gradually until coal is phased out completely in 2050.[17] It has seen a 74% reduction in the scale of its project pipeline; 484 GW have been cancelled since Paris, compared to only 198 GW which became operational.[18] Internationally, China has taken a significant step by committing to building no new coal plants abroad, which could impact up to 40 GW of coal-fired electricity across 20 countries.[19] While there remains skepticism on China's climate commitments, the country continues to face mounting pressure from national governments and civil society.

- In India, coal power has decreased over two consecutive years,[20] and utilization rates continue to decline.[21] States within India have announced plans to end development of new coal-fired generation,[22] and each year, India invests more into renewable energy than it does into coal.[23]
- Japan has set a net-zero target for 2050. It will retire all its inefficient coal plants by 2030,[24] and has no plans for additional plants.[25] However, there are no current phase-out plans for its next-generation coal plants, which are more efficient.

[16] Chloe Farand, "US pledges to double international climate finance at Earth Day summit," *Climate Home News*, April 22, 2021. https://www.climatechangenews.com/2021/04/22/us-pledges-double-international-climate-finance-earth-day-summit/

[17] Bloomberg News, "China to phase out coal power around 2050," September 29, 2020. https://www.mining.com/web/china-to-phase-out-coal-power-around-2050/

[18] E3G, *China: Home to over half the world's coal pipeline* (2021), 2. https://9tj4025ol53byww26jdkao0x-wpengine.netdna-ssl.com/wp-content/uploads/No-New-Coal-by-2021-4.-China.pdf

[19] E3G, " 'No new coal by 2021' turbocharged as China to end overseas coal finance." https://www.e3g.org/news/no-new-coal-2021-turbocharged-china-end-overseas-finance-cop26/

[20] Hannah Broadbent, "Top 25 Coal Power Countries in 2020," *Ember Climate,* April 14, 2021. https://ember-climate.org/commentary/2021/04/14/top-25-coal-power-countries-in-2020/

[21] Climate Action Tracker, "India," September 22, 2020. https://climateactiontracker.org/countries/india/

[22] Julia Pyper, "How Long will Coal remain King in India?" *Greentech Media,* January 20, 2021. https://www.greentechmedia.com/articles/read/coal-king-india

[23] International Energy Agency, *World Energy Investment 2019* (2019), 20. https://iea.blob.core.windows.net/assets/c299fa1e-f2f4-4b81-bfb2-672d3a50ccab/WEI2019.pdf

[24] Osamu Tsukimori, "Japan's phaseout plan forces utilities to rethink reliance on coal," *The Japan Times*, July 16, 2020. https://www.japantimes.co.jp/news/2020/07/16/business/corporate-business/japan-utilities-rethink-coal/

[25] Stephen Stapczynski, "Japan Cancels its Last Coal Power Plant Project," *Bloomberg Green*, April 26, 2021. https://www.bloomberg.com/news/articles/2021-04-27/japan-s-coal-pipeline-is-bare-after-last-planned-project-axed

- In South Korea, a few sub-national governments have already committed to banning new coal and phasing out coal power.[26] The country has also announced it will no longer be financing overseas coal-fired power investments.[27]
- In addition to governments, a growing list of major banks, including Bank of America, JPMorgan Chase, Citigroup, and Morgan Stanley, are stepping away from coal.[28] While some of them are motivated to reduce the environmental footprint of their assets, many simply view coal as a risky investment. Multinational development banks are also following suit. The Asian Development Bank, for example, has committed to ending financing for all coal mining and coal-generated power plants.[29]

As the list demonstrates, Canada is not alone in endeavouring to transition away from coal-fired power. Even countries with a large portfolio of coal plants are either clearly stepping away from coal or seeing signs of a slowdown. Continuing challenges remain, particularly in developing economies and economies heavily dependent on coal. The energy crunch experienced in China, India, Europe and elsewhere in October 2021 reinforces that policy-makers will need to develop approaches that are both robust in the face of potential short-term imbalances in supply and demand and capable of providing a longer-term framework that can consistently drive investment in clean generation.

As a developed nation with world-leading electricity generation alternatives, Canada must demonstrate clear and definitive leadership in this transition, to model the path to phasing out coal for all kinds of nations and economies around the world.

[26] Powering Past Coal Alliance, "South Korea's cities and provinces pave the way for faster coal phase-out," May 18, 2021. https://www.poweringpastcoal.org/news/member-news/south-koreas-cities-and-provinces-pave-the-way-for-faster-coal-phase-out

[27] Powering Past Coal Alliance, "South Korea's pledge to end coal finance a gamechanger for global efforts to phase out coal power generation," media release, April 23, 2021. https://www.poweringpastcoal.org/news/press-release/south-koreas-pledge-to-end-coal-finance-a-gamechanger-for-global-efforts-to-phase-out-coal-power-generation

[28] Michael Corkery, "As Coal's Future Grows Murkier, Banks Pull Financing," *The New York Times,* March 20, 2016. http://www.nytimes.com/2016/03/21/business/dealbook/as-coals-future-grows-murkier-banks-pull-financing.html

[29] Chloe Farand, "Asian Development Bank plans exit from coal finance," May 7, 2021. https://www.climatechangenews.com/2021/05/07/asian-development-bank-plans-exit-coal-finance/

# 3. Canada's recent history with coal power

Coal power in Canada is highly concentrated in only a handful of provinces. This is not new. Five of the provinces (British Columbia, Manitoba, Quebec, Newfoundland and Labrador, and Prince Edward Island) have near-zero grid emissions, and the other five have high-to-very-high grid emissions. Coal power has been the dominant emitter among electricity generation in the high-emitting half. Not only has coal power in these provinces been responsible for the vast majority of electricity GHG emissions in Canada, it has also contributed significant air pollution in these provinces, causing serious health impacts.

To set the context for the recent spate of climate action addressing coal power emissions, this section lays out the role of coal in Canada's electricity generation in the 15 years leading up to 2015. Action in this era was dominated by an ambitious and successful Ontario coal phase-out, which was completed by 2014. Federal action, meanwhile, conclusively turned the page on new coal power capacity in Canada but set the country on a slow course to gradual transition away from it. As of 2015 four provinces — Alberta, Saskatchewan, Nova Scotia, and New Brunswick — were still on a course for the highest electricity emissions in Canada, with air pollution that could harm residents' health for decades to come.

## 3.1 The regional challenge with coal emissions

Today, much of Canada's electricity is generated from non-emitting sources, particularly hydroelectricity and nuclear, as shown in Figure 5. This low-carbon electricity capacity is largely a legacy of investments from the last century that have positioned Canada well for the low-carbon global economy of this century. It contributes to Canada's global reputation for clean energy and will enable strong competitiveness in attracting businesses seeking low-carbon electricity inputs and new cleantech industries like green hydrogen. However, the high prevalence of non-emitting generation capacity in certain regions creates a considerable regional grid emissions challenge.

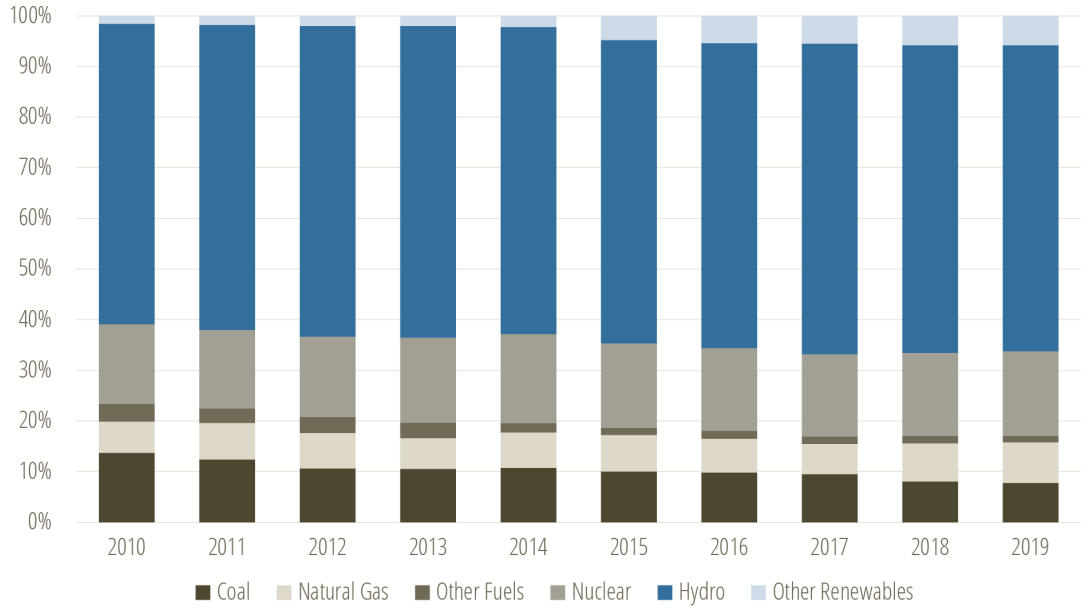


Figure 3. Canada's electricity generation mix, 2010-2019

Data source: Environment and Climate Change Canada (ECCC)[30]

At 132 Mt, electricity generation still produced 18% of Canada's GHG emissions in 2000.[31] These emissions were highly geographically concentrated. The four provinces dominated by hydro generation — Newfoundland and Labrador, Quebec, Manitoba and New Brunswick — combined for one-thirtieth (3.33%) of Canada's electricity GHG emissions.[32] At the time, Prince Edward Island used mostly refined petroleum products for electricity generated in-province, which only amounted to a tiny fraction (0.040%) of national emissions and were reduced to almost nothing by 2005.[33] The remainder (96.6%) came from the other five provinces, where coal emissions dominated power generation. Though coal only generated 19.7% of electricity nationally in the year 2000,

[30] Environment and Climate Change Canada, *National Inventory Report 1990-2019: Greenhouse Gas Sources and Sinks in Canada, Part 3* (2021),60 [*NIR 2021*]. 60. https://unfccc.int/documents/271493 NIR-2021,

[31] *NIR 2021, Part 3*, 11, 60. Though the table on page 11 of Part 3 of the NIR shows electricity emissions in Canada at 129 Mt, these emissions are categorized by industrial sectors and exclude emissions for generating electricity where that generation is part of a facility that is classified in another industry. The table on page 60 more accurately reports electricity generation emissions at 132 Mt.

[32] *NIR 2021, Part 3,* 60-73. Manitoba had only one coal plant, which was predominantly kept on standby for emergency reserve. (Tim Weis, PJ Partington, Ben Thibault, Sachi Gibson, and Kristi Anderson, *The High Costs of Cheap Power: Emissions from coal-fired electricity in Canada* (Pembina Institute, 2012), 5. https://www.pembina.org/pub/high-costs-of-cheap-power) It never produced more than 0.11% of coal-fired electricity emissions after 2014 and was retired in 2018.

[33] *NIR 2021, Part 3*, 60, 62.

coal power in these five provinces was responsible for 82.6% of Canada's electricity sector emissions.[34]

### 3.1.1 Ontario's early action to phase out coal

By 2015, the problem had become even more concentrated. In 2000, Ontario made up one-third (33.5%) of national electricity GHG emissions and over a third (37.4%) of coal-fired electricity generation in Canada. In 2003, Ontario announced its commitment to phasing out coal power entirely, focusing on the merits of cleaner air, starting with Lakeview Generating Station in 2005. By the time of the Atikokan Generating Station's conversion to biomass in 2012,[35] coal accounted for just 2.8% of Ontario's power supply.[36] Two more plants closed in 2013, and with the closure of Thunder Bay Generating Station in 2014, Ontario's coal phase-out was complete. This was an impressive achievement for Canada's most populous province, which once relied on coal power for over 40% of its electricity.[37]

In 2019, approximately 94% of Ontario's electricity generation was emissions-free.[38] Retiring coal power eliminated 40 Mt of GHG emissions from coal over 15 years, from 2000 to 2015, as shown in Figure 4. Having replaced coal generation over this period mostly with non-emitting generation (including nuclear, wind and solar),[39] energy efficiency and conservation, emissions from Ontario's entire electricity system also declined significantly over this period. Ontario's coal phase-out has rightfully been referred to as "the single largest greenhouse gas reduction measure in North America."[40]

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[34] *NIR 2021, Part 3*, 60-73.

[35] Ontario Power Generation, "Biomass power." https://www.opg.com/powering-ontario/our-generation/biomass/

[36] Ontario Independent Electricity System Operator, "Ontario's Independent Electricity System Operator Releases 2012 Electricity Production, Consumption and Price Data." https://www.ieso.ca/en/Corporate-IESO/Media/Year-End-Data/2012

[37] Ibid.

[38] Ibid.

[39] Ontario Ministry of Energy, *Coal Closure in Ontario*, August 2015, 5. https://www.nerc.com/gov/bot/botquarterlyitems/Coal%20Closure%20in%20Ontario%20-%20v6%20clean-6-2.pdf

[40] Melissa Harris, Marisa Beck, and Ivetta Gerasimchuk, *The End of Coal: Ontario's coal phase-out*, (International Institute for Sustainable Development, 2015), 1. https://www.iisd.org/system/files/publications/end-of-coal-ontario-coal-phase-out.pdf

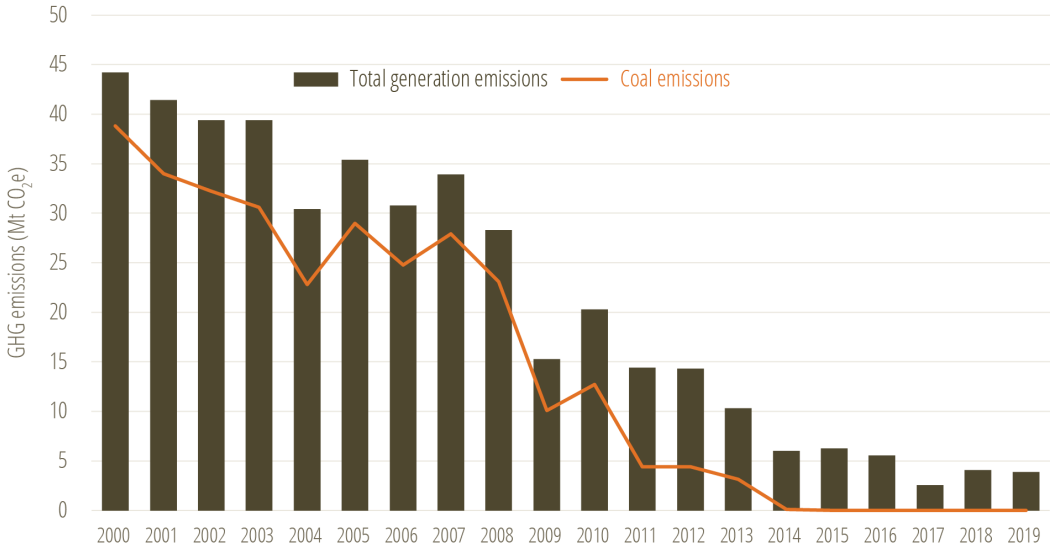


Figure 4. Coal and total electricity generation emissions in Ontario, 2000-2019

Data source: ECCC[41]

Beyond climate action, a key impetus for the coal phase-out in Ontario was air quality and human health. In 2005, Ontario experienced 53 smog advisory days.[42] Ten years later, following the 2014 coal phase-out, the province did not issue a single smog advisory.[43] The improvements in Ontario's air quality have been attributed to coal phase-out efforts in Ontario, as well as from actions taken to address transboundary coal pollution in the United States.[44]

Ontario provides an example for phasing out coal power completely without increasing emissions in other segments of the electricity sector, at a pace that meets the efforts needed to fulfill Canada's Paris Climate Agreement commitments.

With Ontario's continent-leading action complete by 2014, Ontario's coal emissions problem was resolved before the heightened climate policy attention that came to coal in 2015. Therefore, Ontario's coal emissions do not feature in the baseline of Canada's coal emissions in 2015 — instead, they form part of the history for how to phase out coal power successfully.

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[41] *NIR 2021, Part 3*, 66.

[42] Air Quality Ontario, "Ontario Smog Advisories for 2005." http://www.airqualityontario.com/history/aqi_advisories.php?year=2005&t=1

[43] Ministry of the Environment and Climate Change, *Air Quality in Ontario 2015 Report* (2017), 26. http://www.airqualityontario.com/downloads/AirQualityInOntarioReportAndAppendix2015.pdf

[44] Stephanie Gower, Ronald Macfarlane, Marco Belmont, Kate Bassil, and Monica Campbell, *Path to Healthier Air: Toronto Air Pollution Burden of Illness Update* (Toronto Public Health, 2014), 20. https://www.toronto.ca/wp-content/uploads/2017/11/9190-tph-Air-Pollution-Burden-of-Illness-2014.pdf

### 3.1.2 Coal power in Canada at the beginning of 2015

By the time of the Paris Climate Agreement and Pan-Canadian Framework on Clean Growth and Climate Change in 2015 and 2016 respectively, only four provinces — Alberta, Saskatchewan, New Brunswick, and Nova Scotia — still used coal power. New Brunswick operated only one coal plant, which provided about 20% of the province's electricity. The other three coal-burning provinces relied more heavily on coal, which generated around 50% of electricity in Saskatchewan and Nova Scotia, and around 65% in Alberta.[45] The correlation between the prevalence of coal in these provinces' electricity supply and the very high carbon intensity of their grids is illustrated in Figure 5.

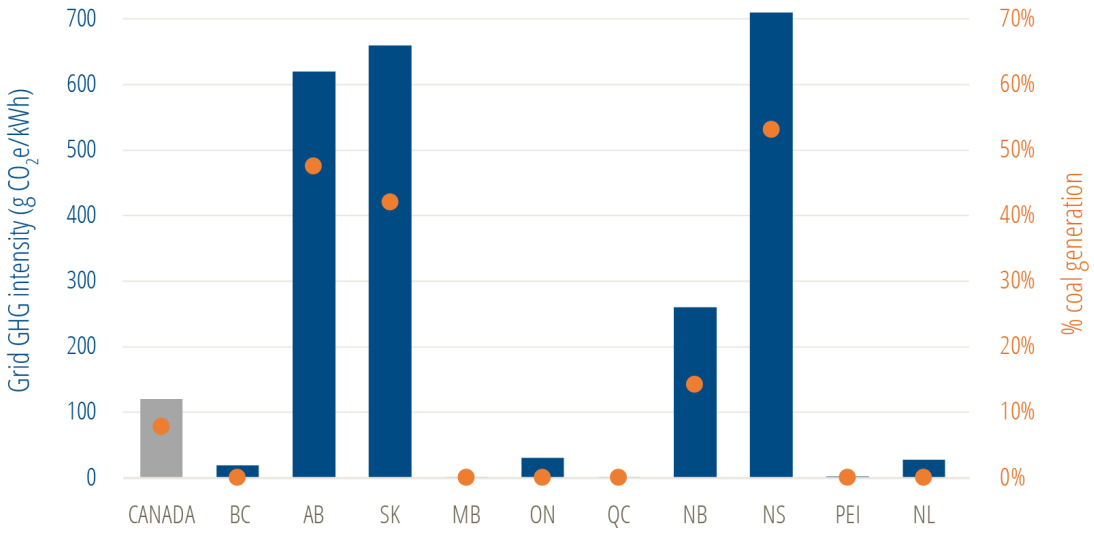


Figure 5. Canadian coal generation by province in 2019

Data source: ECCC[46]

Within two main regions of the country — namely two Atlantic provinces and two prairie provinces — coal power continued to present serious climate challenges and opportunities past the midpoint of the 2010s, though for somewhat different reasons. In Nova Scotia and New Brunswick, electricity emissions are relatively dominant in terms of total emissions reduction opportunities. In 2015, electricity represented two-fifths (41.9%) of all emissions in Nova Scotia and over a quarter (27.6%) of emissions in New Brunswick. Clearly, electricity cannot be ignored in any serious climate effort.

[45] *NIR 2021, Part 3*, 60-73.

[46] *NIR 2021, Part 3*, 60-73.

The absolute scale of the coal emissions problem is much larger in the prairies. In 2015, Saskatchewan (12.6 Mt) and Alberta's (44.1 Mt) coal plants emitted two times and eight times more GHGs, respectively, than Nova Scotia's (4.45 Mt) and New Brunswick's (1.16 Mt) combined.[47] Moreover, these emissions are added onto other highly emitting sectors in both provinces. In 2015, electricity generation emitted 21.1% of all GHGs in Saskatchewan and 18.5% in Alberta, second only to oil and gas extraction in each province.[48] This exacerbates these provinces' problems with climate performance and their high-carbon reputations globally. They are not only the highest-emitting provinces in Canada, but are among the highest-emitting jurisdictions in the world per capita,[49] underscoring the compelling need to address the issue from all sources.

## 3.2 Coal's uniquely polluting power generation

In addition to GHG emissions, coal power plants also emit air pollutants that are linked to an increased risk of developing illnesses or exacerbating pre-existing conditions within populations. Sulphur dioxide ($SO_2$) and nitrogen oxides ($NO_x$), which are emitted into the air when coal is burned, have been linked to respiratory issues and premature death.[50] They also react with other elements in the atmosphere to produce fine particulate matter, commonly referred to as $PM_{2.5}$, which can cause asthma attacks and chronic bronchitis in children, as well as chronic obstructive pulmonary disease (COPD), and lung cancer.[51] Long-term exposure to fine particulate matter has been clearly and consistently associated with higher rates of cardiovascular diseases, including heart failure and cardiac arrest.[52] Air pollution from the major components of smog — including fine particulate matter, nitrogen dioxide, sulphur dioxide, and ozone — results in an estimated 15,300 premature deaths each year in Canada.[53]

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[47] NIR 2021 Part 3, 63, 64, 68, 69.

[48] *NIR 2021, Part 3*, 29, 31.

[49] Paul Boothe and Felix-A. Boudreault, *By the Numbers: Canadian GHG emissions* (Ivey Business School at Western University and Lawrence National Centre for Policy and Management, 2016), 12. https://www.ivey.uwo.ca/media/2112500/4462-ghg-emissions-report-v03f.pdf

[50] Benjamin Israël and Erin Flanagan, *Out with the coal, in with the new: National benefits of an accelerated phase-out of coal-fired power* (Pembina Institute, 2016), 6. https://www.pembina.org/pub/out-with-coal

[51] *The high costs of cheap power*, 14.

[52] *Out with the coal, in with the new*, 7.

[53] Health Canada, *Health Impacts of Air Pollution in Canada: Estimates of morbidity and premature mortality outcomes* (2021), 4. https://www.canada.ca/en/health-canada/services/publications/healthy-living/2021-health-effects-indoor-air-pollution.html

Burning coal also releases large amounts of airborne mercury, a neurotoxin that is especially detrimental to prenatal and child development. Mercury becomes a health issue when it is absorbed through the food we eat, occurring most often when we eat contaminated fish. Even low levels of mercury can pose a risk to the developing organs and systems of children, and fetal exposure to mercury can negatively affect the development of motor and cognitive skills.[54]

Not all coal plants are created equal with respect to emissions. Technology has been developed and applied to newer coal plants since 2000 that has reduced both GHG emissions and air pollution. Still, GHG emissions from coal plants remain much higher than any alternative power generation, except for the one coal unit (Boundary Dam 3 in Saskatchewan) that is operating expensive[55] carbon capture and storage technology. In all instances, though, emissions of health-harming air pollutants remain much higher from coal plants than any other generation source.

Canada has three broad types of coal plants that differ in their emissions intensities, as shown in Table 1 below. The most common — and most polluting — are traditional or sub-critical plants. Two units in Canada have super-critical technology which is more efficient and less polluting. And only one unit (Boundary Dam 3) has carbon capture technology.

[54] Health Canada Mercury Issues Task Group, *Mercury: Your Health and the Environment* (2004). 24. https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/ewh-semt/alt_formats/hecs-sesc/pdf/pubs/contaminants/mercury/mercur-eng.pdf

[55] Benjamin Israel, "Carbon capture can't beat energy efficiency," *Pembina Institute,* December 6, 2016. https://www.pembina.org/blog/carbon-capture-cant-beat-energy-efficiency

## Table 1. Types of coal-fired generation units in Canada

| Type of coal unit | Description | GHG emissions | Pollution | Prevalence in Canada |
|---|---|---|---|---|
| Traditional or sub-critical | Boilers heat up water until it is gaseous (steam) to drive a steam turbine | Least efficient; highest GHG emissions intensities, typically approaching or surpassing 1,000 t/GWh | Typically have the highest emissions of air pollutants due to inefficiency, and as many did not incorporate mitigation technologies that were not commercial or not required at the time of their construction and they have not been retrofitted to include them. There are some exceptions, such as controls for mercury emissions with Alberta units. | Most common in Canada |
| Super-critical | Water is heated to high enough temperatures and pressures that it acts as a supercritical fluid, i.e. neither liquid or gas | More efficient; GHG emissions intensities typically in the range of 800-900 t/GWh | As the newest facilities, these units often have scrubbers and other emissions-control technologies. | Keephills 3 and Genesee 3 |
| Coal with carbon capture | Carbon emitted from the coal plant stack is captured and may be utilized or stored underground.<br>In theory, up to 90% of $CO_2$ emissions can be captured, but in practice rates are much lower. | Emissions are reduced by more than 50%, reducing intensity to below 420 t/GWh in order to operate under regulatory limits (detailed further in section 3.3) | Commonly, some pollution reduction is achieved as part of the capture technology, though this can vary. The additional energy required to operate the capture technology can increase the air emissions intensity. | Boundary Dam 3<br>Given the poor economics of this technology, there are no additional plans for coal with carbon capture in Canada |

Some coal defenders and advocates have marshalled arguments around "clean coal" in response to greater public attention to coal's highly polluting record in the 2010s,[56] but this is misleading. As shown in Figure 6, even the newest, most efficient coal facilities in Canada with the most advanced emissions control technologies (Alberta's Genesee 3 and Keephills 3) emit many times more $NO_x$ than any other generation source, and coal plants account for virtually all electricity sector $SO_2$. There is no informative comparison for mercury, as coal is unique among generation sources in releasing mercury.

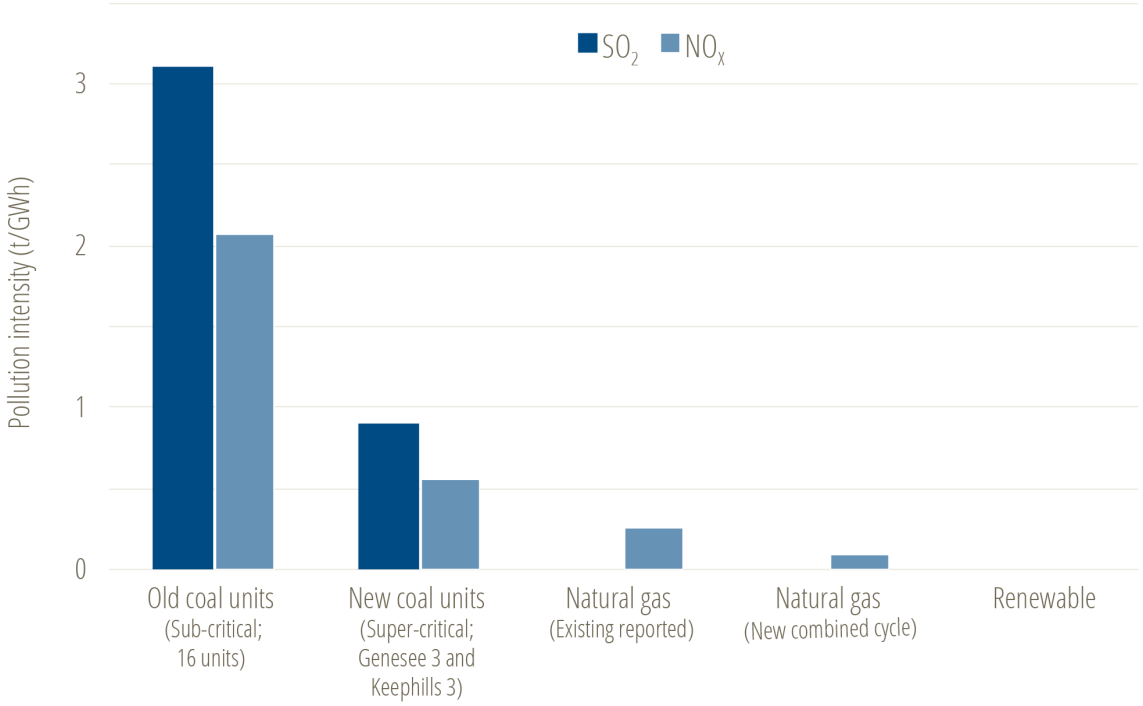


Figure 6. $SO_2$ and $NO_x$ pollution intensity by generation source in Alberta

Data source: Alberta Environment and Parks[57]

As a result, years into efforts by coal lobbyists to tout the benefits of "clean coal," coal power still accounted for 23% of Canada's total $SO_2$ emissions in 2014 and accounted for ten of the top 17 sources of $SO_2$ in Canada.[58] While efforts were made in Alberta to reduce mercury emissions by applying mitigations to coal plants, this has not been

[56] See, e.g., Benjamin Thibault and Andrew Read, "Fact checking the coal industry's 'information meetings'," *Pembina Institute*, March 2, 2016. https://www.pembina.org/blog/fact-checking-coal-industry-s-information-meetings

[57] Alberta Environment and Parks, "2006 to 2015 Annual Reports From Generators" (data accessed 2016). http://www.environment.alberta.ca/apps/etr/Documents.aspx

[58] *Out with the coal, in with the new*, 9.

consistent across Canada. In Saskatchewan, for instance, around three-quarters of total provincial mercury emissions were still attributable to coal-fired electricity through the 2010s.[59]

The scale of the health impacts in Canada are sizable. The most comprehensive official assessment of the health benefits of reducing coal power came from the federal government under Prime Minister Stephen Harper. When it published regulations in 2012 that were expected to gradually force the retirement of Canada's coal units over nearly 50 years (explained further in section 3.3), Environment Canada also published a comprehensive cost-benefit analysis of their health and economic impacts. The Regulatory Impact Analysis Statement (RIAS) found that the 2012 federal regulations would result in 900 fewer premature deaths in Canada between 2015 and 2035, 120,000 fewer asthma episodes, and over $4.2 billion in avoided health outcomes.[60] [61] A coalition of health organizations and the Pembina Institute extrapolated these modelled health benefits to estimate that coal caused around 92 premature deaths and nearly $500 million of avoidable health outcomes per year in 2015 in Alberta alone.[62]

[59] Environment and Climate Change Canada, "APEI_Tables_Canada_Provinces_Territories," spreadsheet, April 26, 2021. https://data.ec.gc.ca/data/substances/monitor/canada-s-air-pollutant-emissions-inventory/APEI_Tables_Canada_Provinces_Territories/?lang=en

[60] Environment Canada, *Regulatory Impact Analysis Statement (RIAS), Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations* (2012). Available in Canada Gazette Part II, Vol. 146, No. 19 (2012), 2050. http://publications.gc.ca/collections/collection_2012/gazette/SP2-2-146-19.pdf

[61] In 2018, the federal government, under Prime Minister Justin Trudeau, published regulations accelerating the end-of-life dates for applying the 420 t/GWh standard to no later than the end of 2029. When they updated the RIAS, they estimated that this acceleration resulted in an additional 260 fewer premature deaths, and health benefits from improved air quality equating to $1.2 billion through 2055. Government of Canada, *Regulations Amending the Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations*. Canada Gazette, Part I, Vol. 152, No. 7 (2018). https://gazette.gc.ca/rp-pr/p1/2018/2018-02-17/html/reg3-eng.html. Notably, this change does not reflect the full acceleration of coal retirement to 2029 in Alberta, because the Alberta government had already announced and implemented its policy for phasing out coal by 2030. As such, the RIAS only factored in the one year of accelerated retirement of the six remaining units in Alberta, from 2030 to 2029.

[62] Pembina Institute, Asthma Society of Canada, CAPE, and the Lung Association, *Breathing in the Benefits: How an accelerated coal phase-out can reduce health impacts and costs to Albertans* (2016), 21. https://www.pembina.org/pub/breathing-benefits

## 3.3 The 2012 federal regulations for gradual coal phase out by 2061

Even though Ontario started its coal phase-out efforts in 2004, the federal government of Canada did not follow suit until the early 2010s. In 2012, the federal government under Prime Minister Stephen Harper was looking for low-hanging fruit to obtain substantive GHG reductions and sought to curb emissions from coal-fired generation by setting new standards for coal-fired power GHG emissions. The standard, set at 420 tonnes of $CO_2e$ per gigawatt-hour of electricity generated (t/GWh), would preclude unabated coal, as even the most efficient supercritical coal plants in the country would still emit double that rate.[63] In other words, coal facilities would only achieve the standard if they deployed carbon capture.

The standards would not come into force until July 1, 2015. Once in force, they would prevent the commissioning of new, unabated coal power in Canada. However, they would apply to existing facilities only once those facilities reached an end-of-life date, usually 50 years after their commissioning date.[64] This would have allowed ten units in Canada to continue for a significant period without any GHG abatement into the 2030s, eight of which could continue into the 2040s. The final two plants — both in Alberta — would not be subject to the standard until the end of 2055 and 2061.

Although some commentators believed that further investments in carbon capture and storage (CCS) would extend the operative lives of these units beyond their end-of-life dates, these prospects waned over time. By the time the regulations were finalized in 2012, plans for only one unit to deploy CCS in Canada were moving forward (Boundary Dam 3 in Saskatchewan). Plans in Alberta to apply CCS to Keephills 3 had been shelved in early 2012 despite more than $779 million in public subsidies committed from the federal and provincial governments.[65] This threw into serious question any further plans for investment in coal with CCS, showing it was uncompetitive against other generation options. SaskPower has not confirmed any plans to pursue CCS in other facilities, which would mean retirement for all units at end-of-life, except for Boundary Dam 3.

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[63] Government of Canada, *Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations*, SOR/2012-167, August 30, 2012, s. 3(1). https://laws-lois.justice.gc.ca/eng/regulations/sor-2012-167/fulltext.html

[64] Ibid., s. 2(1). Where a unit was already over 45 years by the end of 2019 or 2029, it would hit its end-of-life at the end of that year, so units could be required to meet the standard as soon as 45 years after commissioning.

[65] Reuters, "TransAlta abandons Alberta's $1.4B carbon-capture plant", *Financial Post*, April 26, 2012. https://financialpost.com/news/transalta-abandons-albertas-1-4b-carbon-capture-plant

The final 2012 regulations had been weakened relative to their draft version from a year earlier, which had already been weakened relative to original plans, both in response to industry lobbying.[66] Analysts viewed the result as essentially regulating "business as usual",[67] meaning that they would not force unit retirements any earlier than would have happened anyway. Indeed, the most recently decommissioned coal power unit before the regulations, Wabamun 4 in Alberta, had retired at 42 years after commissioning, without the policy obligation to do so.[68] Because the analysis in this report looks mainly at progress and plans made since the beginning of 2015, the "2012 Federal Regulations" are taken as a baseline and a good proxy for a status quo, business-as-usual scenario against which this progress is compared.

The final regulations were also not accompanied by any just transition legislation. Perhaps owing to the long phase-out timeline, serious measures to support impacted workers and communities were not considered, meaning those affected would have been left on their own to develop and fund transition initiatives.

[66] Mike de Souza, "Feds pressured by coal industry to weaken regulations, records reveal", April 20, 2012. https://vancouversun.com/news/feds-pressured-by-coal-industry-to-weaken-regulations-records-reveal; Heather Scoffield, "Ottawa to unveil weakened emissions rules for coal-fired power", September 5, 2012. https://www.theglobeandmail.com/news/national/ottawa-to-unveil-weakened-emissions-rules-for-coal-fired-power/article4519655/

[67] Pembina Institute, "Pembina reacts to federal climate change regulations for coal-fired power," media release, September 5, 2012. https://www.pembina.org/media-release/2372

[68] TransAlta, "TransAlta fully retires all units of its Wabamun power plant," media release, April 1, 2010, https://transalta.com/newsroom/news-releases/transalta-fully-retires-all-the-units-of-its-wabamun-power-plant/. The prior three units at Wabamun had also retired around 42-48 years after commissioning.

# 4. Alberta: Canada's accelerated phase-out role model

Over the first decade of the 2000s, Alberta quickly became Canada's dominant coal-power user. Whereas Alberta and Ontario shared this status at the turn of the millennium, Ontario's rapid transition off coal from 2001 to 2013 left Alberta as the single largest coal power emitter by a large margin. Over this same period, the province invested billions of dollars in two new coal-fired generating units. Alberta became an outlier province, burning twice as much coal for electricity than all other provinces combined.

Beginning in 2015, however, Alberta embarked on a transition away from coal power that has so far matched Ontario's pace and scale and is now slated to complete even faster. Alberta is accomplishing this with a mutually reinforcing package of policy measures that the province began developing in 2015, which were then entrenched with federal backstops. Though Alberta embarked on this coal phase-out nearly 15 years after Ontario began, it is now scheduled to finish the job over only eight years.

## 4.1 A history of coal power within Alberta's electricity system

Unlike other provinces in Canada, private sector utilities built and operated the coal-fired power plants that Alberta has long relied on for electricity. Prior to the deregulation of the electricity sector, plants were built under conventional cost-of-service utilities regulation, guaranteeing cost recovery and a rate of return on capital invested by the vertically integrated private sector utilities. By the time the province implemented deregulation in the late 1990s and early 2000s, this regulatory model oversaw 20 operating coal units, producing nearly 80% of the province's electricity.[69] With nearly equivalent coal combustion ongoing in Ontario at the time, Alberta emitted around 40% of Canada's coal-fired electricity GHG emissions.[70]

[69] *NIR 2021, Part 3*, 69.

[70] *NIR 2021, Part 3*, 60,69.

Deregulation and the creation of a competitive, energy-only wholesale market brought important changes in how generation is dispatched and earns revenue. Unbeknownst to policymakers and generators at the time, the competition would ultimately facilitate coal's demise. By the time effective carbon pricing was implemented in the late 2010s, Alberta had seen substantial new investment in lower-emitting generation developed over the first 15 years of the 2000s, particularly wind energy and gas-fired cogeneration in the oilsands. These assets were poised to undercut coal's economics when they all incurred the same carbon price signal starting in 2018.

Nevertheless, two new coal units were also built in this era: Genesee 3's 450 MW were commissioned in 2005 and Keephills 3's 495 MW in 2011. These investments reflected Alberta's rapidly rising and forecasted electricity demand at the time and the prevailing orthodoxy held over from the prior regulatory regime — that coal was an inexpensive and abundant fuel source and capital investments in these generators could safely be recovered. However, these long-held tenets did not account for the costs that coal-fired units would have to incur if they were forced to pay for their GHG emissions. As a result, more than $3 billion in additional capital was invested in new coal-fired power in Alberta at the same time that Ontario began measures to phase coal power out entirely.[71]

In fact, the growth in coal-fired power between 2000 and 2014 outpaced retirements of old units. The deregulation process saw existing coal unit owner/operators largely insulated from market dynamics for these units under a transition approach: power purchase agreements (PPAs). The PPAs were initially intended to preserve the utilities' investment expectations for a guaranteed return on their capital investments while preventing them from capturing the windfall of higher market prices. In essence, the PPAs insulated the units and their operators from the market dynamics that emerged as efficient, lower-emitting generation developed and carbon pricing progressed.[72] Most of the PPAs were set by government for a period of 20 years, continuing until the end of 2020, although the PPAs applicable to the oldest units (with the least remaining capital for the utilities to recover) expired some years sooner.

[71] TransAlta, "Keephills 3 power plant begins commercial operation," media release, September 1, 2011. https://transalta.com/newsroom/news-releases/keephills-3-power-plant-begins-commercial-operation/ (citing Keepills 3 construction costs at $1.98 billion).

[72] They did so by placing offer control and market upside potential and downside risk in the PPA buyers, who mostly purchased the PPAs at auction. The main exception was for PPAs that failed to find an appropriate buyer, so a public agency, the Balancing Pool, stepped in to act as the buyer.

As such, even with the first introduction of Alberta's carbon pricing regime in 2009 and the growth of low-cost natural gas and wind generation, only one coal plant retired during this period: TransAlta retired its Wabamun plant's four units, totaling 537 MW. All four units had operated for approximately 40 to 50 years,[73] and the facility's PPA had expired in 2003.[74] TransAlta also attempted to retire its oldest two units at Sundance in December 2010, several years ahead of the relevant PPA expiry, but an arbitration panel ordered the units returned to operation in 2013 to fulfill its obligations under the PPA.[75] With Keephills 3 newly commissioned in 2011 and Sundance 1 and 2 resuming operation in 2013, Alberta's coal power capacity continued to grow through 2014, finally peaking just shy of 6,300 MW.[76] Notably, the height of coal in Alberta came just after Ontario completed its coal-power phase-out, which it had begun over a decade earlier.

By 2015, the flow of new, multi-billion-dollar coal capacity investments in Alberta had been stemmed. Utilities were precluded — under federal law — from sinking additional capital into highly emitting coal-fired power projects. But at the beginning of 2015 the policy landscape still didn't fully favour a clean break. The federal regulatory schedule then in place would only gradually retire the 18 existing units, leaving a large percentage of coal power still operating through the coming decades.

## 4.2 Phase-out accelerants

Beginning in 2015, climate policy relevant to Alberta's coal plants evolved rapidly. It began with the recently elected provincial government's platform commitment to phase out coal by 2030, affirmed by the government's Climate Leadership Panel recommendations. The phase-out was reinforced by an across-the-board, sector-wide

[73] TransAlta, "TransAlta fully retires all units of its Wabamun power plant," media release, April 1, 2010. https://transalta.com/newsroom/news-releases/transalta-fully-retires-all-the-units-of-its-wabamun-power-plant/

[74] TransAlta Corporation, "2004 Renewal Annual Information Form: For the Year Ended December 31, 2003" (March 29, 2004), 11. Available at https://www.sec.gov/Archives/edgar/data/1144800/000113717104000383/aif.htm

[75] TransAlta, "Independent arbitration panel validates TransAlta's operating practices and grants claim of force majeure on Sundance units 1 and 2," media release, July 23, 2012. https://transalta.com/newsroom/news-releases/independent-arbitration-panel-validates-transaltas-operating-practices-and-grants-claim-of-force-majeure-on-sundance-units-1-and-2/

[76] Small upratings were completed at coal facilities in 2015 and 2016, so Alberta's coal power capacity ultimately peaked at 6,299 MW in 2016. AESO, "Annual market statistics reports," 2010, 2015, and 2019 data files. https://aeso.ca/market/market-and-system-reporting/annual-market-statistic-reports/

carbon pricing benchmark in Alberta and entrenched with the federal government's own declaration in 2016 of an accelerated coal phase-out by 2030. The province's sector-wide benchmark came into effect in 2018 and then survived the change in government brought by the 2019 provincial election. From that point, the transition away from coal-fired power accelerated dramatically, putting the province on course to phase out coal-fired power completely by the end of 2023 instead of 2061.

### 4.2.1 The 2030 coal phase-out

After a comprehensive consultation and negotiation process, the province inked transition agreements in November 2016 with the owners of the six coal units that would be affected by the 2030 phase out.[77] The agreements provided for annual payments to the companies until 2030, totaling $1.1 billion, in return for the complete cessation of emissions from coal-fired electricity generation by the end of 2030. The evaluation of the transition payments took into account the net book value of the six units in 2030, considerably reduced by the value that the owners could salvage by converting the units to natural gas.[78]

Soon after, the federal government entrenched Alberta's 2030 phase-out by announcing the acceleration of its good-as-gas standard for coal (initiated with the 2012 federal coal regulations) such that no unabated unit could continue to operate after the end of 2029.[79] This backstopped Alberta's phase-out agreements with federal law, affording greater certainty for the action against political change in Alberta.

As part of the transition agreements with the companies, Alberta also committed to encourage the federal government to modify its initial approach to regulations for gas-fired generation to enable conversions. The original plan for these regulations — first drafted, though not published, in 2014 — would have precluded converted units that could not reach the 420 t/GWh standard from operating. Prior to the execution of the coal transition agreements, coal plant owners in Alberta had accentuated their high

[77] Alberta, "Alberta announces coal transition action" media release, November 24, 2016. https://www.alberta.ca/release.cfm?xID=44889F421601C-0FF7-A694-74BB243C058EE588

[78] Letter from Terry Boston to Premier Rachel Notley, September 30, 2016. Available at https://www.yumpu.com/en/document/read/56730797/electricity-terry-boston-letter-to-premier

[79] Environment and Climate Change Canada, "Technical backgrounder: Federal regulations for electricity sector", December 12, 2018. https://www.canada.ca/en/environment-climate-change/services/managing-pollution/energy-production/technical-backgrounder-regulations-2018.html

estimates of the costs of phasing out coal, including conversions to natural gas.[80] They did not raise an issue about the draft federal regulations' effective prohibition against converted units.[81]

Once the province made clear its commitment to the phase-out and finalized transition agreements with the coal plant owners, industry broadly recognized the opportunity to extend asset life through conversion to gas. Alberta worked to enable conversions by pursuing accommodations for converted units in the then-under-development federal gas-fired generation GHG regulations. By 2018, the federal government accepted the rationale of GHG reductions achieved through conversion and issued a sliding-scale approach to life extensions for converted units, allowing short extensions for higher-emitting converted units (five years beyond their coal plant end-of-life dates) and longer extensions for lower-emitting units.[82]

### 4.2.2 Sector-wide carbon pricing benchmark

Alberta had first implemented industrial carbon pricing with the Specified Gas Emitters Regulation (SGER) in 2009. It eventually required the province's largest GHG emitters to reduce their emissions intensity by 12% from their established baseline, but with flexibility mechanisms including payment into a technology fund at $15 per tonne (t) of $CO_2e$. Effectively, this created a $15/t carbon tax, but with a facility-specific allocation of free tax credits for 88% of their facility's emissions baseline. In essence, facilities did not have to pay the carbon tax for 88% of their emissions, meaning more free emissions for higher emitting facilities.

Despite initial intentions to do so, the province failed to increase either the price or stringency over the subsequent half-decade. Given the much larger subsidy (in the form of free allocations) handed to higher-emitting facilities, the effect on coal power operations was minimal. A typical subcritical coal plant would incur costs around

[80] This was particularly apparent in the generators' submissions to Alberta's 2015 Climate Leadership Panel. These submissions are available online at https://drive.google.com/drive/u/1/folders/0B1whOKweyfKHfndDdUpxYXlQdUF0MGhSM25jR3RuLXppLU01NXlMcDFqR2pJZHpkSmo2T2M

[81] Only TransCanada (now TC Energy) — a company with both substantial natural gas pipeline infrastructure and a large electricity market participant — raised its concern that the regulations would impede what it saw as the benefits of early coal-to-gas conversions, both in engagements with the federal government and in Alberta's Climate Leadership Panel submission.

[82] "Technical backgrounder: Federal regulations for electricity sector."

$1.80/MWh,[83] a small fraction of coal's average electricity market revenue, which ranged from $49 to $77/MWh during this period.[84]

Looking to take quick action while undertaking the consultation and policy development necessary to implement more substantive changes, the new 2015 government immediately increased the price and stringency of SGER to $20/t on a15% reduction from the facilities' baselines in 2016 and $30/t on a 20% reduction in 2017. This increased the carbon price's relative cost on coal and helped to decrease coal-fired generation by 5.4% from 2015.

In 2018 the provincial government implemented the new Carbon Competitiveness Incentive Regulation (CCIR), replacing SGER. Though still set at $30/t for 2018, CCIR effectively required all electricity generators to pay for emissions down to a "good-as-best-gas" benchmark of 370 t/GWh — or, if their emissions were under this benchmark, receive emission performance credits (EPCs) up to the benchmark, making the benchmark even across all generators. The same subcritical coal facility's effective carbon costs would rise more than ten-fold from 2015, to around $18.90/MWh, while combined cycle gas plants' costs fell relative to SGER and renewable energy and cogeneration could actually earn money from CCIR EPCs.

### 4.2.3 Policy success

Once coal-fired power was exposed to carbon pricing on a fair benchmark, its poor economics ushered in its demise. With coal power's marginal operating costs considerably worsened, particularly in comparison with lower-emitting electricity generation, it consistently fell "out of merit" in the province's power pool. In other words, it was no longer among the lowest-cost bids, so it was not called on ("dispatched") unless higher demand required it — it was displaced by lower-emitting generation.

The effects were two-fold. Coal-fired power was immediately used much less, in favour of lower-emitting sources; then, rather than continue with uneconomic assets, coal plant owners quickly developed plans to retire or convert to lower-emitting options.

Coal generation fell sharply. Even at just $30/t, coal-fired GHG emissions fell 32.6% immediately in the first year that carbon pricing switched from facility-specific

[83] At an assumed emissions intensity of 1.0 t/MWh, requiring an emissions reduction of 0.12 t/MWh).

[84] AESO, 2014 Annual Market Statistics Data File, February 19, 2015, available at https://www.aeso.ca/market/market-and-system-reporting/annual-market-statistic-reports/

benchmarks that effectively subsidized coal power to a sector-wide benchmark. These were even deeper reductions from a lower baseline after coal generation had already fallen modestly in 2016 and 2017. Although the coal power was predominantly replaced with gas, electricity emissions still fell 10.2 Mt, or 21.8%, an astounding decline for a single year. Indeed, 2018 marks the year that coal was permanently replaced as the largest source of net-to-grid electricity generation in Alberta, after decades of dominance, as shown in Figure 7.

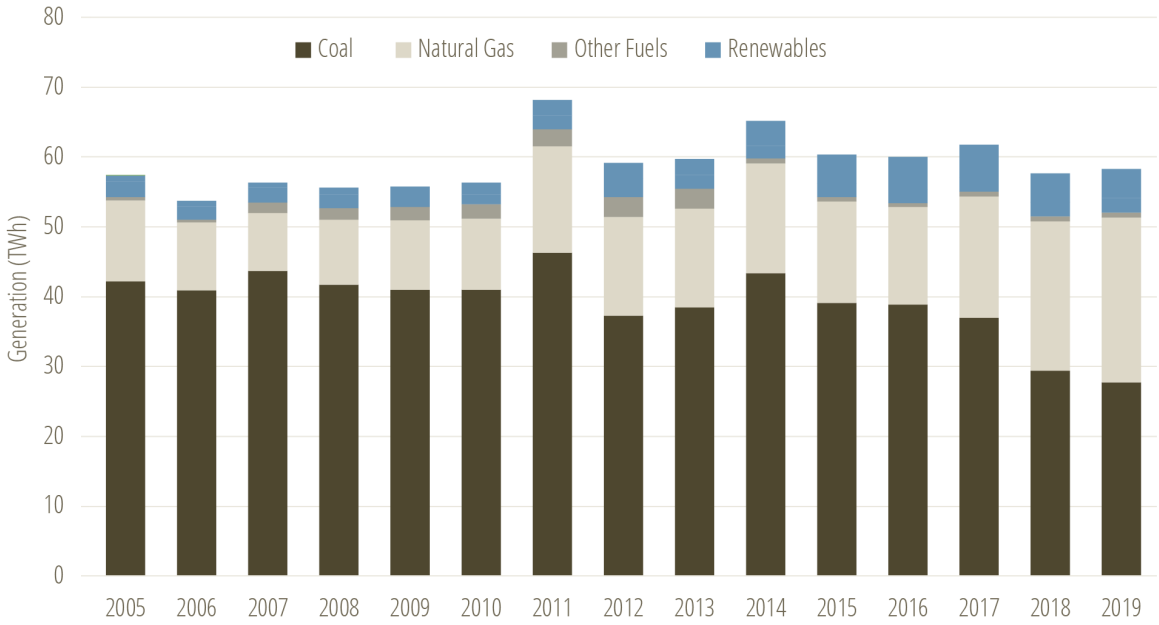


Figure 7. Alberta's electricity mix since 2005, showing notable coal decline beginning in 2018

Data source: ECCC[85]

The greater effect for accelerating Alberta's transition away from coal would come through the combined, mutually reinforcing effect of federal and provincial policies. With coal generation prohibited both provincially and federally within a decade and coal-fired economics immediately undermined by carbon pricing, the impetus to abandon coal-fired generation arrived very quickly. Moreover, policy stability had been attained — the hard-stop phase-out was entrenched with the federal backstop. The sector-wide carbon pricing standard for electricity survived political change in 2019 with the introduction of a new provincial government and implementation of the Technology Innovation and Emissions Reduction (TIER) regulation.[86] Having survived

[85] NIR 2021, Part 3, 69.

[86] Although TIER abandoned the sector-wide approach for all other sectors, it retained it for the electricity sector.

elections at both the provincial and federal level in 2019, the policy milieu of mutually reinforcing phase-out regulations and carbon pricing firmed up against continued coal generation. The policy certainty required to invest capital to replace coal was in place.

The effect was very quick. Over 2019 and 2020, in anticipation of PPA terminations and expiries, coal plant owners seemed to trip over each other to announce unit retirements and conversions to natural gas (see Table 2).

Clearly spurred on by the poor economics of coal in a fair, sector-wide carbon pricing regime that no longer subsidized coal with free allocations, companies were also keen to land environmental, social and governance (ESG) wins by embracing decarbonization and the elimination of coal. Investor pressures for addressing climate liability only accentuated the economic basis for ending coal early. All 18 then-operating coal units will cease to burn coal within six years after the sector-wide carbon pricing standard was implemented.

Table 2. Retirement schedules of Alberta coal plants

| Plant name | Unit | Capacity (MW) | Commis-sioning year | Original end-of-life date | Retirement or gas conversion year |
|---|---|---|---|---|---|
| Battle River | 3 | 150 | 1969 | 2019 | Retired Dec. 31, 2019[87] |
| | 4 | 155 | 1975 | 2025 | Converted to gas by Q4 2021[88] |
| | 5 | 385 | 1981 | 2029 | Converted to gas by Q4 2021[89] |
| Genesee[90] | 1 | 400 | 1994 | 2044 | Converted to gas by end of 2023 |
| | 2 | 400 | 1989 | 2039 | Converted to gas by end of 2023, repowered in 2024 |
| | 3 | 466 | 2005 | 2055 | Converted to gas by end of 2023 |

[87] Global Energy Wiki Monitor, "Battle River Power Station," May 13, 2021. https://www.gem.wiki/Battle_River_power_station

[88] Dustin Owens, Heartland Generation, personal communication, September 8, 2021.

[89] Ibid.

[90] Capital Power, *Winter 2021 Genesee Connection* (2021). https://www.capitalpower.com/wp-content/uploads/2021/03/2021-Winter-%E2%80%93-Genesee-Newsletter.pdf

| | | | | | |
|---|---|---|---|---|---|
| Keephills | 1 | 395 | 1983 | 2029 | Retired Dec. 31, 2021[91] |
| | 2 | 395 | 1983 | 2029 | Converted to gas July 19, 2021[92] |
| | 3 | 463 | 2011 | 2061 | Converted to gas by mid-Dec. 2021[93] |
| Milner | 1 | 150 | 1972 | 2019 | Ceased coal-fired operations in 2020, may resume as gas[94] |
| Sheerness[95] | 1 | 400 | 1986 | 2036 | Converted to gas March 21, 2021 |
| | 2 | 400 | 1990 | 2040 | Converted to gas Q2 of 2021 |
| Sundance | 1 | 280 | 1970 | 2019 | Retired Jan. 1, 2018[96] |
| | 2 | 280 | 1973 | 2019 | Retired July 31, 2018[97] |
| | 3 | 407 | 1976 | 2026 | Retired July 31, 2020[98] |

[91] Alberta Electric System Operator, "Notice of Retirements - Keephills Unit 1 (KH1) effective December 31, 2021 and Sundance Unit 4 (SD4) effective April 1, 2022," September 28, 2021. https://www.aeso.ca/market/market-updates/2021/notice-of-retirements-keephills-unit-1-kh1-effective-december-31-2021-and-sundance-unit-4-sd4-effective-april-1-2022/

[92] TransAlta, "TransAlta Completes Second Off-Coal Conversion – Another Major Milestone in its Phase Out of Coal," media release, July 19, 2021. https://transalta.com/newsroom/news-releases/transalta-completes-second-off-coal-conversion-another-major-milestone-in-its-phase-out-of-coal/

[93] TransAlta, "TransAlta Completes First Off-Coal Conversion and Achieves Major Milestone in Phase-out of Coal," media release, January 31, 2021. https://transalta.com/newsroom/news-releases/transalta-completes-first-off-coal-conversion-achieves-major-milestone-in-phase-out-of-coal/

[94] Maxim Power Corp, "HR Milner Generating Station." https://maximpowercorp.com/hr-milner-generating-station/

[95] Global Energy Wiki Monitor, "Sheerness Power Station," May 17, 2021. https://www.gem.wiki/Sheerness_power_station

[96] TransAlta, "TransAlta Board Approves Plan for Accelerating Transition to Clean Power in Alberta," media release, April 19, 2017. https://www.transalta.com/newsroom/news-releases/transalta-board-approves-plan-for-accelerating-transition-to-clean-power-in-alberta/

[97] TransAlta, "TransAlta Announces Retirement of Sundance Unit 2," media release, July 18, 2018. https://transalta.com/newsroom/news-releases/transalta-announces-retirement-sundance-unit-2/

[98] TransAlta, "TransAlta Announces Retirement of Sundance 3 Coal Unit," media release, July 22, 2020. https://www.transalta.com/newsroom/news-releases/transalta-announces-retirement-of-sundance-3-coal-unit/

| | | | | | |
|---|---|---|---|---|---|
| | 4 | 406 | 1977 | 2027 | Converted to gas by end of 2021, Retired April 1, 2022[99] |
| | 5 | 406 | 1978 | 2028 | Retired Nov. 1, 2021[100] |
| | 6 | 401 | 1980 | 2029 | Converted to gas Jan. 31, 2021[101] |

The combined effect is a dramatic acceleration of Alberta's coal phase-out. Alberta will be free of coal-fired power by the end of 2023.[102] By comparison, recall that in 2015, Alberta had 18 operating coal units — 13 of which were slated to continue through 2026. At the time of writing, half the units have either retired (Sundance 1, 2 and 3, and Battle River 3), or converted to gas-fired generation (Sundance 6, Sheerness 1 and 2, Keephills 2, and H.R. Milner), while two more are now operating on coal and gas (Battle River 4 and 5) until they are slated for full conversion to natural gas by the end of 2021.[103] The remaining seven units will all convert by the end of 2023.[104]

Units converted to gas are subject to a separate federal end-of-life regulation for gas-fired electricity, with a graduated schedule depending on their emissions intensity. These regulations may allow converted units to operate indefinitely (for any units that emit less than the 420 t/GWh standard) or for as little as five years beyond their coal end-of-life dates (for units that attain an emissions intensity between 550-600 t/GWh). In between, the allowance is for eight extra years for units falling between 480-550 t/GWh and 10 years for units falling under 480 t/GWh but not reaching the 420 t/GWh threshold.[105]

[99] Alberta Electric System Operator, "Notice of Retirements - Keephills Unit 1 (KH1) effective December 31, 2021 and Sundance Unit 4 (SD4) effective April 1, 2022," September 28, 2021. https://www.aeso.ca/market/market-updates/2021/notice-of-retirements-keephills-unit-1-kh1-effective-december-31-2021-and-sundance-unit-4-sd4-effective-april-1-2022/

[100] Alberta Electric System Operator, "Sundance 5 Mothball Update Notification." https://www.aeso.ca/market/market-updates/2021/sundance-5-mothball-update-notification/

[101] "TransAlta Completes First Off-Coal Conversion and Achieves Major Milestone in Phase-out of Coal,"

[102] Pembina Institute, "Industry plans herald a coal-free grid in Alberta by 2023," media release, December 3, 2020. https://www.pembina.org/media-release/industry-plans-herald-coal-free-grid-alberta-2023.

[103] As of August 11, 2021, Battle River 4 and 5 are listed as dual fuel on the AESO Current Supply Demand Report. However, Heartland Generation have stated in personal communications that they are no longer burning coal at these units, but no public announcement has been made confirming this.

[104] Alberta Electric System Operator, *Current Supply Demand Report*. http://ets.aeso.ca/ets_web/ip/Market/Reports/CSDReportServlet (accessed August 2, 2021).

[105] "Technical backgrounder: Federal regulations for electricity sector."

Figure 8 shows the acceleration in coal-fired GHG reductions effected by new policies announced and implemented since 2015 ("Current Plans"), relative to the pre-existing coal retirement schedule ("2012 Federal Regulations") and the outlook for coal under the 2030 federal phase-out ("ECCC 2030 Phase-out") announced in 2016 but in the absence of carbon pricing policies.

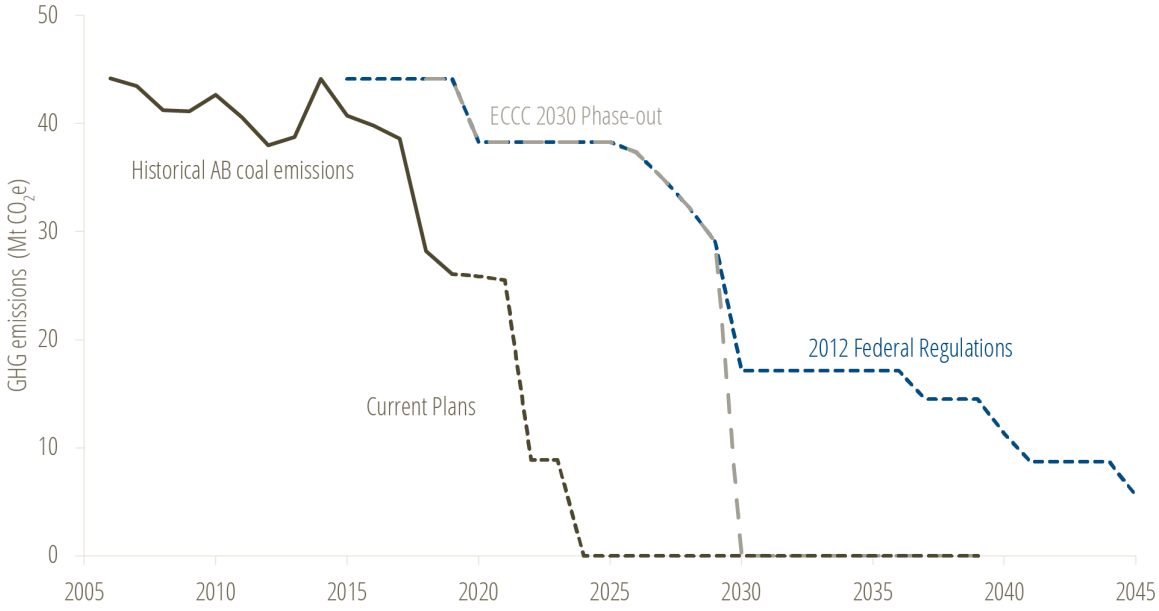


Figure 8. Projected GHG emissions from coal-fired power in Alberta under progressive policy scenarios in place since 2015

Source: Pembina Institute modelling[106]

## 4.3 The impact of Alberta's accelerated phase-out

By accelerating the elimination of coal power, Alberta's mutually reinforcing policies will bring substantial benefits to the province. The accelerated phase-out will lead to considerable near-term GHG reductions, improved air quality and avoided health impacts, all while maintaining reliability and power prices in line with the historical average going back to deregulation.

### 4.3.1 GHG reductions

The accelerated decline in GHG emissions is caused by unit retirements and reduced generation from operating facilities, largely effected by the sector-wide carbon pricing

[106] The data analysis and sources used for these scenarios is available in *From Coal to Clean: Emissions Model* at www.pembina.org.

regime and its mutually reinforcing interplay with the coal phase-out.[107] Figure 9 shows the additional gross reductions in emissions from coal-fired electricity generation from announcements and operational changes made since improved carbon pricing was implemented in Alberta beginning in 2015, beyond the reductions secured from regulatory phase-out policies alone.

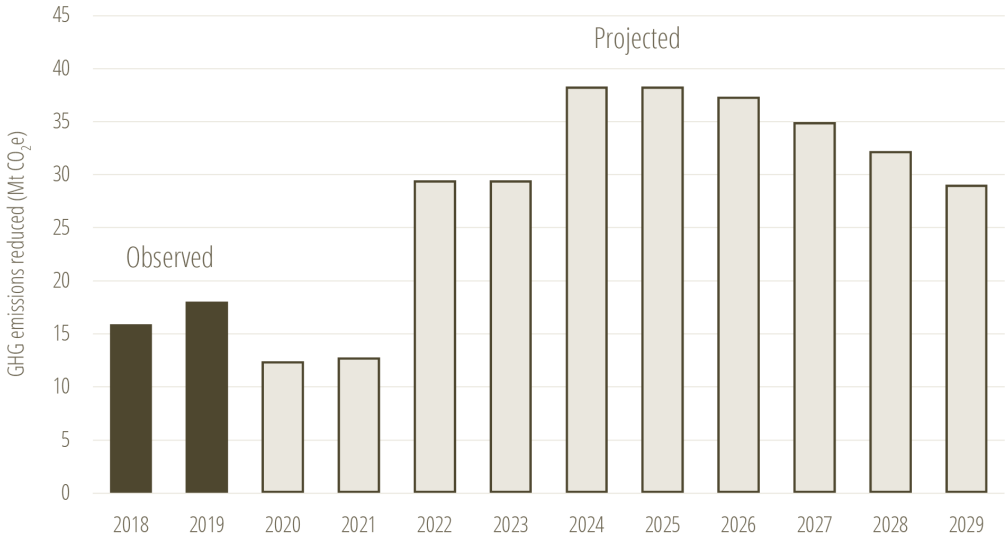


Figure 9. Observed and projected coal-fired electricity GHG emissions reductions (gross) attributable to policies implemented since 2015

Source: Pembina Institute modelling[108]

The pace of emissions reductions from Alberta's electricity transition already ties the Canadian record for pace of climate action. Greenhouse gas emissions from coal-fired electricity fell 18 Mt (41%) from 2015 to 2018 and continued to decline modestly in 2019 (see Figure 8).[109] This is clearly correlated to the sector-wide carbon pricing benchmark and will continue further as the carbon price rises each year and as coal plants are retired and converted. Even netting out the emissions from replacement generation, electricity greenhouse gas emissions fell 15 Mt (26%) from 2015 to 2018 — more than all emissions from New Brunswick and PEI combined in 2018. To date, only the Ontario coal phase-out — which, along with strong renewable energy and energy efficiency

[107] The 2012 Federal Regulations and ECCC 2030 Phase-out scenarios are based on a 2014 baseline unit emissions/utilization rate. The "Current Plans" scenario is based on the coal unit retirement and conversion schedules recently announced by coal owners and a 2019 baseline unit emissions/utilization rate, in order to isolate the effect of new carbon pricing measures announced and implemented between 2015 and 2018.

[108] The data analysis and sources used for these scenarios is available in *From Coal to Clean: Emissions Model* at www.pembina.org.

[109] *NIR 2021, Part 3*, 69.

measures, managed a 40 Mt electricity sector GHG reduction from 2000 to 2019 — has realized a greater absolute GHG emissions reduction. During this 20-year period, Ontario's electricity emissions tied Alberta's record of 15 Mt over three years only once: 2009 relative to 2006.[110]

But with 25 Mt of coal-fired emissions remaining in Alberta as of 2019, even more reductions are on their way thanks to the coal phase-out. Environment and Climate Change Canada forecasts that emissions in Alberta's electricity sector will fall to 9.9 Mt by 2023, fall further to 8.0 Mt by 2025, then rise slightly to 9.4 Mt per year by 2030.[111] After hitting 47.4 Mt in 2015, this would mean a near-40 Mt decline in electricity emissions in one decade. This would roughly match Ontario's 20-year decline of 40 Mt, in half the time.

The upshot for Alberta is dramatic improvement in investors' perspectives of the climate risk and carbon pricing liability of investing in power-intensive operations in Alberta. With heightened investor attention on companies' Scope 2 emissions (which include the emissions embodied in electricity consumption), grid emissions intensity is becoming a key criterion in siting decisions for electricity-intensive industries. Alberta's electricity emissions grid intensity has already fallen 25% since 2015[112] and the completion of the coal phase-out will likely bring that to 60% or more by 2024.[113] Combined with opportunities to secure non-emitting power like low-cost renewable energy and Alberta becomes a more attractive jurisdiction for climate-conscious investors in the next decade.

### 4.3.2 Health benefits

The accelerated transition away from highly polluting coal power will bring considerable health benefits for Albertans, as well as downwind provinces like

[110] Environment and Climate Change Canada, *National Inventory Report 1990-2014: Greenhouse Gas Sources and Sinks in Canada, Part 3*, 94, available at https://publications.gc.ca/site/eng/9.506002/publication.html

[111] Environment and Climate Change Canada, *Canada's Greenhouse Gas and Air Pollutant Emissions Projections,* Current projections, "Detailed_GHG_emissions_GES_detaillees" dataset. https://data-donnees.ec.gc.ca/data/substances/monitor/canada-s-greenhouse-gas-emissions-projections/Current-Projections-Actuelles/GHG-GES/?lang=en. The electricity emissions forecast by ECCC do not include emissions from cogeneration plants in Alberta's oilsands.

[112] *NIR 2021, Part 3*, 69.

[113] At the lowest range, if the electricity that replaces coal and meets new demand in 2024 matches the current emissions intensity of non-coal-fired electricity in Alberta (371 t/GWh in 2019), this would reflect a 56% reduction in intensity from 2015 (850 t/GWh). *NIR 2021, Part 3*, 69. Given the increasing complement of renewable energy, there are strong prospects that this could be beat.

Saskatchewan. In the Regulatory Impact Analysis Statement (RIAS) of the original federal coal-fired GHG regulations published in 2012, the federal government estimated the health impacts avoided as a result of the regulations. They estimated that between 2015 and 2035, Alberta alone would avoid 590 premature deaths, 520 ER visits and hospitalizations, 80,000 asthma episodes and 1.9 million days of breathing difficulty and reduced activity. Cumulatively, these represented $2.7 billion in avoided health outcomes from ozone and fine particulate matter alone, with a wide range of additional health harms avoided through mercury reductions.[114]

In 2014, a coalition of health and environmental organizations estimated that an accelerated phase-out would more than double the health impacts claimed in the 2012 RIAS, for a total of over $5 billion in avoided health outcomes and more than 1,100 avoided premature deaths.[115] Notably, the group's proposed scenario was much slower than the 2023 coal phase-out that is currently underway in Alberta, retiring coal units gradually over 15 years from 2015 to 2030, instead of just eight years.

The accelerated transition underway in Alberta, mediated by appropriate, sector-wide carbon pricing, is already providing cleaner air and reducing health impacts for Albertans and will continue to do so for years to come.

### 4.3.3 Mitigating impacts on workers and communities

When coal plants and mines close, impacts to workers and the local community vary widely depending on demographic factors and geographic locations. In communities located closely enough to major cities, workers have the option to seek employment in the city, without having to disrupt their family units by relocating or leaving for weeks at a time to live temporarily on a job site. On the other hand, in communities that were built around coal mining or a coal plant as the primary industry, the off-coal transition presents a major economic challenge. In addition, communities are impacted by the loss of revenue from coal facilities, as well as the potential migration of residents away from the community.

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[114] *Regulatory Impact Analysis Statement (RIAS), Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations.* To be clear, these health outcomes are caused by the $NO_x$, $SO_2$, and mercury emissions from coal plants, not directly by the GHGs represented in Figure 8. However, those air pollution emissions are correlated closely with the GHGs because they are themselves a product of the same coal combustion. Moreover, any form of replacement generation — including gas-fired generation — has only a fraction of coal's $NO_x$ emissions and typically no $SO_2$ or mercury emissions. As such, Figure 9's model of GHG emissions reduced from coal power plants provides an illustrative proxy for the air pollution — and resultant health impacts — reduced as well.

[115] *Breathing in the Benefits,* 28.

Parallel to the two funding programs offered by the federal government in 2018 (the Canada Coal Transition Initiative and Canada Coal Transition Initiative Infrastructure Fund), the Government of Alberta instituted two provincial-level programs specifically targeted toward workers and communities affected by the province's accelerated coal phase-out. The Coal Workforce Transition Program provides targeted support to coal workers, including financial assistance for re-employment, retirement, relocation, and education, and the Coal Community Transition Program awards grants to fund projects that facilitate community economic diversification.

Alberta's provincial transition programs are partially funded through the Technology Innovation and Emissions Reduction (TIER) Regulation, the province's carbon pricing system. Because the purpose of this fund is to support programs directly related to climate and emissions management, this model can provide a sustainable financing channel for funding transition support programs.

### 4.3.4 Alberta as climate policy role model

Alberta’s experience effecting policy to capture the benefits of phasing out coal offers a model to other jurisdictions, both in Canada and globally. The province’s carbon pricing policy set clear pricing signals for generation operators that put the economics of high-carbon coal power into stark contrast with far-lower-emitting power. Once these decision-makers — in Alberta’s case, the private sector plant owner/operators who set their bids in the province’s power pool and make facility investment decisions — internalized a sector-wide carbon price signal, the path was clear.

First, they decreased the utilization of coal power facilities by internalizing the carbon price in their bids. Next, they recognized the competitive benefits of retiring coal units to invest in alternative generating capacity or converting the units to lower-emitting natural gas and, in some instances, retrofitting the facilities to dramatically improve efficiency and lower emissions even further using relatively recent technology innovations. In this way, the operators’ decisions will further mitigate the impact of carbon pricing on electricity costs. More concisely: a lower-emitting generation supply will incur less carbon price liability. The generators are replacing capacity in a rapid but orderly fashion, salvaging use of existing assets where it makes economic sense to continue to supply affordable electricity and avoiding locking in large new capital investment in other generation sources that will take decades to pay off.

Notably, the scale and pace of the action by the coal plant owners/operators was well beyond — and in many ways contradictory — to the general electricity industry sentiment when the first conversations of coal phase-out began.

The outcome for Albertans is cleaner electricity that is providing healthier air and an investment climate that appeals better to a climate-risk-focused and ESG-centric modern global financial sector. This is taking place while maintaining security of supply[116] and better insulating consumers against future carbon price risk.

[116] The Alberta Electric System Operator has expressed confidence in future supply in a number of recent publications, including supporting the cancellation of the capacity market and rejecting the need to increase the power pool price cap.

# 5. Further accelerating Canada's coal phase-out

In addition to Alberta, Canada has had three remaining coal-burning provinces since 2015 — Saskatchewan, Nova Scotia and New Brunswick — each at a different stage and with a different posture toward phasing out coal completely across Canada. These provinces' absolute emissions from coal and their proportional reliance on coal never reached the same level as Alberta's, but their emissions are still proportionally large. Moreover, as Alberta moves rapidly toward a coal-free grid by the end of 2023, the ongoing combustion of highly polluting thermal coal for electricity in these three provinces will attract greater attention at home and abroad, as the country endeavours to demonstrate international leadership to "power past coal".

Federal policy actions taken since 2015 have had some impact in all three provinces, in addition to individual actions taken at the provincial level, with differing forecasts for coal-fired power over the 2020s and 2030s and effects on coal-fired emissions. Each of these provinces also has opportunities to secure the benefits of accelerating a transition away from coal and avoid locking capital into unabated fossil fuel replacement generation.

## 5.1 Federal policy action since 2015

Since the beginning of 2015, two key federal policy actions have impacted the most recent trajectories of coal-fired power in Canada: the 2030 coal phase-out and economy-wide carbon pricing. These actions have set new policy scenarios and plans for coal phase-out in each of the three provinces.

### 5.1.1 2030 coal phase-out

Following on Alberta's coal-power phase out announcement in 2015, the Trudeau government announced in November 2016 that it would institute its own nation-wide coal phase-out by 2030. Environment and Climate Change Canada implemented this

policy in November 2018 by amending the 2012 federal regulations so that no unit's end-of-life date could extend beyond 2029.[117]

Rather than allowing coal units to operate for 50 years as per the 2012 federal regulations, if enforced as written the 2018 policy would accelerate the retirement of any unit commissioned after 1985. This would apply to one of Saskatchewan's seven operating units (reducing Shand's operating life by 13 years), one of eight in Nova Scotia (reducing Trenton 6 by 22 years), and New Brunswick's only unit (reducing Belledune's life by 24 years). It would also apply to six units in Alberta, but because the Government of Alberta was already implementing its policy to end coal-fired power pollution by the end of 2030, this effectively only removed one year of operating life.

In practice, by the time the federal government announced its 2030 phase-out in 2016, it was already signalling to Nova Scotia that the province would be allowed to continue to use unabated coal power beyond 2030 through an equivalency agreement. Under such agreements, the federal government removes the application of the end-of-life regulations for set periods of time in provinces where provincial regulations are seen to attain equivalent overall electricity sector emissions reductions (though perhaps higher coal emissions). This has the effect of diluting defined coal-unit retirement dates. Equivalency agreements were signed with Nova Scotia in 2018 and Saskatchewan in 2020.

### 5.1.2 Carbon pricing

The federal government also announced a national carbon price in 2016. It would start at $10/t in 2018 and rise $10/t each year, reaching $50/t in 2022. In late 2020, the federal government announced that the price beyond 2022 would rise $15/t each year, to $170/t in 2030. Under this carbon pricing legislation, the federal government will stand the federal carbon price system aside where it concludes that provincial carbon pricing meets certain minimum thresholds, such as price level and scope. Where the federal price does apply, the federal government developed an output-based pricing system (OBPS) based partly on the output-based allocation system implemented under the CCIR in Alberta. By general principle, all facilities would receive the same number of free allocations for the same amount of product, much like with Alberta's CCIR.

However, for electricity, the federal carbon pricing system sets different benchmarks for different fuels, with some receiving more free emissions for each GWh produced than

[117] *Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations*, s. 2(1) (definition of "useful life").

others. Table 3 shows the schedule of federal emissions benchmarks for electricity generators between 2019 and 2030, which is essentially the rate of free allocations given to electricity facilities.[118] While renewable energy receives no allocations for the electricity it generates (though it does in Alberta) and natural gas receives allocations at the same rate as plants under Alberta's system (namely, the rate of the most-efficient gas plant, 370 t/GWh), coal receives far more free allocations.

In 2019, the "solid fuels" benchmark for coal sat at a very high 800 t/GWh, effectively a large subsidy of free emissions allocations, particularly relative to other, lower-emitting generation.[119] At $20/t in 2019, the very weak emissions benchmark meant a very small cost to coal plants: only around $4/MWh for a typical subcritical 1,000 t/GWh coal plant. Coal plants are sheltered from most of the cost until the solid fuels benchmark becomes more stringent over the decade.

Table 3. Emissions benchmarks by fuel type

| Year | Solid fuels ($CO_2e$ t/GWh) | Liquid fuels ($CO_2e$ t/GWh) | Gaseous fuels ($CO_2e$ t/GWh) |
|---|---|---|---|
| 2019 | 800 | 550 | 370 |
| 2020 | 650 | 550 | 370 |
| 2021 | 622 | 550 | 370 |
| 2022 | 594 | 550 | 370 |
| 2023 | 566 | 550 | 370 |
| 2024 | 538 | 550 | 370 |
| 2025 | 510 | 550 | 370 |
| 2026 | 482 | 550 | 370 |
| 2027 | 454 | 550 | 370 |
| 2028 | 426 | 550 | 370 |
| 2029 | 398 | 550 | 370 |
| 2030 and after | 370 | 550 | 370 |

Source: Government of Canada[120]

[118] The standard is the emissions intensity that generators must meet through emissions reductions, offsets, carbon price payments, or any combination thereof.

[119] Government of Canada, "Carbon pollution pricing – what you need to know," May 5, 2020. https://www.canada.ca/en/revenue-agency/campaigns/pollution-pricing.html

[120] Government of Canada, *Output-Based-Pricing-System Regulations*, SOR/2019-266, Schedule 1. https://laws-lois.justice.gc.ca/eng/regulations/SOR-2019-266/index.html

However, with the carbon price rising to $170/t by 2030 and the emissions benchmark for coal tightening over that period to ultimately reach the gas benchmark by 2030, the price impact on coal will increase significantly over the coming decade. Under the federal carbon price, that same coal plant would see its $4/MWh 2019 carbon cost increase to around $93/MWh in 2029 with a 398 t/GWh benchmark and $155/t price.

### 5.1.3 Coal emissions scenarios under recent policy developments

In order to examine the progress made to date and the remaining opportunity to reduce coal emissions, the phase-out of coal in the three remaining coal-burning provinces is assessed under three specific scenarios. These scenarios reflect three different stages of coal policy development in Canada and a fourth option of an accelerated transition. The scenario modelling includes the impact of federal and provincial plans, as described here.

#### 2012 Federal Regulations scenario

The analysis in each of the provinces below adopts the 2012 federal regulations as a baseline for climate action related to coal emissions. As detailed in Section 3.3, the end-of-life dates from 2012 adopted approximately business-as-usual operating lifespans for coal power units. For this reason, the "2012 Federal Regulations" scenario provides an appropriate baseline against which to assess more recent developments and further opportunities. Taking a snapshot of this policy milieu from the perspective of the start of 2015, this scenario adopts the 2014 emissions and operations of each unit as a baseline for its continued operations until it reaches retirement.[121]

#### ECCC 2030 Phase-Out scenario

The next scenario was the "ECCC 2030 Phase-Out", announced by the federal government in 2016 and implemented in 2018. This scenario isolates the impact of accelerating the retirement schedules to 2030 by maintaining the 2014 baselines. It also takes account of retirement schedule dilutions accepted by the federal government through equivalency agreements with Saskatchewan and Nova Scotia, while applying the sector-wide GHG caps in these provinces to coal emissions in lieu of the retirement schedules.

[121] Exceptions in particular provinces are applied, such as the equivalency agreement in Nova Scotia and operational outliers like units that were undergoing refurbishment in 2014.

### Current Plans scenario

The third scenarios modelled current plans in each province, which show recent plans announced since 2018, which are assumed, in part, to recognize factors driving accelerated climate action, including the federal carbon price schedule. For Saskatchewan, this shows the effect of operational decisions by SaskPower to reduce the use of its highly emitting coal assets where possible. In Nova Scotia, this mainly means accelerating the phase-out of coal to 2030, despite signals that equivalency agreements with the federal government would allow the province to continue beyond 2030. New Brunswick has recently advanced policy development to extend its coal unit beyond 2030 by setting a sector-wide emissions cap and seeking equivalency from the federal government, so recent plans there are weakening the transition schedule. To capture recent reductions in utilization of these facilities to reduce emissions and carbon price liability by operating cleaner facilities, 2019 emissions levels are taken as the baseline.

### Accelerated Transition scenario

Finally, an "accelerated transition" scenario is offered in each province that shows the additional reductions achievable with certain actions to reduce operations or retire capacity earlier.

## 5.2 Saskatchewan

After Alberta, Saskatchewan has the highest coal emissions in Canada. The province relied on coal for over half of its electricity generation as recently as 2015. Coal use and emissions declined gradually over most of the last decade, with small capacity reductions from retirements and the application of GHG emissions reduction technology to one unit. Very recently, Saskatchewan has reduced coal-fired power in favour of lower-emitting generation from natural gas and non-emitting generation from renewable energy, motivated by climate action and efforts to reduce exposure to forthcoming and increasing carbon pricing. Coal power will be eliminated gradually over the course of this decade, but with retirements backloaded toward the end of the 2020s. Emissions could be tackled more aggressively if the transition away from coal were accelerated — mediated by accelerating progress toward fair, sector-wide carbon pricing standards — and with bolder initiatives toward non-emitting generation.

### 5.2.1 Looking back: Reliance on coal for electricity

Coal was one of the first commodities to be mined in Saskatchewan, beginning in 1857. Today, Saskatchewan is the third-largest producer of thermal coal in Canada.[122] These local mines supply Saskatchewan's three remaining coal-fired power plants, shown in Figure 10, which are owned and operated by the Government of Saskatchewan's crown corporation electric utility, SaskPower.[123]


Figure 10. Capacity of coal-fired electricity generating units (MW) in Saskatchewan

As shown in Figure 11, coal comprised 42% of Saskatchewan's electricity generation in 2019, down from nearly 70% in 2000. While adding other forms of generation to reduce

[122] Government of Saskatchewan, "Coal and Lignite Dispositions." https://www.saskatchewan.ca/business/agriculture-natural-resources-and-industry/mineral-exploration-and-mining/mineral-tenure/coal-and-lignite-dispositions

[123] SaskPower, "System Map." https://www.saskpower.com/our-power-future/our-electricity/electrical-system/system-map/; Westmoreland Mining LLC, "Estevan Mine--Saskatchewan." https://westmoreland.com/location/estevan-mine-saskatchewan/; Cloe Logan, "A small Sask. town sits amid uncertainty as coal, its main industry, is set to be phased out by 2030," *Canada's National Observer,* July 6, 2021. https://www.nationalobserver.com/2021/07/06/news/saskatchewan-town-coronach-coal-phaseout-transition

coal's proportion, the province has also slowly moved away from highly emitting coal. SaskPower retired Boundary Dam units 1 and 2 in 2013 and 2014, in advance of the federal regulations announced in 2012 coming into effect on July 1, 2015.[124] By that time, both units had been operating for more than 50 years.

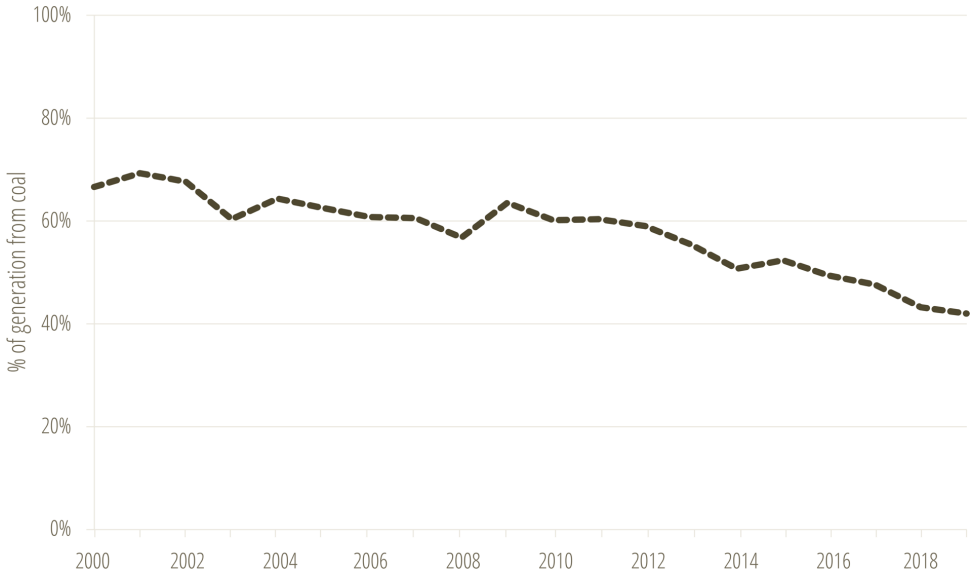


Figure 11. Electricity generation from coal in Saskatchewan, 2000-2019

In 2014, SaskPower added carbon capture and storage (CCS) to their next-oldest remaining unit, Boundary Dam Unit 3, which would otherwise have hit its regulatory end-of-life at the end of 2019.[125] Boundary Dam Unit 3 was described as the world's first fully integrated, full-chain coal plant CCS facility, with technology that can reduce greenhouse gas emissions by one million tonnes each year.[126] In 2012, Boundary Dam 3 emitted 1.26 Mt $CO_2$e. By 2014, the unit emitted 0.43 Mt $CO_2$e, a 0.83 Mt reduction.[127] The reduction in net emissions from the plant has been sufficient to reach a level lower than the clean-as-gas level of performance of 420 t/GWh as defined in federal GHG regulations for coal-fired electricity.[128] Because of this, Boundary Dam Unit 3 will be

[124] SaskPower, "Boundary Dam Power Station." https://www.saskpower.com/our-power-future/our-electricity/electrical-system/system-map/boundary-dam-power-station

[125] "Boundary Dam Power Station."

[126] International CCS Knowledge Centre, "Boundary Dam 3 Carbon Capture and Storage (CCS) Facility." https://ccsknowledge.com/bd3-ccs-facility

[127] Kayla Klassen, SaskPower, personal communication, July 9, 2021.

[128] *Regulations Amending the Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations.*

allowed to operate past 2030, and beyond even the 45-to-50-year end-of-life dates stipulated in the 2012 federal regulations.[129]

The planned transition under the 2012 regulations still in place at the start of 2015 would have been slow and prolonged — the last coal plant to retire would be Shand 1 in 2042.[130] As of 2019, SaskPower's three remaining coal plants were still Saskatchewan's top three emitters, as shown in Figure 12. In fact, they released more GHG emissions in 2019 than the next 13 largest emitters combined.[131]

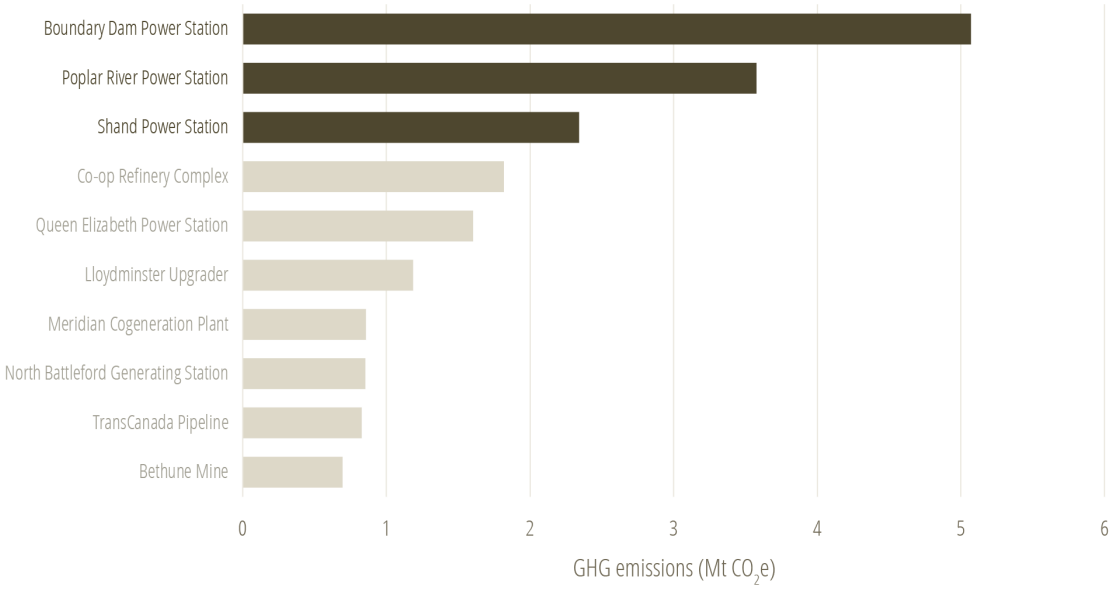


Figure 12. Top 10 GHG emitters in Saskatchewan, 2019

Data source: ECCC[132]

Coal plants are also the largest sources of harmful air pollutants in Saskatchewan. As shown in Figure 13 and Figure 14, in 2019, 73% and 66% of Saskatchewan's mercury and $SO_2$ emissions came from coal. Given that any replacement generation would emit only a fraction of these emissions — or none, in the case of mercury — these emissions in Saskatchewan will fall dramatically when coal is eliminated, to a fraction of current province-wide levels.

[129] *Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations*, Section 2(1).

[130] *Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations*, Section 2(1).

[131] Environment and Climate Change Canada, "Greenhouse Gas Reporting (GHGRP) – Facility Greenhouse Gas (GHG) Data," spreadsheet, April 4, 2021. https://open.canada.ca/data/en/dataset/a8ba14b7-7f23-462a-bdbb-83b0ef629823

[132] "Greenhouse Gas Reporting (GHGRP) – Facility Greenhouse Gas (GHG) Data."

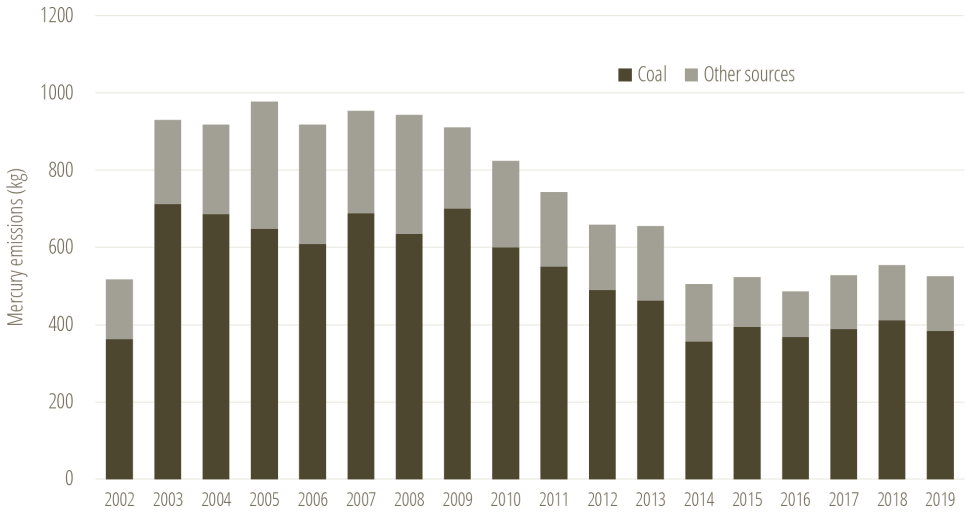


Figure 13. Mercury emissions from coal in Saskatchewan, 2002-2019

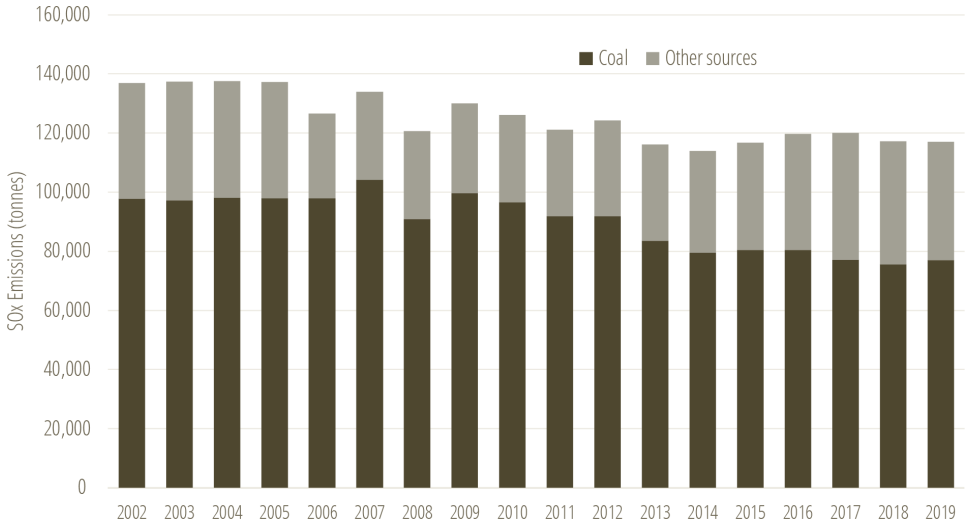


Figure 14. $SO_2$ emissions from coal in Saskatchewan, 2002-2019

Total $SO_x$ value is inclusive of $SO_2$ and all industries and sources. Coal emissions value is for $SO_2$.
Data source: ECCC[133]

## 5.2.2 Current status: Plans for phasing out coal

On January 1, 2018, Saskatchewan released the Management and Reduction of Greenhouse Gases (General and Electricity Producer) Regulations, in a bid to secure an

[133] Environment and Climate Change Canada, "National Pollutant Release Inventory." https://open.canada.ca/data/en/dataset/40e01423-7728-429c-ac9d-2954385ccdfb; "APEI_Tables_Canada_Provinces_Territories."

equivalency agreement with ECCC to displace the application of federal regulations.[134] The regulations establish a hard limit (or "cap") on total electricity sector GHG emissions for a specific set of years as shown in Table 4.

Table 4. Saskatchewan electricity sector GHG emissions caps 2018-2029

| Period | Electricity sector GHG emissions cap (Mt $CO_2e$) |
|---|---|
| 2018-2019 | 33.5 |
| 2020-2024 | 77 |
| 2025-2029 | 64.5 |

The federal government determined that Saskatchewan's regulations would achieve electricity sector emissions reductions equivalent to phasing out coal, and an equivalency agreement was allowed to come into force on January 1, 2020. The agreement exempts the province from the federal regulations and gives the Government of Saskatchewan discretion to retire coal plants so long as the total emissions cap set in the equivalency agreement is not exceeded.[135]

Under its own terms, the 2018 equivalency agreement can only be renewed to 2029, with no commitment from the federal government to extend it past 2030 or initiate a new agreement. Barring any future agreements (which neither the federal government nor Saskatchewan is apparently seeking), the federal 2018 coal regulations will again be applicable after 2029 and Saskatchewan will be legally required to retire any remaining unabated coal plants at that time.[136]

Although Saskatchewan now has discretion around all unit retirements, SaskPower only plans to extend the economic life of Boundary Dam units 4 and 5 — both were meant to be retired by 2019 under the federal end-of-life regulations, but will now be retired in 2021 and 2024, respectively. According to the Saskatchewan government, this extension will ensure greater employment certainty for coal miners and workers at the two coal-

[134] Government of Saskatchewan, "Legislation and Regulations." https://www.saskatchewan.ca/business/environmental-protection-and-sustainability/a-made-in-saskatchewan-climate-change-strategy/legislation-and-regulations

[135] Government of Canada, Government of Saskatchewan, *An Agreement on the Equivalency of Federal and Saskatchewan Regulations for the Control of Greenhouse Gas Emissions from Electricity Producers in Saskatchewan* (2020). https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/agreements/equivalency/canada-saskatchewan-greenhouse-gas-electricity-producers.html

[136] *An Agreement on the Equivalency of Federal and Saskatchewan Regulations.*

power units.[137] Other units are currently slated for retirement in line with the federal schedule, with the exception of Boundary Dam 3 which operates with CCS at a level under the federal emissions intensity standard (see Section 5.2.1). It is currently unknown when Boundary Dam 3 will retire. Table 5 summarizes the currently planned coal unit retirement schedules, accounting for federal regulations, equivalency agreements, and SaskPower's operating plans.

Table 5. Retirement schedules of Saskatchewan coal plants

| Plant name | Unit | Capacity (MW) | Commissioning Year | Original end-of-life date | Retirement year |
|---|---|---|---|---|---|
| Boundary Dam | 3 (with CCS) | 120 | 1970 (CCS added 2014) | 2019 | Unknown |
| | 4 | 139 | 1970 | 2019 | 2021[138] |
| | 5 | 139 | 1973 | 2019 | 2024[139] |
| | 6 | 284 | 1978 | 2028 | 2027[140] |
| Poplar River | 1 | 291 | 1981 | 2029 | 2029[141] |
| | 2 | 291 | 1983 | 2029 | 2029[142] |
| Shand | 1 | 276 | 1992 | 2042 | 2029[143] |

[137] CBC News, "Saskatchewan reaches deal with Ottawa on coal-burning power plants," January 11, 2019. https://www.cbc.ca/news/canada/saskatchewan/sask-ottawa-coal-agreement-1.4974402

[138] "Saskatchewan reaches deal with Ottawa on coal-burning power plants."

[139] "Saskatchewan reaches deal with Ottawa on coal-burning power plants."

[140] Auditor Report of Saskatchewan, *Report of the Provincial Auditor to the Legislative Assembly of Saskatchewan* (Volume 2, 2020), "Chapter 23: SaskPower--Planning to Shut Down and Decommission Boundary Dam." https://auditor.sk.ca/publications/public-reports/item?id=165

[141] "Saskatchewan reaches deal with Ottawa on coal-burning power plants."

[142] "Saskatchewan reaches deal with Ottawa on coal-burning power plants."

[143] SaskPower, "Shand Power Station." https://www.saskpower.com/Our-Power-Future/Our-Electricity/Electrical-System/System-Map/Shand-Power-Station

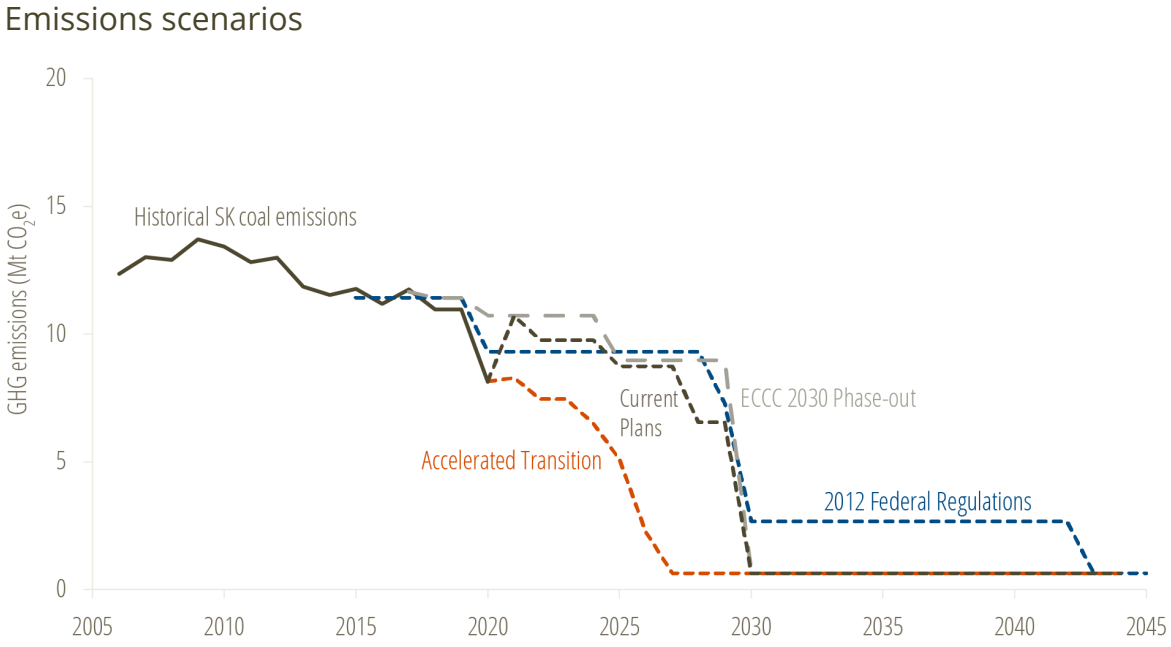


Figure 15. Saskatchewan emissions scenarios

Source: Pembina Institute modelling[144]

Figure 15 demonstrates the effects of the recent progression of climate policy action on projected coal-power GHG emissions in Saskatchewan. Comparing the line projections highlights some important conclusions.

- **Eliminating the long tail** — The 2030 phase-out announced in 2016, and subsequent actions and plans, served to eliminate the long tail on Shand operating until 2042, bringing emissions down to the level of CCS-abated Boundary Dam 3 indefinitely. However, because all other unabated units were already slated to retire by 2029 under the 2012 federal regulations, the effect of the 2030 phase-out was somewhat muted in Saskatchewan. Nevertheless, saving 13 extra years of more than 2 Mt/year of coal emissions at Shand alone is substantial.
- **Equivalency backslide on near-term retirements** — Because the federal government accepted the equivalency of Saskatchewan's electricity sector cap alongside its 2030 phase-out implementation, near-term unit retirements were deferred. This increased emissions relative to the 2012 federal regulations scenario until 2025. By 2025, Saskatchewan's electricity sector emissions cap is expected to reduce coal emissions relative to the original phase-out timeline.

[144] The data analysis and sources used for these scenarios is available in *From Coal to Clean: Emissions Model* at www.pembina.org.

Because of the initial retirement delays under the equivalency agreement, however, the net effect is likely to result in substantially higher coal emissions over this decade to 2030.

- **Potential for emissions rebound** — In large part due to the aberrance of 2020 and depressed electricity demand, electricity sector emissions were substantially lower in 2020 than previous years. SaskPower anticipates that emissions will rebound in 2021. Because of the five-year cap period (2020-2024, as reflected in Table 4), GHG savings in 2020 could exacerbate sector and coal GHG emissions in 2021-2024, within Saskatchewan's regulations and the federal government's equivalency.
- **Operational decisions to use coal less are effective** — The Current Plans scenario incorporates SaskPower's planned unit retirements (which are earlier than required under the federal equivalency agreement). The plan forecasts unit emissions on the basis of a 2019 baseline, by which point SaskPower had begun to implement operational decisions to run its coal units at "partial capacity … when more generation could be achieved by other lower-/non-emitting facilities".[145] According to SaskPower, this reflects efforts to optimize generation from renewable sources while maintaining reliability, to achieve emissions reductions and to limit carbon tax payments.[146] The approach is proving effective so far and has the potential to reduce coal emissions relative to the federal government's 2012 phase-out schedule and 2018 equivalency agreement.

The Current Plans scenario broadly aligns with SaskPower's emissions reductions goals. SaskPower is forecasting a 50% reduction in 2005 emissions levels by 2030.[147] This reduction would mean sector-wide emissions of approximately 4.3 Mt by 2030,[148] which aligns with the modelled 0.63 Mt remaining coal emissions by 2030 in this scenario, with the remaining emissions coming from gas-fired power. However, while the Current Plans scenario is modelled based on coal utilization in 2019,[149] evolving carbon pricing systems will likely continue to affect the usage of coal plants in Saskatchewan, accelerating and deepening coal emissions reductions later in the 2020s until full

[145] Kayla Klassen, SaskPower, personal communication, July 8, 2021. Notably, coal utilization and emissions fell even further in 2020, but SaskPower noted that they would like rise again in 2021, due to less hydro availability and increased demand overall.

[146] Kayla Klassen, SaskPower, personal communication, July 9, 2021.

[147] SaskPower, "Emissions." https://www.saskpower.com/Our-Power-Future/Powering-2030/Emissions

[148] "Emissions."

[149] Using 2019 captures SaskPower's recent efforts to reduce coal in favour of lower-emitting power, but avoids the aberrant 2020 emissions drop due in part to reduced demand caused by the global pandemic.

phase-out in 2030. While there was only a very small incentive for SaskPower to reduce coal operations based on price and stringency in 2019, this incentive will multiply more than 20-fold by 2029 under the federal carbon pricing schedule. The Government of Saskatchewan proposed a provincial carbon pricing plan for electricity generation to replace the federal plan, but it was rejected by the federal government.[150]

### 5.2.3 Looking forward: What Saskatchewan can achieve

Relative to the retirement schedule mandated by the 2012 federal regulations, Saskatchewan's 2018 equivalency agreement and electricity sector hard cap (ECCC 2030 Phase-Out scenario) would reduce coal GHG emissions by a total of 19 Mt between 2020 and 2045, as shown in Figure 16, representing a 15% reduction in cumulative total emissions over this period. The carbon pricing embedded into SaskPower's dispatching decisions by optimizing lower-emitting generation, plus SaskPower's current plan for coal unit retirements, project at least another 11 Mt of reductions over this same period, for a 30 Mt (23%) reduction relative to the status quo at the start of 2015.[151]

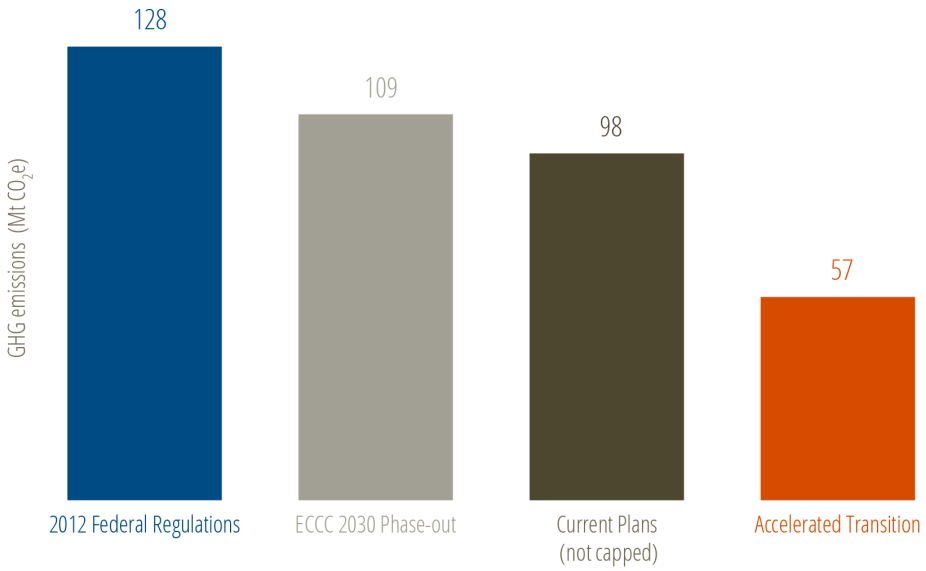


Figure 16. Cumulative coal emissions under Saskatchewan emissions scenarios, 2020-2045

[150] Stephanie Taylor, "Saskatchewan's carbon pricing plan has been rejected by federal government, premier says," *National Post*, July 12, 2021. https://nationalpost.com/news/politics/saskatchewan-premier-says-ottawa-has-rejected-provinces-carbon-pricing-plan

[151] This analysis is based on SaskPower operations in 2019. As the carbon price rises and the emissions benchmark for coal power tightens over this decade, SaskPower could push coal utilization down further and faster to limit its carbon price liability.

SaskPower would achieve further emissions reductions with accelerated coal plant retirements, accelerated renewable energy development, and optimized operations. Under the Accelerated Transition scenario:

- Earlier unit retirements were modelled loosely after the schedules announced by utilities last year in Alberta (though with a delay, to reflect announcements this year in Saskatchewan), in recognition of the strong commonalities between the two provinces and the availability of alternative generating sources, including fuel conversions and renewable energy resources.
- Reductions in coal power utilization achieved in 2020 were maintained in coming years. Although coal utilization was particularly low in part due to the pandemic and high-water runoff that maximized hydroelectric generation,[152] this scenario assumes that SaskPower would be able to continuously improve on climate progress by identifying opportunities to minimize coal use and strategically investing in the lower-emitting generation, storage and transmission projects necessary to reduce coal use.

As shown in Figure 16, if SaskPower accelerated coal phase-out to meet the Accelerated Transition scenario, an additional incremental 41 Mt of coal emissions could be avoided relative to the Current Plan scenario. This would result in a total of 71 Mt of coal-fired emissions avoided (55%) relative to the 2012 Federal Regulations scenario.

## Accelerated coal phase-out

Alberta's experience shows that accelerating the transition is feasible when mediated by fair, sector-wide carbon pricing. Under current federal and planned Saskatchewan electricity sector carbon pricing policy, however, large subsidies in the form of free emissions are allocated to coal-fired power (as shown in Table 3). This sustains an undue economic advantage for coal power and an unfair disadvantage for lower-emitting sources. Meanwhile, Alberta is on course for a dramatically accelerated coal phase-out, mediated largely by the sector-wide carbon pricing standard. If the same standard were applied immediately in Saskatchewan — or applied internally by SaskPower to prepare for this eventual reality, as a form of "shadow pricing" — it may incite the same types of operating and investment decisions that have led to a dramatic acceleration of the transition away from coal in Alberta.

[152] "Emissions."

## Greater renewable energy deployment

Renewable energy development can also accelerate the elimination of coal in Saskatchewan.[153] The province has immense untapped wind energy resources,[154] and with the upcoming Blue Hill, Golden South, and Bekavar wind energy projects, SaskPower will have installed an additional 885 MW of wind power by 2030.[155]

Southern Saskatchewan has nation-leading solar potential,[156] and geothermal energy is also a growing sector. Recently, testing for the first 20 MW geothermal well in Saskatchewan was completed, with plans to finish development by 2023. If it performs well, the province is considering expanding geothermal power up to 100 MW, though no clear timeline for this has been provided.[157]

To further increase the amount of renewable energy on Saskatchewan's electricity grid, SaskPower has entered into agreements with Manitoba Hydro to deliver up to 190 MW of hydroelectric power through a transmission line between the two provinces. The transmission, slated to start in 2022,[158] will help to integrate the growth of variable renewables in Saskatchewan and will be fed by Manitoba's predominantly non-emitting electricity generation.[159]

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[153] SaskPower, "Balancing Supply Options." https://www.saskpower.com/Our-Power-Future/Our-Electricity/Electrical-System/Balancing-Supply-Options

[154] Canwea, "Wind Energy in Saskatchewan." https://canwea.ca/wind-energy/saskatchewan/

[155] SaskPower, *Renewing our Commitment: Corporate Responsibility and Sustainability Report (2019-2020)*, 12-14. https://www.saskpower.com/about-us/Our-Company/Current-Reports; SaskPower, "Bekevar Wind Energy Project to Generate 200MW of Clean, Renewable Energy in SE Saskatchewan," media release, June 17, 2021. https://www.saskpower.com/about-us/media-information/news-releases/2021/bekevar-wind-energy-project-to-generate-200-mw-of-clean-renewable-energy-in-se-saskatchewan

[156] Natural Resources Canada, "Photovoltaic potential and solar resource maps of Canada," December 22, 2020. https://www.nrcan.gc.ca/our-natural-resources/energy-sources-distribution/renewable-energy/solar-photovoltaic-energy/tools-solar-photovoltaic-energy/photovoltaic-potential-and-solar-resource-maps-canada/18366

[157] Geothermal: Geothermal Canada, "Saskatchewan, Canada-based DEEP Earth Energy Production Corp. Geothermal Project Ready for Final Feasibility Engineering," media release, March 23, 2021. https://www.geothermalcanada.org/news/2021/3/23/saskatchewan-is-ready-for-final-geothermal-power-feasibility-engineering-53-day-large-volume-production-and-injection-test-successful-first-in-canada

[158] *Renewing our Commitment,* 12-14.

[159] Manitoba Hydro, "Facilities & Operations." https://www.hydro.mb.ca/corporate/facilities/

Saskatchewan is targeting 50% renewable energy capacity by 2030.[160] To reach this goal, SaskPower will be adding an additional 973 MW of clean energy in the province, along with the additional 190 MW of Manitoba hydro imports, by 2030.[161] However, with the rapidly developing trend toward 2035 net-zero electricity commitments in OECD countries, SaskPower may have to accelerate investments into clean energy.

Earlier retirements of coal units, which are all located in the south, would free up valuable transmission capacity in this sunniest and windiest region of the province. Further reductions could be achieved long-term if the Government of Saskatchewan and SaskPower devote greater investment to clean energy, energy efficiency, and storage to ensure long-term decarbonization and reduced reliance on other fossil fuels such as natural gas.

## 5.3 Nova Scotia

Nova Scotia has historically relied on coal power for more than half of its in-province electricity generation. While this reliance decreased along with coal emissions over the first 15 years of this century, both metrics have remained high in recent years. Considering the recent progress made in Alberta and Saskatchewan, Nova Scotia may have generated a larger proportion of its in-province electricity from coal in 2020 than any other province, which would make it the most coal-reliant province in Canada.

However, recent provincial plans to move away from coal entirely by 2030 — despite signals from the federal government that this may not be required under current and prospective future equivalency agreements — will institute a crucial transition over this decade. This will be facilitated by substantial growth in renewable energy and new transmission interconnections to dramatically reduce the province's carbon intensity. At present, however, the planned transition away from coal is largely backloaded in the

[160] Government of Saskatchewan, "The Path to 2030: SaskPower Updates Progress on Renewable Electricity," media release, November 28, 2017. https://www.saskpower.com/about-us/media-information/news-releases/2018/03/the-path-to-2030-saskpower-updates-progress-on-renewable-electricity

[161] The 973 MW reflects a sum of renewable energy announcements from 2020 through June 2021, including 60 MW of new solar, 685 MW of new wind, the 200 MW Bekeyar project, 20 MW of new geothermal and 8 MW of new biomass. SaskPower, *Annual Report (2020-21)*, 14. https://www.saskpower.com/about-us/Our-Company/Current-Reports; SaskPower, "SaskPower's First Battery Energy Storage System Will Support Renewables to Help Balance the Grid," media release, March 31, 2021. https://www.saskpower.com/about-us/media-information/news-releases/2021/saskpowers-first-battery-energy-storage-system-will-support-renewables-help-to-balance-grid

late 2020s, meaning Nova Scotia could be left hanging as an outlier in coal reliance through most of the decade.

### 5.3.1 Looking back: Reliance on coal for electricity

Nova Scotia's coal mining history dates back to 1720, when commercial mining commenced on Cape Breton Island. Coal from local mines fueled the province's power plants until the last Devco mine closed in 2001.[162] Since then, the province's four remaining coal plants have been powered by imported coal. Nova Scotia Power (NS Power) — the province-wide, privatized but regulated and vertically integrated electric utility — operates all four coal plants, shown in Figure 17. These four facilities accounted for 10% of Canada's overall coal capacity in 2014.[163]

The Trenton Generating Station is located in Trenton, on the province's northern coast, only a few kilometers north of New Glasgow. Cape Breton Island houses the Point Aconi and Point Tupper generating stations, as well as Lingan, the province's largest generating station. In 2012, NS Power began operating two of Lingan's four units only on a seasonal basis due to "decreased industrial load, increased renewable energy use and to meet environmental requirements."[164] These two units were included in our analysis.

[162] Government of Nova Scotia, "Nova Scotia's Historic Underground Coal Mine Workings Information," April 8, 2020. https://novascotia.ca/natr/meb/hazard-assessment/historic-coal-mine-workings.asp

[163] *Out with the Coal, in with the New*, 4.

[164] Nova Scotia Power, "How we make electricity," 2021. https://www.nspower.ca/about-us/electricity/producing

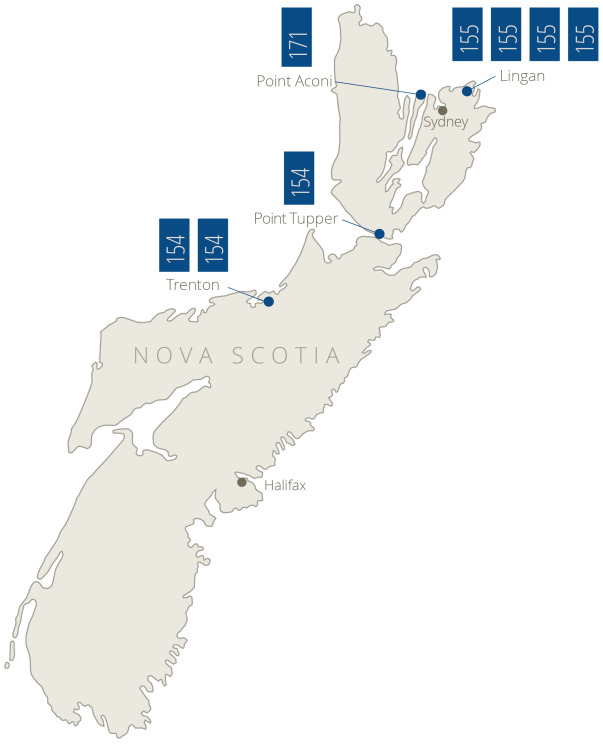


Figure 17. Capacity of coal-fired electricity generating units (MW) in Nova Scotia

Despite its long history with coal-fired electricity, Nova Scotia has begun to gradually move away from coal in recent years. After peaking at over 80% in 2001, coal power production decreased to 55.8% in 2018, as shown in Figure 18.[165]

[165] Canada Energy Regulator, "Canada's Renewable Power – Nova Scotia." https://www.cer-rec.gc.ca/en/data-analysis/energy-commodities/electricity/report/canadas-renewable-power/canadas-renewable-power/provinces/renewable-power-canada-nova-scotia.html

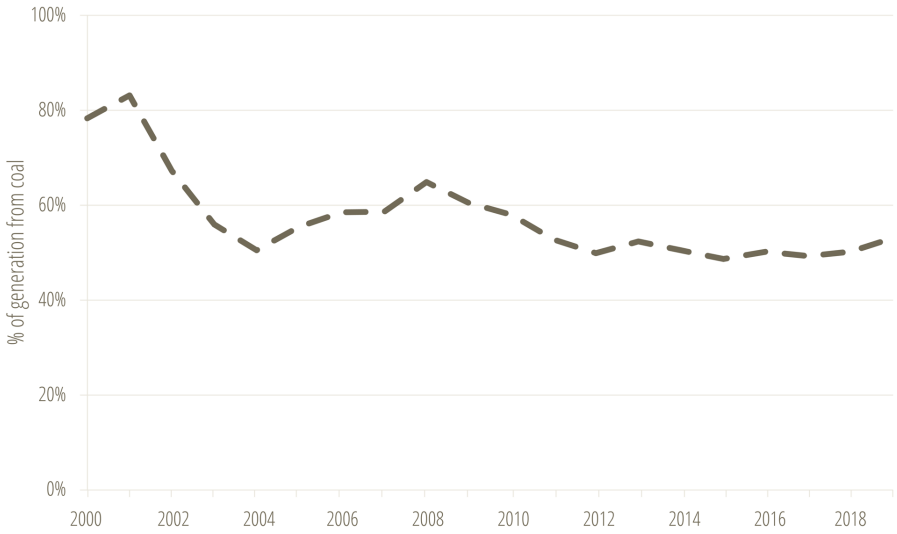


Figure 18. Electricity generation from coal in Nova Scotia, 2000-2019

However, despite Nova Scotia's modest movement away from coal, as of 2019 coal plants were still the province's four largest emitters. Figure 19 shows Nova Scotia's highest emitters in 2019, with the coal plants followed by Tufts Cove, a combination oil and natural gas plant. These four coal facilities combined emit 86.9% of electricity GHGs and 35.9% of all GHGs in Nova Scotia.[166] While coal power and electricity sector emissions fell between 2005 and 2012, they have remained stubbornly high since 2015.

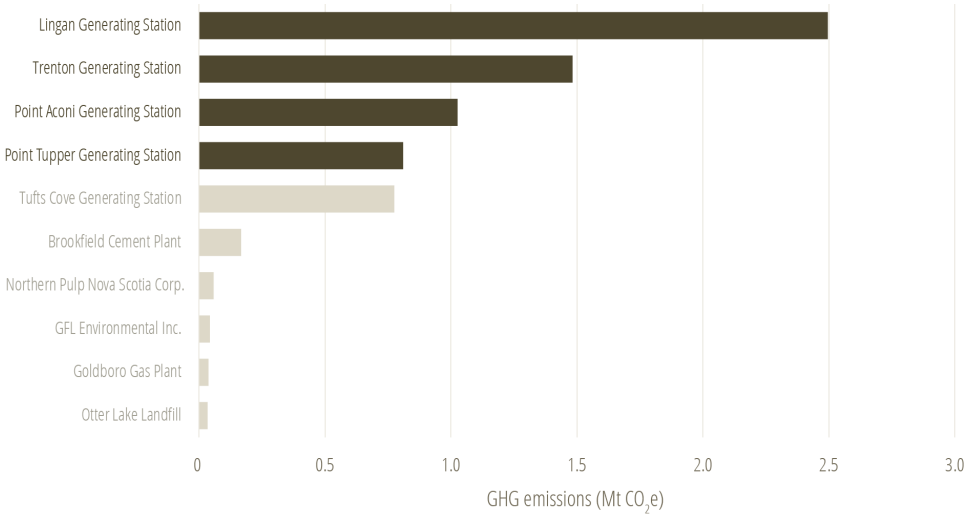


Figure 19. Top 10 GHG emitters in Nova Scotia, 2019

Data source: ECCC[167]

[166] *NIR 2021, Part 3*, 19, 63.

[167] "Greenhouse Gas Reporting (GHGRP) – Facility Greenhouse Gas (GHG) Data."

Coal is also a major contributor to Nova Scotia's air emissions. In 2019, coal was responsible for 64% of the province's mercury emissions, and nearly 95% of $SO_2$ emissions, as seen in Figure 20 and Figure 21, respectively. Phasing out coal would dramatically reduce the province's mercury pollution and would all but eliminate $SO_2$ pollution.

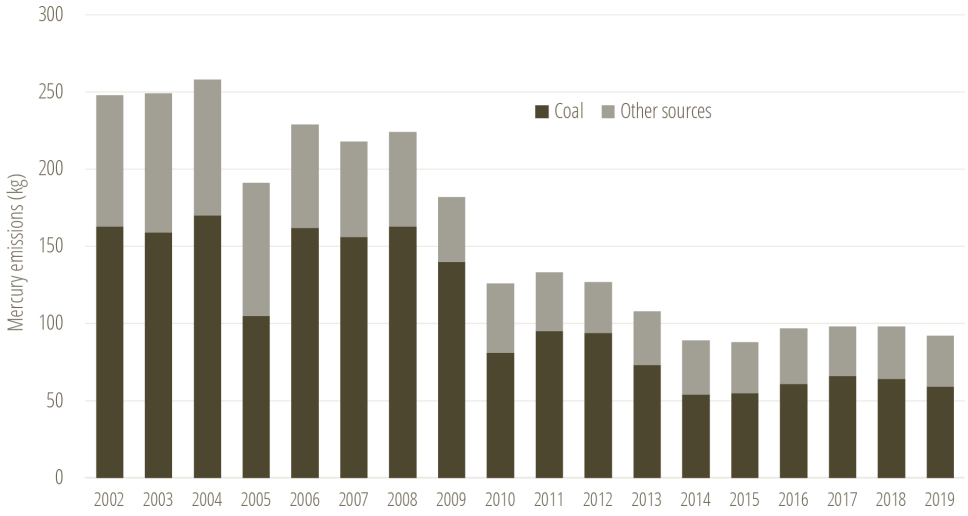


Figure 20. Mercury emissions from coal in Nova Scotia, 2002-2019

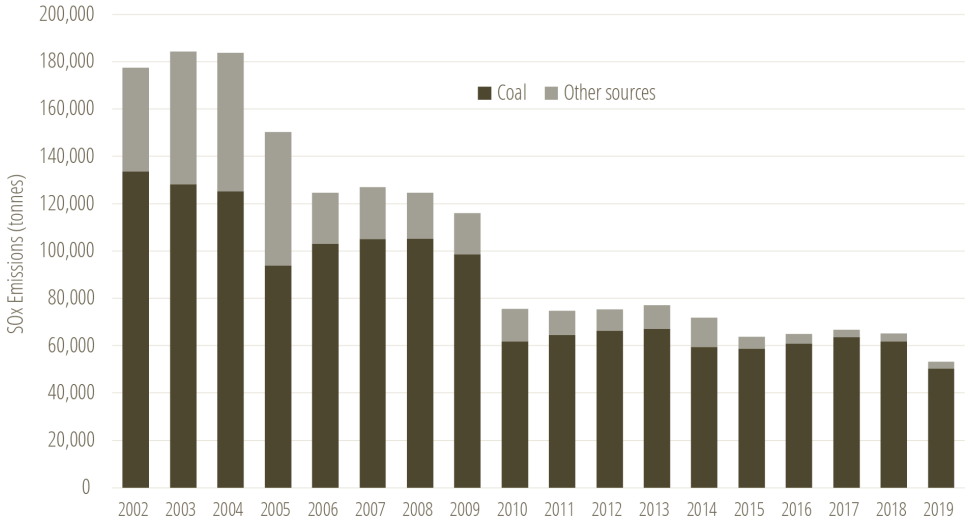


Figure 21. $SO_2$ emissions from coal in Nova Scotia, 2002-2019

Total $SO_x$ value is inclusive of $SO_2$ and all industries and sources. Coal emissions value is for $SO_2$.
Data source: ECCC[168]

[168] "National Pollutant Release Inventory"; "APEI_Tables_Canada_Provinces_Territories."

### 5.3.2 Current status: Plans for phasing out coal

In 2014, the federal government entered an equivalency agreement with Nova Scotia under the Canadian Environmental Protection Act (CEPA) to exempt the province from the 2012 coal-fired GHG regulations. In return, Nova Scotia committed to maintaining emissions from all electricity sources below the province's regulated hard cap on electricity sector emissions. Per Nova Scotia's Greenhouse Gas Emissions Regulations, total electricity sector emissions must remain below hard caps for particular years or cumulatively across sets of years, as shown in Table 6.

Table 6. Nova Scotia electricity sector GHG emission caps 2014-2030

| Period | Electricity sector GHG emissions cap (Mt $CO_2e$) |
|---|---|
| 2014-2016 | 26.32 |
| 2017-2019 | 24.06 |
| 2020 | 7.5 |
| 2021-2024 | 27.5 |
| 2025 | 6 |
| 2026-2029 | 21.5 |
| 2030 | 4.5 |

Data source: Government of Canada, Government of Nova Scotia[169]

The equivalency agreement gave greater discretion to decision-makers in Nova Scotia to continue to use unabated coal units beyond the 2012 regulations' end-of-life dates, so long as they operated their entire electricity system within the provincially regulated hard caps. According to the federal government's assessment (required for securing an equivalency agreement under CEPA), the cap was deemed equivalent in total GHG emissions to the scenario they modelled for their own 2012 coal-fired GHG regulations. Little information was provided to the public about how these scenarios were modelled and assessed against each other and, in particular, which emissions intensity the federal government assumed for the replacement generation in its 2012 regulations scenario.

[169] Government of Canada, "Canada-Nova Scotia equivalency agreement regarding greenhouse gas emissions from electricity producers, 2020." https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/agreements/equivalency/canada-nova-scotia-greenhouse-gas-electricity-producers-2020.html; *Greenhouse Gas Emissions Regulations*, S.N.S. 1994-95, c. 1, s. 4. https://www.canlii.org/en/ns/laws/regu/ns-reg-260-2009/latest/ns-reg-260-2009.html

Table 7 summarizes Nova Scotia's currently planned coal unit retirement schedules per the 2012 federal regulations and as outlined in NS Power's 2020 Integrated Resource Plan (IRP).[170]

Table 7. Retirement schedules of Nova Scotia coal plants

| Plant name | Unit | Capacity (MW) | Commis-sioning year | Retirement year (per 2012 Federal Regulations) | Retirement year (NS Power 2020 IRP) |
|---|---|---|---|---|---|
| Lingan | 1 | 155 | 1979 | 2029 | 2039 |
| | 2 | 155 | 1980 | 2029 | 2021 |
| | 3 | 155 | 1983 | 2029 | 2039 |
| | 4 | 155 | 1984 | 2029 | 2039 |
| Point Aconi | 1 | 171 | 1984 | 2029 | 2039 |
| Point Tupper | 1 | 154 | 1973 | 2019 | 2039 |
| Trenton | 5 | 150 | 1969 | 2019 | 2023 |
| | 6 | 155 | 1991 | 2041 | 2039 |

## Emissions scenarios

Figure 22 shows the effects of recent climate policy action on projected coal power GHG emissions in Nova Scotia.

[170] NS Power, *2020 Integrated Resource Plan*. https://irp.nspower.ca

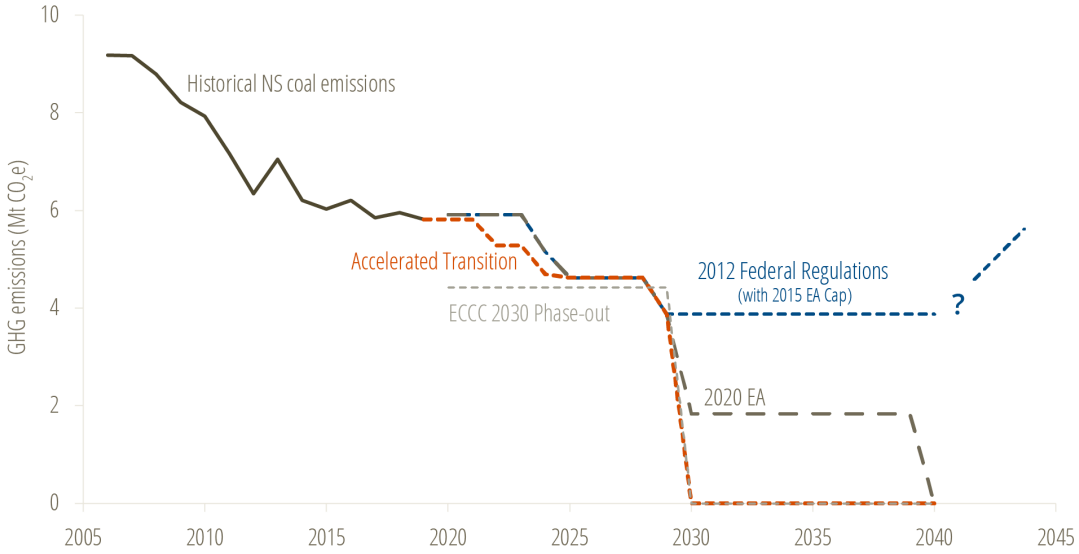


Figure 22. Nova Scotia emissions scenarios

Source: Pembina Institute modelling[171]

- The 2012 Federal Regulations scenario charts projected emissions under the provincial cap, as permitted under the 2014 equivalency agreement.[172] Because the equivalency agreement had no expiry, it exempted the application of the 2012 regulations indefinitely so that emissions could remain the same or even increase post-2030. Meanwhile, Nova Scotia's hard electricity sector emissions caps were only regulated out to 2030. The default under the agreement, without further regulatory action, would be to allow coal units to return to their full prior baseline operation after the 2030 cap.
- After the Government of Canada released its updated 2018 federal coal regulations adjusting end-of-life dates to no later than 2029, Nova Scotia and the federal government reached a renewed equivalency agreement in 2020, shown in the "2020 EA" line. Like the previous agreement, it suspended application of the federal regulations in Nova Scotia in consideration of the same electricity sector hard caps that the province already had in place. The renewed agreement also allows coal facilities to operate past the 2030 retirement deadline with no set retirement dates if equivalent emissions cuts are made elsewhere to remain below the sector-wide emissions limit. Unlike the 2014 agreement, however, the 2020 agreement is not indefinite: it expires in

[171] The data analysis and sources used for these scenarios is available in *From Coal to Clean: Emissions Model* at www.pembina.org.

[172] The analysis assumes that coal-fired electricity will resume the same proportion of emissions under the cap as its baseline proportion of electricity emissions in 2014.

> 2024 and can be renewed through 2029 but no further, meaning that without further action coal units would have to retire at the end of 2029. However, section 5.5 of the agreement commits the Government of Canada and Government of Nova Scotia to negotiate a new or amended equivalency agreement through 2040.[173]

To replace retiring coal units, Nova Scotia committed to sourcing non-emitting hydroelectricity imported from Muskrat Falls in Labrador via the Maritime Link, rather than using natural gas-fired generating units.[174] The federal government's equivalency assessment saw this as an "early action taken to decarbonize the electricity system in the pre-2030 period."[175] NS Power's 2020 IRP reference scenario does not phase out coal power until 2040, indicating that the utility expects another equivalency agreement will be reached before the current 2029 end date.

Rather than adopting a carbon tax, Nova Scotia instituted a cap-and-trade program to contribute to the province's plan to reduce GHG emissions to 45% to 50% below 2005 levels. The program sets annual limits on the total amount of GHG emissions allowed in the province from all emitting sectors, effective from 2019 through 2022. Companies receive allowances to cover set amounts of emissions, and they can trade allowances by buying or selling them. Because the cap declines each year, fewer allowances will be available, incentivizing companies to find ways to further reduce their emissions.[176]

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[173] While the federal government has not provided further information to foretell what requirements a post-2029 equivalency agreement would include, it is possible to glean some information from the precedents it has set for assessing the equivalency of provincial policies. The ECCC 2030 phase-out line takes the 7.9 Mt that the 2020 equivalency assessment determined Nova Scotia would reduce beyond the federal regulations scenario from 2015-2029 and allows Nova Scotia to use up those banked reductions over the subsequent decade, while accounting for the 550 t/GWh replacement generation that the federal government assumes in its model for its own ECCC regulatory scenario. From "Canada-Nova Scotia equivalency agreement regarding greenhouse gas emissions from electricity producers, 2020."

[174] Canada Energy Regulator, "Canada's Renewable Power – Nova Scotia." https://www.cer-rec.gc.ca/en/data-analysis/energy-commodities/electricity/report/canadas-renewable-power/canadas-renewable-power/provinces/renewable-power-canada-nova-scotia.html

[175] Government of Canada, *Quantitative analysis of equivalency determination of the renewed equivalency agreement for the Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations* (2019). https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/agreements/equivalency/canada-nova-scotia-greenhouse-gas-electricity-producers-2020/quantitative-analysis-equivalency-determination-final.html

[176] Nova Scotia Environment, *Nova Scotia's Cap and Trade Program: Regulatory Framework* (2019). https://climatechange.novascotia.ca/sites/default/files/Nova-Scotia-Cap-and-Trade-Regulatory-Framework.pdf

However, this market-based program is subject to forces of supply and demand for emissions allowances. There have been two emissions allowance auctions since the program began. While the June 2021 settlement price of $36.71[177] is higher than the June 2020 settlement price of $24.00, it remains below the $40 benchmark compliance price established by the federal Greenhouse Gas Pollution Pricing Act's output-based pricing system.[178] The efficacy of this system will continue to depend on the government's ability to incentivize capping emissions through higher prices, especially as the federal government raises its carbon price to $170/t by 2030.[179]

At the provincial level, Nova Scotia is moving toward accelerating its transition off coal. In the March 2021 Throne Speech, the Government of Nova Scotia committed to phasing out coal by 2030, as well as becoming Canada's first province to achieve carbon neutrality.[180] Because the platform of Nova Scotia's newly elected government echoes the previously committed 2030 coal phase-out date,[181] it is reasonable to conclude that existing coal policy will continue. However, the Reference Scenario in NS Power's 2020 IRP still models coal phase-out at the end of 2039, and only two of the seven remaining coal units are scheduled for retirement prior to 2030. Now, the province needs to implement these stated commitments by instituting binding legislation that will hold the province and NS Power to achieving these goals.

### 5.3.3 Looking forward: What Nova Scotia can achieve

Nova Scotia's emissions have decreased since 2005, but due to the equivalency agreements granted for the 2012 and 2018 federal regulations, these reductions have come more slowly than they could have. Without an equivalency agreement on the 2018 federal regulations, based on 2014 baseline emissions levels and unit end-of-life

[177] Government of Nova Scotia, *Nova Scotia Cap-and-Trade Program Auction of Emission Allowances: Summary Results Report,* (June 2021). https://climatechange.novascotia.ca/sites/default/files/June_2021_Auction_Summary_Results_Report.pdf

[178] Government of Nova Scotia, *Nova Scotia Cap-and-Trade Program Auction of Emission Allowances: Summary Results Report* (June 2020). https://climatechange.novascotia.ca/sites/default/files/Cap-and-Trade_Regulations_Summary_Results_Report.pdf

[179] Environment and Climate Change Canada, *A Healthy Environment and a Healthy Economy* (2020), 27. https://www.canada.ca/content/dam/eccc/documents/pdf/climate-change/climate-plan/healthy_environment_healthy_economy_plan.pdf

[180] Arthur J. LeBlanc, "Speech from the Throne: Third Session of the 63rd General Assembly of the Nova Scotia Legislature," speech, March, 9, 2021. https://novascotia.ca/news/release/?id=20210309007

[181] PC Nova Scotia, *Solutions for Nova Scotians* (2021). Available at https://d3n8a8pro7vhmx.cloudfront.net/nspcparty/pages/1945/attachments/original/1628774094/SOLUTIONS_FOR_NOVA_SCOTIANS_-_Full_length_platform-20.pdf?1628774094

retirements starting in 2019, Nova Scotia would have reduced $CO_2$ emissions from coal to around 4.4 Mt starting in 2020. However, under the equivalency agreement, assuming coal maintains its proportion of electricity sector emissions, coal-fired power may continue to produce close to 6 Mt of emissions annually from 2020 through 2023, equating to more than an extra year's worth of coal emissions over that time.

## Accelerated coal phase-out

The Accelerated Transition scenario result in Figure 23 reflects Nova Scotia's opportunity to reduce cumulative coal emissions in the near term by retiring Lingan Unit 1 in 2021 and Trenton Unit 5 in 2023 as suggested in the NS Power IRP, while following through on eliminating coal power by 2030. Had Nova Scotia stuck with the original 2018 federal regulations rather than negotiating an equivalency agreement, the province would have realized an even greater reduction, with coal emissions 50 Mt lower than the 2012 federal regulations required.

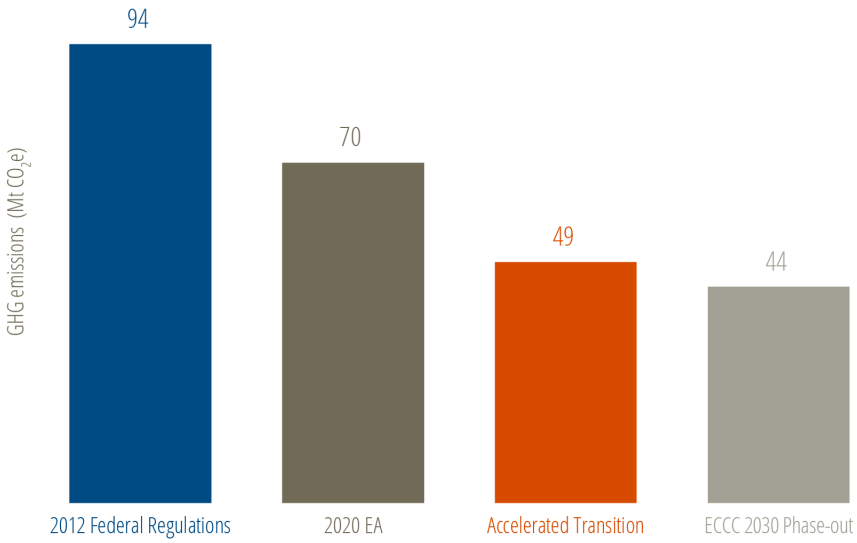


Figure 23. Cumulative coal emissions under Nova Scotia emissions scenarios, 2020-2040

## Greater renewable energy deployment

Renewable energy generation in Nova Scotia is growing, led primarily by wind, which generated 13% of Nova Scotia's total electricity in 2018. Renewable energy provided 26.1% of Nova Scotia's power generation in 2018, up from 14.8% in 2010, and the province has the potential to continue on the path toward a low-carbon electricity

system.[182] The province recently committed to a new renewable energy standard, with 80% of Nova Scotia's energy coming from renewable sources by 2030.[183] This program was followed by an announcement in July 2021 to issue a request for proposals to attract low-cost and innovative solutions to supply 350 MW of renewable energy, accounting for 10% of the province's electricity generation. Once operational, these plans are projected to reduce Nova Scotia's GHG emissions by more than one million tonnes annually.[184]

Additionally, Nova Scotia benefits from major transmission interties such as the Maritime Link, which supplies the province with hydropower from the Muskrat Falls Generating Project. The key to ensuring timely decarbonization of the electricity sector and avoiding unnecessarily prolonged use of highly polluting coal power, however, is to ensure that these non-emitting generation options are pursued in time to avoid coal use beyond 2030.

### More effective carbon pricing

The province's cap-and-trade program is an innovative strategy for achieving decarbonization outcomes across all emitting sectors — if the market price on carbon remains high enough and the emissions cap low enough to encourage continued emissions reductions. After the first implementation period ends in 2022, overall program effectiveness should be analyzed to determine if the program achieved deeper decarbonization than the federal price on carbon, and if so, to what extent. Based on that outcome, the program should either be extended through 2030 or an alternate program should be implemented if it is more effective.

## 5.4 New Brunswick

Although New Brunswick has only one operating coal power plant, the Belledune Generating Station is a major contributor to the province's overall emissions. The province has consistently relied on Belledune to provide approximately one-fifth of its electricity since the beginning of this century, with no signs of reducing this

[182] Government of Nova Scotia, "Jobs Created in Rural Nova Scotia with Largest Electricity Procurement of Renewable Energy Projects," media release, July 10, 2021. https://novascotia.ca/news/release/?id=20210710001

[183] Government of Nova Scotia, "Province Invests in Climate Change Action, Supports Jobs and Commits to Renewable Future," media release, February 24, 2021. https://novascotia.ca/news/release/?id=20210224001.

[184] "Jobs Created in Rural Nova Scotia with Largest Electricity Procurement of Renewable Energy Projects,"

dependence. New Brunswick has presented no concrete plans to phase out coal power to meet the federal 2030 deadline and has proposed an equivalency agreement that would extend Belledune's life to 2040 or beyond. In the absence of action to decarbonize its electricity system by eliminating coal power, New Brunswick risks becoming an outlier as the nation's only coal-burning province after 2030.

### 5.4.1 Looking back: Reliance on coal for electricity

Large-scale coal mining in New Brunswick began after the completion of the railroad in 1904 to the centrally located village of Minto.[185] The Minto Coal Mines supplied coal to Grand Lake Generating Station from its commissioning in 1931 until its closure in 2010.[186] Today, Belledune Generating Station, the province's sole remaining coal-fired plant, is powered by coal imported from Colombia, as well as petroleum coke from the United States.[187] New Brunswick Power Corporation (NB Power), the province's vertically integrated crown corporation utility, owns and operates Belledune, which sits adjacent to the Port of Belledune on New Brunswick's northern coast, less than 40 km northwest of Bathurst.

[185] New Brunswick Museum, "Minto Coal Mines." https://magnificentrocks-rochesmagnifique.ca/the_periods-les_periodes/upper_carboniferous-carbonifere_superieur/community_connections-connexions_communautaires/minto_coal_mines-minto_mines_de_charbon-eng/

[186] CBC News, "Grand Lake station closed 3 months early," *CBC News*, March 10, 2010. https://www.cbc.ca/news/canada/new-brunswick/grand-lake-station-closed-3-months-early-1.944700

[187] Jacques Poitras, "Countdown to obsolescence: A look inside the Belledune coal-fired plant," CBC News, August 20, 2018. https://www.cbc.ca/news/canada/new-brunswick/future-belledune-power-plant-1.4789524


Figure 24. Capacity of coal-fired electricity generating units (MW) in New Brunswick

The Belledune Generating Station has an operating capacity of 450 MW. The facility produced 19% of New Brunswick's power in 2018.[188] Commissioned in 1993, the plant is scheduled for retirement in 2040 or later, under a pending equivalency agreement with the Government of New Brunswick.[189]

[188] Canada Energy Regulator, "Canada's Renewable Power – New Brunswick." https://www.cer-rec.gc.ca/en/data-analysis/energy-commodities/electricity/report/canadas-renewable-power/canadas-renewable-power/provinces/renewable-power-canada-new-brunswick.html

[189] Government of New Brunswick, *Phasing Out of Coal-fired Electricity Generation Regulation – Climate Change Act,* draft regulations, July 12, 2021. https://www2.gnb.ca/content/dam/gnb/Departments/eco-bce/pdf/pr/2021/06/21-083E.pdf

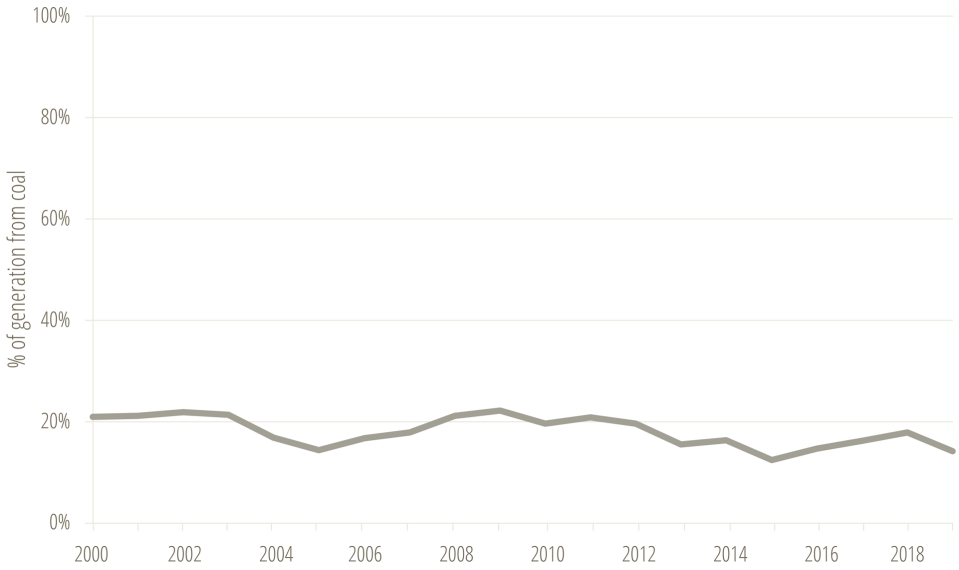


Figure 25. Electricity generation from coal in New Brunswick, 2000-2019

Although Belledune is just one facility, it accounts for close to half of the emissions contributions from the province's five largest emitters, as seen in Figure 26. Coal's share of mercury and $SO_2$ emissions has declined slowly over time, but it still contributed 21% of the province's mercury emissions and 34% of $SO_2$ emissions in 2019.[190] Considering the province's additional mercury, $SO_2$, and $NO_x$ emissions from heavy industry, phasing out coal power is a key part of reducing New Brunswick's overall air emissions.

[190] "National Pollutant Release Inventory"; "APEI_Tables_Canada_Provinces_Territories."

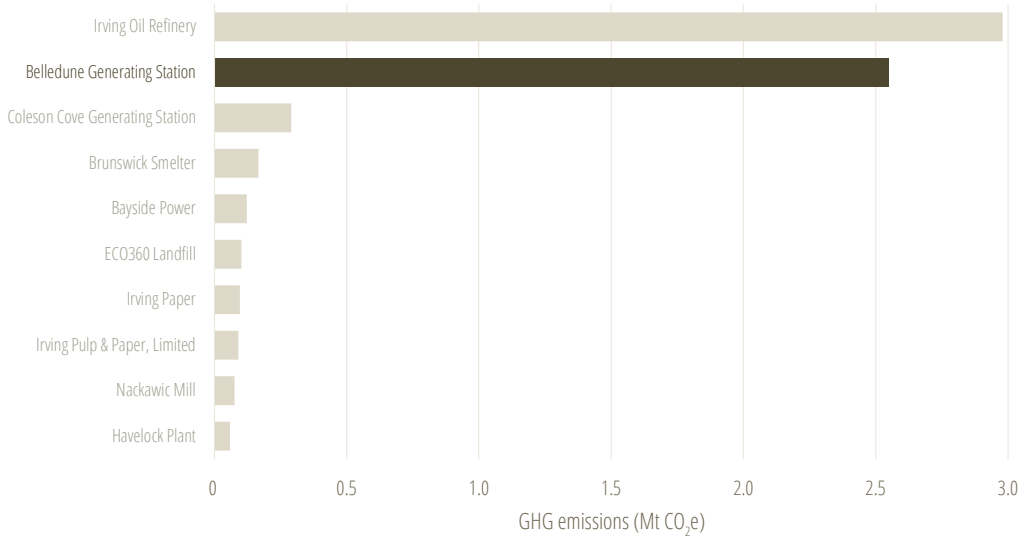


Figure 26. Top 10 GHG emitters in New Brunswick, 2019

Data source: ECCC[191]

## 5.4.2 Current status: Plans for phasing out coal

New Brunswick's coal generation has remained stable since 2012. Under Canada's 2012 federal coal regulations, Belledune Generating Station could continue operating until it reached its "useful end-of-life" in 2043. When the 2018 federal coal regulations moved unabated coal retirement dates to the end of 2029, the New Brunswick government began pursuing an equivalency agreement. The province has drafted proposed regulations — which have yet to be accepted and are not yet in force — to cap electricity sector emissions between 2020 and 2040, similar to Nova Scotia's sector-wide cap approach. According to officials, this equivalency agreement would provide the provincial government enough time to put in place alternative electricity generation options, such as small nuclear reactors.[192] Table 8 outlines the emissions caps proposed in the equivalency agreement.

[191] "Greenhouse Gas Reporting (GHGRP) – Facility Greenhouse Gas (GHG) Data."

[192] Jacques Poitras, "New Brunswick can't meet 2030 deadline for coal phaseout, minister says," July 21, 2021. https://www.cbc.ca/news/canada/new-brunswick/nb-power-electricity-coal-climate-change-1.6111369

Table 8. Proposed New Brunswick electricity sector GHG emissions caps 2020-2040

| Period | Proposed electricity sector GHG emissions cap ($Mt CO_2e$) |
|---|---|
| 2020 | 2.0 |
| 2021-2025 | 14.5 |
| 2026-2030 | 14.0 |
| 2031-2035 | 12.0 |
| 2036-2040 | 11.5 |

The proposed electricity sector regulation cap would allow, on average, 2.8 Mt of electricity sector emissions in the 2026 to 2030 period and 2.4 Mt in the 2031 to 2035 period,[193] or 22 to 26% of the province-wide 2030 emissions limit, essentially equal to its proportion in 2018. The provincial government claims the cap and its equivalency agreement will achieve equivalent or better greenhouse gas reductions than if they were to shut down Belledune in 2030.[194]

As outlined in Table 8, although it has not yet been entered into law, New Brunswick's draft equivalency agreement has set a 2020 electricity sector emissions limit of 2 Mt.[195] This raises the question of whether the province is looking to bank an aberrant year where no sector cap was in place, but emissions were unusually low due to the low electricity demand common around the world during the pandemic. Using this discrepancy as a credit to bank against prolonged coal power operations in later years would only exacerbate the problem of equivalency agreements permitting more coal-fired emissions.

[193] *Phasing Out of Coal-fired Electricity Generation Regulation* (Draft).

[194] Government of New Brunswick, "Province pursuing an equivalency agreement for greenhouse gas emissions," media release, June 16, 2021. https://www2.gnb.ca/content/gnb/en/news/news_release.2021.06.0467.html

[195] Government of New Brunswick, "Phasing Out of Coal-fired Electricity Generation Regulation – Climate Change Act," draft regulations, July 12, 2021. https://www2.gnb.ca/content/dam/gnb/Departments/eco-bce/pdf/pr/2021/06/21-083E.pdf

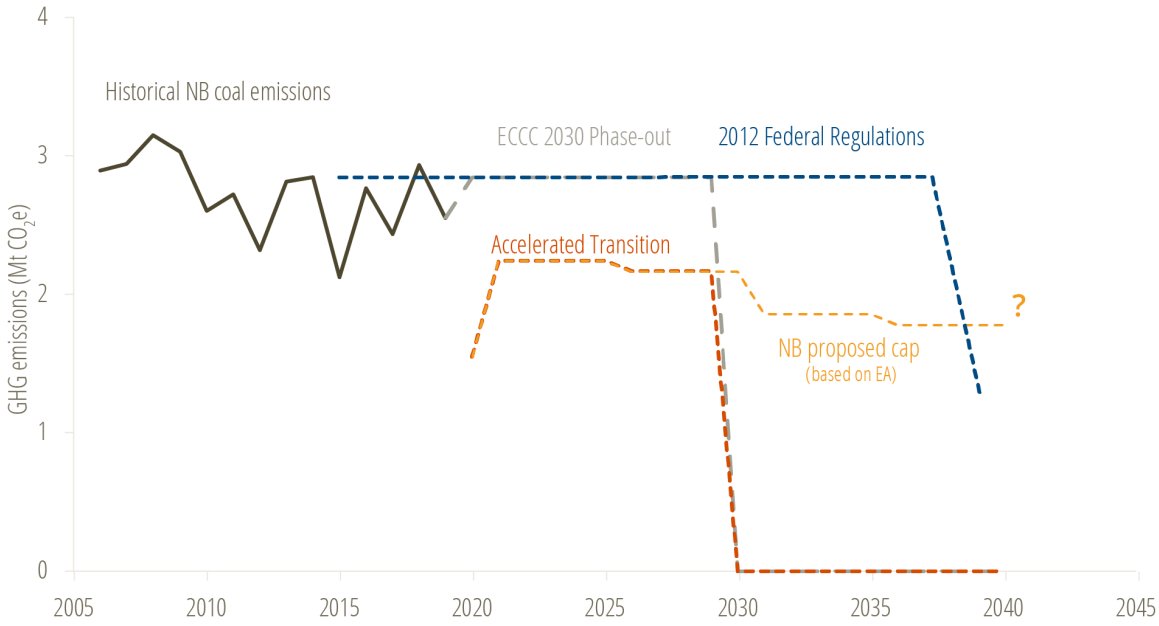


Figure 27. New Brunswick emissions scenarios

Source: Pembina Institute modelling[196]

Figure 27 shows emissions projections for New Brunswick based on current plans along with the possibilities for future reductions if the province implements decarbonization actions.

- The "NB proposed cap (based on EA)" scenario models a 2040 retirement date for Belledune under New Brunswick's proposed equivalency agreement, though the province and NB Power have not been clear about how long they intend to burn coal for electricity at Belledune. Since 2015, the federal government has only offered equivalency agreements that exempt provinces from the regulations until the end of 2029, although they did commit to entering further negotiations with Nova Scotia for the period beginning in 2030 and later (as noted in Section 5.3.2).
- Electricity emissions in New Brunswick under the cap decrease relatively slowly over time, and the current emissions cap still allows an average 2.3 Mt per year (more than 70% of 2018 levels), well into the 2030s. This is incompatible with the need to phase out coal-fired generation from developed countries to meet the requirements of the Paris Agreement. Operating under an equivalency

[196] The data analysis and sources used for these scenarios is available in *From Coal to Clean: Emissions Model* at www.pembina.org.

agreement, New Brunswick would be Canada's last remaining coal-power jurisdiction. This scenario would also affect air pollution and unnecessarily draw down the global climate budget. Given that the federal government highlights these benefits in public statements about the 2030 phase-out and the Powering Past Coal Alliance, and even in the RIAS of their regulations, Canada would have to factor these into any equivalency assessment.

### 5.4.3 Looking forward: What New Brunswick can achieve

#### Accelerated coal phase-out

On its current trajectory, New Brunswick is achieving emissions of just 20% less than the 2012 federal regulations would have allowed, as shown in Figure 28. Under the proposed equivalency agreement, New Brunswick would cut emissions by 40% compared with the 2012 federal regulations, though this projection is uncertain based on the current draft equivalency agreement and potential extensions. If the province followed the 2018 federal regulations' 2030 phase-out deadline, it could achieve cumulative emissions cuts more than 60% greater than called for in the 2012 federal regulations.

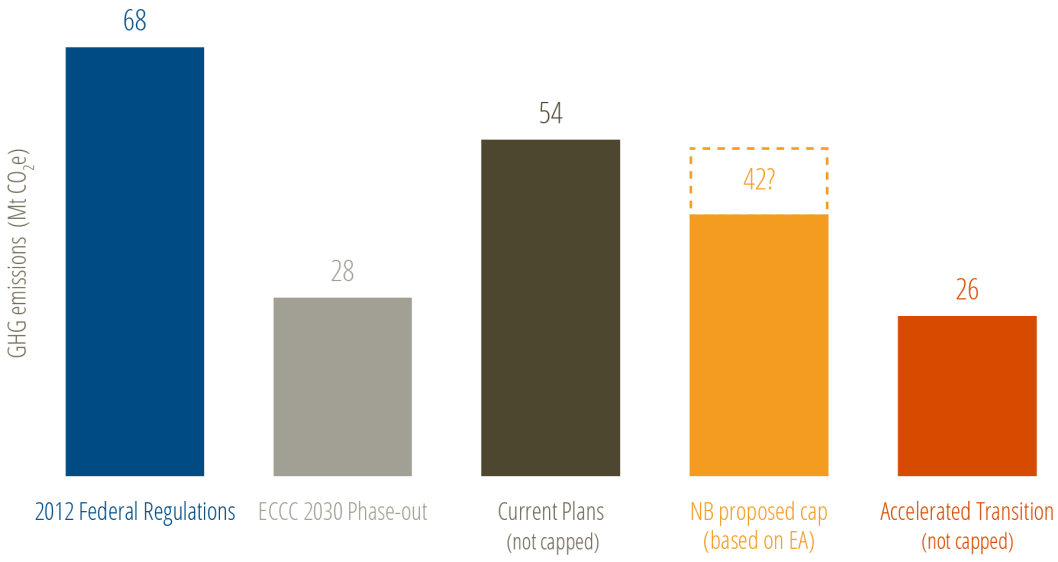


Figure 28. Cumulative coal emissions under New Brunswick emissions scenarios, 2020-2045

## Greater renewable energy deployment

While NB Power owns few renewable energy assets, it currently manages 409 MW of renewable power purchase agreements.[197] The province and the utility could benefit further from tapping into New Brunswick's wind resource potential, which is particularly strong for offshore wind,[198] as well as its favourable solar energy potential, especially in the southern part of the province. The province has a goal of 75% generation from renewable energy by 2040.[199] New Brunswick also hosts one of the most interconnected electricity systems in Canada, with electricity interties to Quebec, Nova Scotia, Prince Edward Island, and the northeastern United States.[200] The province can leverage these connections to help cost-effectively integrate new, home-grown renewable energy in New Brunswick, to achieve greater decarbonization and set more ambitious targets for 2030 and 2050.

## More effective carbon pricing

Although the made-in-New Brunswick carbon tax was accepted by the federal government, in 2020 the federal Minister of Environment and Climate Change described the province's carbon pricing plan as "significantly weaker" than the federal system and stressed that benchmark stringency criteria must be strengthened "in order to continue to provide a meaningful price signal to industry and to spur innovation and clean growth."[201]

Other jurisdictions, particularly Alberta, are demonstrating that pricing all electricity sources equivalently and pricing carbon to the same standard drives economic decisions that lead to reduced coal power use and early phase-out. Designing the provincial carbon pricing system to develop a clear pricing signal that will result in the same or

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[197] New Brunswick Power Corporation, *2020 Integrated Resource Plan*, 37. https://www.nbpower.com/media/1490323/2020-irp-en-2020-11-17.pdf

[198] Government of Canada, "Renewable resource assessment: wind energy." https://www.nrcan.gc.ca/energy/offices-labs/canmet/ottawa-research-centre/renewable-energy/renewable-resource-assessment-wind-energy/23556

[199] *2020 Integrated Resource Plan*, 16.

[200] Keith Cronkite, "Submission to the Standing Committee on Natural Resources: Strategic Electricity Inter-ties," *Énergie NB Power*, September 25, 2017. https://www.ourcommons.ca/Content/Committee/421/RNNR/Brief/BR9126267/br-external/NewBrunswickPower-e.pdf

[201] Jacques Poitras, "Federal approval of New Brunswick carbon tax for heavy emitters comes with warning," *CBC News*, September 21, 2020. https://www.cbc.ca/news/canada/new-brunswick/new-brunswick-federal-approval-carbon-tax-warning-1.5732314

greater emissions reductions than federal regulations require would maximize New Brunswick's contribution to Canada's decarbonization efforts.

## 5.5 Summary of provincial opportunities for phasing out coal

While Alberta has long carried the flickering torch for coal power in Canada, that positioning is changing very quickly. Alberta has had far and away the most coal capacity, generation, and emissions since Ontario began its phase-out in the early 2000s. Alberta has also relied more on coal for its electricity generation than any other province for decades, rivaled only by Nova Scotia in rare years around the turn of the millennium. In any conversation around the harms of coal power and the need to transition away from it over the last two decades, Alberta has taken centre stage.

And as demonstrated in Figure 29, Alberta's reliance on coal has declined very quickly since 2015, coming under Nova Scotia's proportional reliance in 2019 and rivalling Saskatchewan's. En route to its complete phase-out by the end of 2023, Alberta's trend away from coal will only accelerate. Since 2019, seven units have retired or converted to gas and six more will transition by the end of this year (2021), leaving only three operating units in 2022 and 2023. By that time, Alberta will likely be less reliant on coal than the other three provinces.

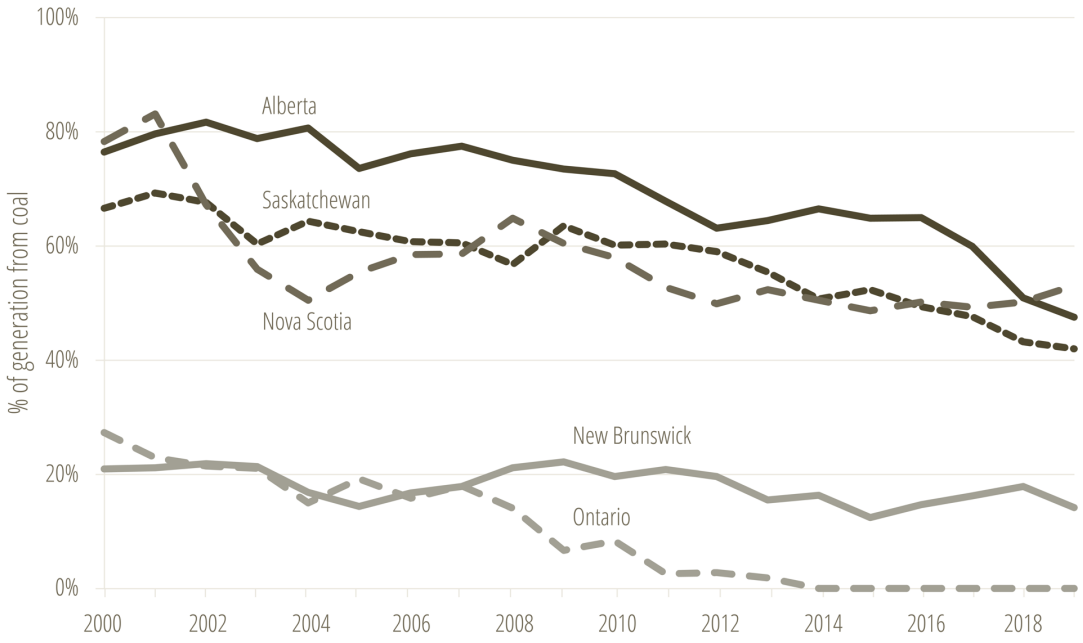


Figure 29. Coal electricity generation percentages by province

Table 9 provides an overview of the current status in each province, showing that Alberta still had the greatest coal capacity in 2019. With recent retirements and conversions, and conversions scheduled by the end of this year, Alberta will be left with 1,266 MW of coal capacity for 2022 and 2023, effectively tied with Saskatchewan and a little higher than Nova Scotia for unabated coal capacity.

This is due, in large measure, to the accelerated transition away from coal compelled by the sector-wide electricity carbon pricing benchmark, as described in Section 4. Given the impact of this carbon pricing not only on accelerating retirement, but also reducing utilization at still-operating coal plants, Alberta ranks lower than Saskatchewan and Nova Scotia in absolute coal GHG emissions in 2022. Alberta's coal-fired GHG emissions already fell close to 40% between 2014 and 2019, nearly quadrupling the proportional decline in any other province.

Table 9. Summary of provinces' policy outcomes and measures

| | Alberta | Saskatchewan | Nova Scotia | New Brunswick |
|---|---|---|---|---|
| Policy outcomes | | | | |
| Unabated coal capacity 2019 (MW) | 3,476 | 1,410 | 1,252 | 450[202] |
| Coal capacity expected 2022 (MW) | 1,266 | 1,271 | 1,097 | 450 |
| Gross generation 2019 (GWh) | 27,908[203] | 11,078[204] | 5,888[205] | 1,823[206] |
| Generation from coal 2019[207] | 48% | 42% | 53% | 14% |

[202] NB Power, "Thermal Tour." https://www.nbpower.com/en/about-us/learning/learn-about-electricity/thermal/thermal-tour/

[203] Government of Alberta, "Annual Reports of Generators 2006 to 2020," spreadsheet, 2020. https://www.environment.alberta.ca/apps/etr/Documents.aspx

[204] Kayla Klassen, SaskPower, personal communication, July 9, 2021.

[205] Nova Scotia Utility and Review Board, *FAM Annual Report*, (2019). https://uarb.novascotia.ca/fmi/webd/UARB15

[206] Statistics Canada, "Electricity from fuels, annual generation by electric utility thermal plants," spreadsheet, November 3, 2020. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2510001901

[207] *NIR 2021, Part 3*, 60-73.

| | Alberta | Saskatchewan | Nova Scotia | New Brunswick |
|---|---|---|---|---|
| Generation from coal 2014[208] | 67% | 51% | 50% | 16% |
| Generation from coal 2005[209] | 74% | 63% | 55% | 14% |
| Coal GHG emissions 2019 (Mt $CO_2e$)[210] | 24.9 | 11.4 | 4.87 | 2.55 |
| Coal GHG emissions 2014 (Mt $CO_2e$)[211] | 41.4 | 12.6 | 4.85 | 2.847 |
| Change 2014 to 2019 | -39.86% | -9.52% | 0.41% | -10.43% |
| Policy measures | | | | |
| End of unabated coal under current law | 2029 | 2029 | >2029 | 2029 |
| Announced or proposed end of unabated coal | 2023 | 2029 | 2029 | >2039 |
| Key measures impacting pace of transition from coal | Sector-wide industrial OBPS benchmark[212] | Federal fuel-specific OBPS benchmark<br>Operational decisions minimizing coal use | Cap-and-trade emissions program<br>Renewable energy programs and Maritime Link | Provincial fuel-specific OBPS benchmark (weaker than federal) |
| Generation carbon costs 2014 ($/MWh) [213] | Coal: $1.80<br>Gas: $0.67<br>Diff: $1.13 | Coal: $0<br>Gas: $0<br>Diff: $0 | N/A | Coal: $0<br>Gas: $0<br>Diff: $0 |

[208] *NIR 2021, Part 3*, 60-73.

[209] *NIR 2021, Part 3*, 60-73.

[210] *NIR 2021, Part 3*, 69, 68, 63, 64.

[211] *NIR 2021, Part 3*, 69, 68, 63, 64.

[212] *Carbon Competitiveness Incentive Regulation*, followed by *Technology Innovation & Emissions Reduction Regulation*

[213] Costs are illustrative, based on a typical subcritical coal facility with 1.00 t/MWh emissions intensity, and a typical combined cycle natural gas plant with 0.37 t/MWh emissions intensity.

| | Alberta | Saskatchewan | Nova Scotia | New Brunswick |
|---|---|---|---|---|
| Generation carbon costs 2019 ($/MWh) | Coal: $18.90<br>Gas: $ 0<br>Diff: $18.90 | Coal: $4.00<br>Gas: $0<br>Diff: $4.00 | N/A | Coal: $3.60<br>Gas: $ 0<br>Diff: $3.60 |
| Generation carbon costs 2021 ($/MWh) | Coal: $25.20<br>Gas: $ 0<br>Diff: $25.20 | Coal: $15.12<br>Gas: $ 0<br>Diff: $15.12 | N/A | Coal: $7.92<br>Gas: $0<br>Diff: $7.92 |
| Policy potential for further coal GHG reductions | | Accelerated retirement of unabated units<br>Sector-wide carbon pricing (stop subsidizing coal) | IRP for the 2030 phase-out<br>Reduce cap-and-trade cap in line with federal $/t | 2030 phase out<br>Sector-wide carbon pricing (stop subsidizing coal) |
| Promising technology options for replacing coal | Short term: Fuel-switching to gas<br>Medium term: Renewable energy + storage + gas w/ CCUS | Short term: Fuel-switching to gas<br>Medium term: Renewable energy + storage + gas w/ CCUS | Renewable energy + Maritime Link + storage | Renewable energy + storage + interconnection |
| Renewable energy goal | 30% by 2030 in legislation — unclear whether this remains gov't policy | 50% capacity by 2030 | 80% capacity by 2030 | 75% by 2040 |
| Net-zero by 2050 goal | No[214] | Yes | Yes | No |

The difference in the cost of carbon pricing on coal power relative to lower-emitting gas generation is also shown in Table 9. Relative to a high-efficiency gas plant, a typical subcritical coal unit incurred as much as $18.90/MWh of additional carbon pricing costs in Alberta in 2019, whereas this number was only $4.00/MWh in Saskatchewan and $3.60/MWh in New Brunswick. The cost on coal will increase in all provinces (including Alberta) in coming years, but under current policies, the three provinces with coal projected to continue beyond 2023 will only close the pricing gap with Alberta in 2030. This is the single largest policy determinant driving Alberta to phase out coal far ahead of the other three provinces.

[214] Janet French, "Abandoning oil and gas a utopian impossibility, Alberta's premier says," *CBC*, August 9, 2021. https://www.cbc.ca/news/canada/edmonton/abandoning-oil-and-gas-a-utopian-impossibility-alberta-s-premier-says-1.6135512

Saskatchewan and Nova Scotia are both playing catch-up. Saskatchewan has a gradual, staged unit retirement schedule out to the end of 2029, though it is still backloaded, with over half (858 MW, or 60.8%) of its current unabated coal capacity still operating in 2029, right up to the 2030 phase-out deadline. The transition could be accelerated with earlier retirements that achieve the phase-out gradually year-over-year. However, Saskatchewan has adopted operating practices to use coal capacity less, which will also continue to reduce emissions in coming years. Nova Scotia, meanwhile, has reversed its previously stated need to continue coal power beyond 2029, ushering forward its final phase-out date.

New Brunswick is taking the opposite course to Nova Scotia, pursuing equivalency to enable it to continue operating coal power beyond 2029. While New Brunswick has been the smallest coal power user in Canada among the five coal-burning provinces, this change would definitively shine the spotlight on the province as the laggard in the transition away from coal. It would concretely undermine the clear commitment Canada has made to the world to phase out coal by 2030.

By contrast, if the federal government guards against this transition slippage and if Saskatchewan grasps opportunities to transition sooner, Canada's coal emissions could decline much more quickly than expected at the start of 2015, as shown in Figure 30.

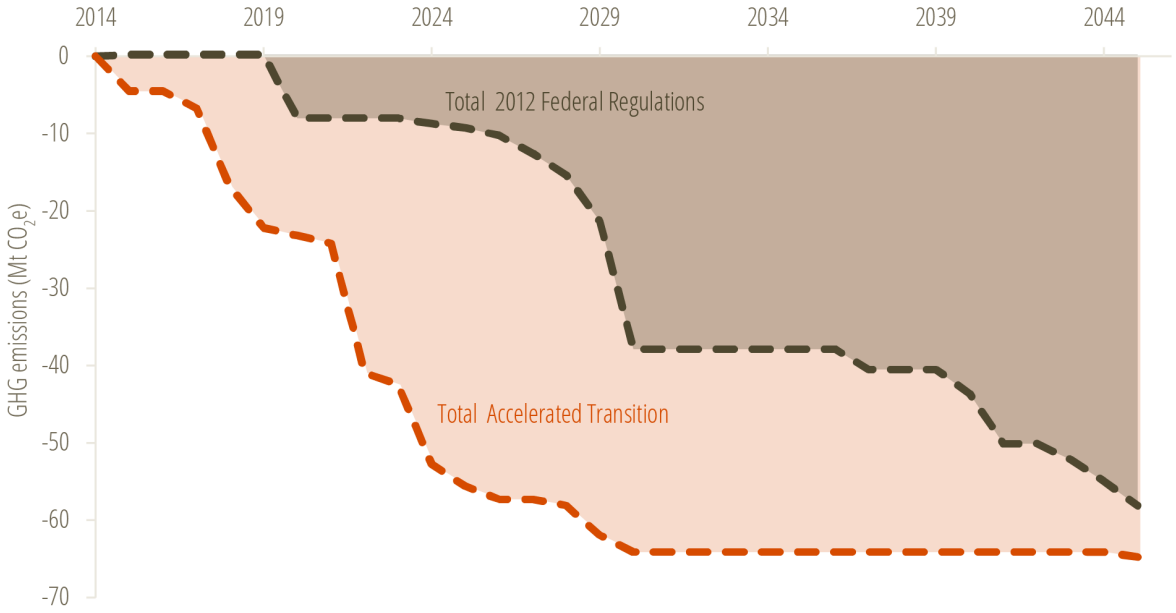


Figure 30. Annual coal emissions reductions under 2012 Federal Regulations and Accelerated Transition scenarios

# 6. Toward a net-zero grid

As the remaining unabated coal capacity is retired across the country over the next decade, the investments made in replacement capacity will result in facilities and infrastructure that will last for decades to come. Canada has committed to a net-zero economy by 2050, and 30 years is a short deadline for new electricity infrastructure. Emitting generation built today that is not net-zero-ready is not compatible with that long-range goal.

Moreover, this 2050 commitment will require electrification in different sectors of the economy, meaning considerable growth in electricity consumption and greater need for a non-emitting power supply well before 2050. These realities underlie the International Energy Agency's determination that developed countries must have a net-zero grid by 2035 matching the U.S. target reviewed in section 2. Phasing out coal is only half the battle — substantial progress can be lost if equal attention is not paid to the immediate decisions around new investment in replacing coal while also growing the power supply.

The ambitions for grid decarbonization have only intensified in recent years and show no sign of slowing down. Given this global trend, jurisdictions that fail to move toward a net-zero grid by 2035 will fall behind in investment and job creation. Companies that are now subject to financial sector scrutiny of climate risk and carbon pricing liability are now factoring grid emissions into siting decisions. Grid decarbonization is quickly becoming a key determinant of global competitiveness.

## 6.1 Emissions from replacement generation

A global effort is underway to cease unabated coal combustion for electricity on the grounds that it is an easily replaceable, highly polluting, uniquely emitting generation source that unnecessarily squanders the little carbon budget we have remaining to balance a safe climate.

But to achieve the grid decarbonization necessary to support a net-zero economy by mid-century, replacement generation cannot be ignored. Figure 31 shows the cumulative reduction in coal GHG emissions in Canada from 2015 to 2030 relative to a 2014 baseline. The left panel shows the modelled 2012 Federal Regulations scenario that reflected business as usual at the start of 2015. The right panel shows the

"Accelerated Transition" opportunities identified in each of the four remaining coal-burning provinces, informed by the monumental progress achieved through additional action since 2015.

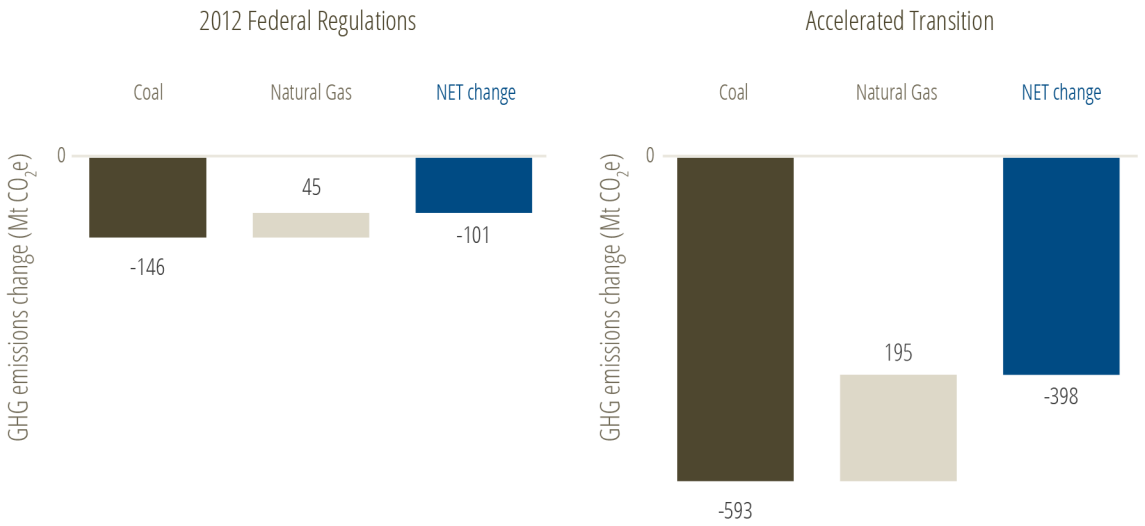


Figure 31. Cumulative emissions changes 2015 to 2030 under 2012 Federal Regulations and Accelerated Transition scenarios and impact of increased natural gas generation[215]

The Accelerated Transition scenarios together would cumulatively reduce coal GHG emissions by 593 Mt by 2030. That is four times more than the 146 Mt saved under business–as-usual as we knew it at the start of 2015. But that goal can only be reached by replacing coal with non-emitting power. If coal is replaced by unabated combined-cycle gas generation, 41% of the emissions savings are lost. This is a conservative estimate as it does not include the upstream emissions — and fugitive methane emissions — from the production and transport of natural gas.

This illustrates the significance of the supply we choose to replace coal. Replacing it with gas generation unabated by technology such as carbon capture or clean hydrogen would make achieving a net-zero grid well before 2050 much more expensive for utilities and ratepayers, and risks stranding recently invested capital.

There are life cycle emissions embedded in any replacement generation option, but Figure 32 shows that the life cycle emissions from renewable energy and nuclear power

[215] This assumes each GWh of coal is replaced with natural gas generation and uses a heat rate of 7500 GJ/GWh for combined cycle plants. It is conservative in its estimate as it does not include the considerable upstream emissions (about 11 kg $CO_2e$/GJ) for the gas used in gas-fired generation.

are relatively negligible against the emission increments represented by even efficient gas generation and coal-fired generation.

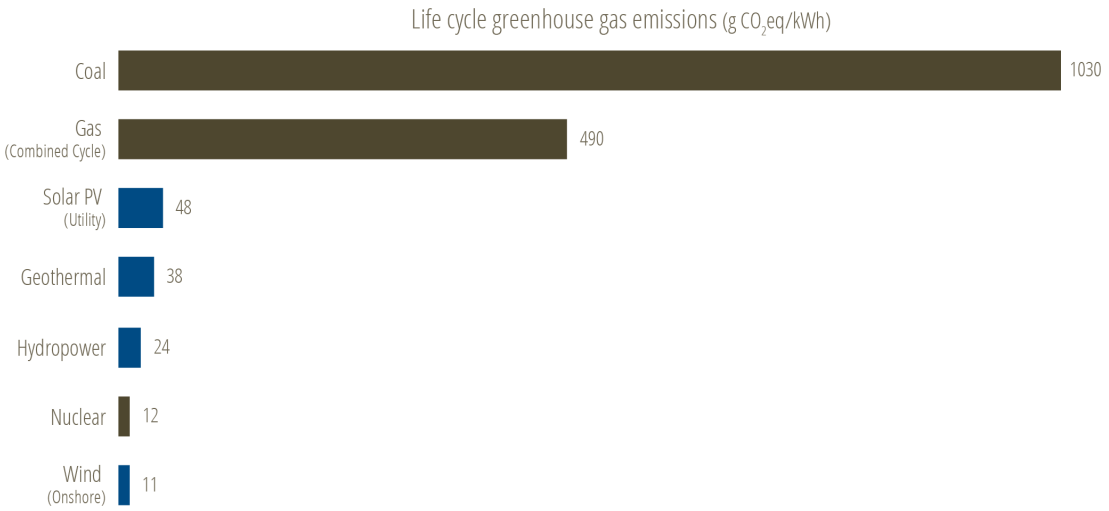


Figure 32. Life cycle GHG emissions of electricity generating technologies

Data source: Bruckner[216]

## 6.2 Canada's affordable, net-zero-compatible replacement generation options

Canada has multiple options to choose from as it navigates toward net-zero and transitions off coal-fired generation by 2030, including:

- Enormous untapped **solar and wind energy**, including very strong resource potential in Alberta, Saskatchewan and Nova Scotia — i.e., the provinces tasked with phasing out the most coal power in terms of absolute capacity and proportional grid reliance
- World-leading **hydroelectricity** assets and potential, along with the experience to finance projects cost-effectively, and the untapped potential to transport this electricity between provinces to help integrate variable renewables
- Strong early experience with **carbon capture, utilization and storage**, which can be applied for very low-emitting thermal electricity generation

[216] Thomas Bruckner et al., "Energy Systems," in *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge University Press, 2014), Annex III, Table A.III.2. https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_annex-iii.pdf; 'Coal' value is estimated from Ibid., Chapter 7, Figure 7.6. https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_chapter7.pdf

- Strong **geothermal and biomass** potential, with existing coal-power provinces offering both expertise in the geology and drilling required for geothermal, as well as agricultural and forestry waste management imperatives
- Long-standing experience with **nuclear** power and interest and initiatives in some provinces to advance the commercialization of small modular reactors
- Considerable untapped **energy efficiency** potential and opportunity to deploy demand flexibility
- Opportunities to increase **transmission** capacity between provinces and with the United States.

No one single option can or should replace all coal generation in Canada. For electricity grids, diversity of supply mitigates technology and fuel price risks. Moreover, the portfolio of options deployed must account for the particular resources available in each province and the characteristics of each province's electricity grid.

The Pembina Institute's previous work has shown that Canada can choose to protect our grids from carbon-pricing risk for the long run while keeping costs as low as possible and maintaining grid reliability. Renewable energy costs have declined dramatically over the last two decades, so that wind and solar energy are now clearly the lowest-cost electricity options available. Increasing carbon pricing and stringency will accentuate the competitive advantage of non-emitting power.

In *Reliable, affordable: The economic case for scaling up clean energy portfolios* (2019), the Pembina Institute compared the cost of generating electricity via clean energy portfolios against new gas plants in Alberta. Clean energy portfolios consist of non-emitting sources: wind, solar, battery energy storage, demand flexibility and energy efficiency. These were compared against two types of gas plants: combined cycle plants, which provide steady power, and simple cycle plants, which provide peak power. In both cases, the clean portfolios provide the same reliable services (including peak capacity, flexibility, and network stability)[217] as the gas plant at a lower cost over the lifetime of the energy source (Figure 33). This illustrates the potential for non-emitting sources to cost-effectively achieve net-zero grids by 2035.

[217] Recent studies have shown that clean energy technologies can meet the reliability demands (including ancillary services such as voltage regulation, frequency response, ramping, black start, system inertia etc.) of the grid even with high penetration of renewables (Paul Denholm et al., *Inertia and the Power Grid: A Guide Without the Spin* (NREL, 2020), vi. https://www.nrel.gov/news/program/2020/inertia-and-the-power-grid-a-guide-without-the-spin.html; California Independent System Operator, Avangrid Renewables, National Renewable Energy Laboratory, and General Electric, *Avangrid Renewables Tule Wind Farm: Demonstration of capability to provide essential grid services* (2020), 5. https://www.caiso.com/Documents/WindPowerPlantTestResults.pdf )

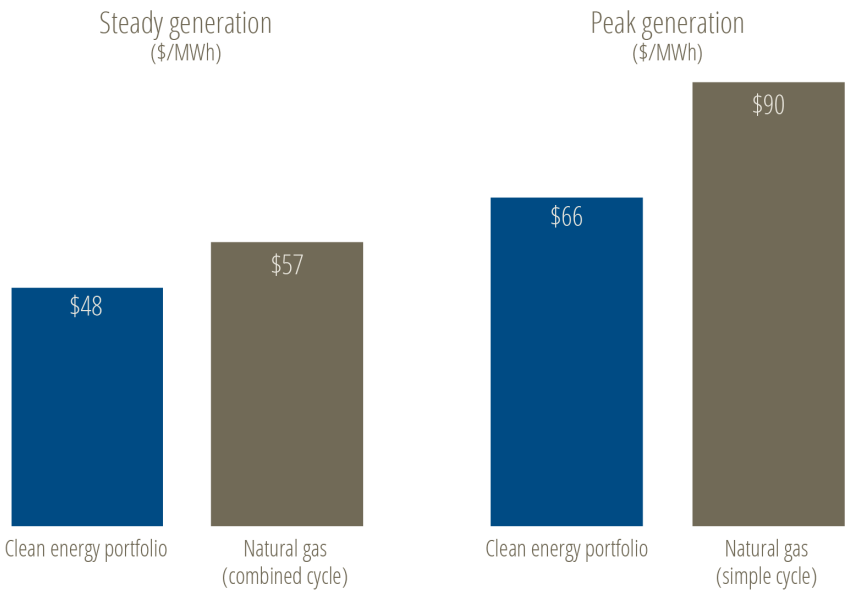


Figure 33. Cost of electricity generation by natural gas plants and by a clean energy portfolio

Source: Pembina Institute[218]

## 6.3 Need for an equitable transition

As Canada transforms its energy system to meet international obligations and achieve a net-zero-emissions grid by 2050, employment opportunities will shift, opening up new opportunities in emerging sectors. While jobs in the traditional energy sector will decline, job growth in the clean energy economy will outpace those losses. Between 2020 and 2030, an estimated 125,800 fossil-fuel-related jobs will be lost, but 208,700 jobs in clean energy will be added during that time.[219] Alberta alone could add 67,200 full-time jobs by 2030.[220] To allow coal workers to benefit from this change, considerations must be made to ensure that they have a voice in shaping the transition, and that the newly available opportunities are of equivalent quality to the jobs and opportunities they are replacing.

[218] Jan Gorski, Binnu Jeyakumar, *Reliable, affordable: The economic case for scaling up clean energy portfolios* (Pembina Institute, 2019), 2. https://www.pembina.org/pub/reliable-affordable-economic-case-scaling-clean-energy-portfolios

[219] Clean Energy Canada, *The New Reality* (2021), 4. https://cleanenergycanada.org/wp-content/uploads/2021/06/Report_CEC_CleanJobs2021.pdf

[220] Saeed Kaddoura, *Alberta's Emerging Economy: A blueprint for job creation through 2030* (Pembina Institute, 2020), 34. https://www.pembina.org/pub/albertas-emerging-economy

The transition to a net-zero economy opens the opportunity to institute structural changes that address the systemic inequalities that have historically existed within traditional energy production. This includes putting policies and programs into place that support workers and communities affected by the off-coal transition, as well as providing opportunities for permanent, well-paying jobs that protect workers' rights for groups that have been historically excluded from the traditional energy system.

# 7. Recommendations for accelerating the transition

Given the climate imperative and the significant health and cost benefits of transitioning to a clean-energy grid, urgent action is needed to hasten coal retirement and deployment of non-emitting resources. This should be done while maintaining or improving grid reliability and consumer price outcomes.

This is an overview of critical transition actions for the next 15 years to decarbonize electricity in Canada, drawing on recent successes in Ontario and Alberta to cease wasting limited carbon budget on unnecessary and harmful coal emissions.

## Set clear investment signals for net-zero grids by 2035

Given the long lifespan of new generation capacity, electricity system decision-makers (including utilities, regulators and investors) require clear, compelling signals from government. This is evident in the progression of coal phase-out policy action. The 2030 coal phase-outs ultimately secured through clear policy action in Alberta and federally could have been much more contentious and expensive if the federal government had not already ended new coal power investments across Canada with its 2012 regulations. In the absence of early signals, the technical, financial and political barriers to stranding invested capital can stymie the required progression of climate action.

With the end of coal-fired power secured, attention must urgently shift to near-term investment in replacement generation. With only 14 years until 2035 and electricity investment horizons counted in decades, governments must immediately issue clear signals that the days of unabated, carbon-intensive thermal generation are numbered. Otherwise, Canada risks locking into capital investment that is incompatible with net-zero grids, raising the cost and acrimony of climate action's next crucial steps.

Where more prescriptive government action is necessary to ensure that investments are directed toward non-emitting generation sources, governments should legislate clear clean-electricity standards to mandate and drive investments that are compatible with 2035 net-zero grids.

## Establish effective sector-wide carbon pricing

As detailed in Section 4, Alberta has shown that pricing carbon equally across all sources of electricity can motivate dramatic change in operating and investment decisions. Remarkably, accelerated retirement decisions were mobilized while the federal price schedule at the time only rose to $50/t. This demonstrates that coal emissions are easy targets for generators when they receive the right price signals.

The "right price signal" in this context means a sector-wide benchmark. Canadian jurisdictions have chosen to protect electricity consumers from power rate impacts by issuing free emissions allocations to generators. Alberta's success with an output-based allocation benchmark that is consistent across all generators (regardless of fuel or technology type) shows that these price protections can be implemented without undermining the economic signal to phase out coal emissions.

Unfortunately, the federal government has chosen not to follow Alberta's lead in its federal carbon pricing backstop. Instead, as detailed in section 5.1.2, it chose to subsidize coal-fired electricity with extra emissions allocations — much like the policy in place in Alberta before the dramatic reduction in coal in 2018 — subsidizing coal-fired power with far more free emissions. This flaw will only gradually correct over the coming decade as the federal benchmark for coal tightens on the way to 2030, when it will finally match the benchmark for existing gas-fired power. Some provinces are following the federal approach in developing provincial carbon pricing systems, protecting coal power from the full immediate effect of carbon pricing. This will similarly neuter the accelerating effect of sector-wide carbon price signals on the transition away from coal.

Policy reforms or schedules that apply the full price signal across all generation types will help to ensure that the low-hanging fruit of coal emissions reductions is fully harvested as early as possible.

## Develop more stringent protocols to protect federal regulations against weakening via equivalency agreements

The federal government needs greater diligence and transparency in protecting the federal GHG regulations from being weakened by Canadian Environmental Protection Act equivalency agreements. The federal government's net GHG emissions approach to assessing provincial policies for equivalency (taking into account emissions reductions from coal and emissions increases from replacement generation) has three serious flaws:

1. The analysis assumes higher emissions from replacement generation in the federal regulation scenario than is actually the case. Retiring coal facilities will reduce emissions further than has been assumed in the equivalency assessment for the 2030 federal regulations because at least some of the replacement generation will come from cost-effective lower- or non-emitting sources. But the equivalency analysis assumes gas-fired replacement generation at 420 t/GWh or even 550 t/GWh, much higher than the average new generation that will be built. As such, the federal assessment has been overly permissive in what emissions reductions are required from the provincial policies that are candidates for "equivalency".
2. The federal government has repeatedly cited the co-benefits of reduced coal-fired power generation, particularly in air quality impacts and human health outcomes. They do this in communicating the 2030 phase-out, but also in the official regulatory impact assessment of the regulations themselves. But the provincial equivalency assessments only look at GHG reductions and do not take co-benefits into account. The analysis in section 5 shows that coal GHG emissions rise under the equivalency agreements, so air pollution must rise as well. This undermines the public health benefits claimed by the federal governments' regulations.
3. Regardless of what the GHG outcomes are, the imperative to phase out coal by 2030 in developed countries is partly about demonstrating this progress to the world. Climate change is a global problem, requiring international action and cooperation. Canada stands on stronger footing to end coal power globally when it holds to its commitments to end it internally by 2030, which it has explicitly stated on the world stage. Professing to phase out coal by 2030 but allowing extensions beyond 2030 under equivalency agreements undermines Canada's international negotiating stance and influence.

Fortunately, both Saskatchewan and Nova Scotia have accepted the need to accelerate coal phase-out relative to their 2018 equivalency agreements. Unless these provinces reverse course again, both are showing that the original assumptions that compelled their effort to seek coal life extensions have proven incorrect. However, the federal government must reject the apparently forthcoming request from New Brunswick to seek an agreement that allows the province to continue using unabated coal power past the end of 2029. Moreover, ECCC must be more transparent around the assumptions, inputs and outputs of its equivalency assessment model, and acknowledge that the co-benefits — such as avoided mortality, avoided asthma days, and avoided hospitalizations — are undermined by equivalency agreements.

## Support provinces in cost-effectively transitioning from coal to net-zero electricity by 2035

The four provinces facing the coal phase-out must grapple with the structural and economic challenges that come with any major transition. They need to ensure grid reliability is maintained and will likely look to use existing infrastructure. There is substantial risk that short-term thinking around ratepayer impacts or provincial budgetary constraints will perpetuate these provinces' existing orientation toward infrastructure built for higher-emitting generation. Ultimately, this will only aggravate rates over the long term as carbon pricing increases and grids have locked even further into the infrastructure appropriate only for conventional high-carbon power supply.

Canada's reputation stands to benefit internationally by phasing out coal by 2030 and achieving a net-zero grid by 2035, so the federal government has a role not only in mandating the coal phase-out, but also in supporting the provinces — including Ontario — to transition successfully to net-zero grids. The coal phase-out offers a major opportunity to invest in a fully decarbonized grid. This means integrating non-emitting power within existing infrastructure built for large, centralized, now-obsolete coal power operations that were typically sited for coal supply.

Much of the coal phase-out underway has been achieved with federal sticks: regulations and potential financial penalties. Now the government should invest in the infrastructure necessary to leap-frog over interim fuel sources in the provinces to avoid locking into long-term assets. This can include:

- Supporting modernised regulations and utility business models to enable alternatives to wires-only delivery options, particularly around distributed generation and electrification, and integrating the full value of storage within markets and tariff design
- Support for piloting and deploying storage technology
- Building interprovincial transmission to support integration of variable renewables like wind and solar
- Modelling grid optimization for reducing GHG emissions and costs, and supporting research
- Allowing corporate procurement of renewables in jurisdictions with vertically integrated crown corporations or regulated utilities (such as Nova Scotia's Green Choice Program), to leverage private sector financial backing for greater renewable energy growth
- Supporting community-owned renewable energy generation, to build social capital around the non-emitting assets necessary for future net-zero grids

## Improve data transparency and accessibility

Canada's data availability around energy systems and emissions is poor and often inaccurate. In preparing the modelling and analysis for this report, numerous inconsistencies were observed between ECCC's National Inventory Report and facility-reported emissions. Moreover, facility- or unit-level electricity generation data is completely unavailable in some provinces.

For example, Nova Scotia Power's online public-facing disclosure of emissions and generation has not been kept up to date and includes inconsistencies and inaccuracies. Detailed Saskatchewan coal plant and electricity generation data was not easily accessible online, though SaskPower was very forthcoming with data upon request and willing to provide further detail about operating practices and plans related to coal plants.

Provinces should improve their unit generation and emissions data availability and make this data public in an accessible online format. The federal government could assist in this regard by endeavouring to match the aggregation of data achieved by the U.S. Energy Information Administration. Transparency is necessary to enable scrutiny by civil society and to question the conclusory decisions of government or utility decision-makers. When the data is more publicly accessible, there is greater accountability in ensuring provinces achieve their emissions reduction goals, assessing the ambition of and progress toward those goals, and capitalizing on informed civil society perspectives to consistently improve the climate performance of electricity generation.

## Implement meaningful measures for an equitable transition

As jobs and communities shift to achieve a net-zero economy, the impacted workers and communities should have a voice in shaping the policies and pathways for the transition. Federal and provincial policies — including people-centered just transition legislation — will play a central role in ensuring an equitable transition. In addition, transparent and early signals from the government, are needed to provide stability and time to plan and engage early in the process.

Government funding should be specifically allocated to supporting affected workers and communities in navigating the transition:

- Offer a pension bridging program that does not compromise workers' earnings and retirement benefits if they must retire early due to plant or mine closures

- Create an employment and benefits bridging program to provide financial assistance to workers as they look for new employment
- Institute retraining programs to help workers access careers in the net-zero economy
- Enable workers to access jobs in the emerging economy through communication efforts, partnerships with educational institutions, and direct support to workers
- Protect family economic security by extending funding and retraining opportunities to individuals indirectly impacted by the net-zero transition
- Establish transition centres in affected communities to provide employment support, training, and social support services
- Provide flexible funding to facilitate local initiatives that strengthen and diversify community assets and create employment opportunities

The net-zero transition also presents an opportunity to address the systemic inequalities that have historically existed in the traditional energy system. These measures can be taken by all levels of government as well as industry and the finance sector. Transition programs should be designed to allow for equitable participation and access to clean energy jobs by:

- Working with municipal, Indigenous, and provincial governments to identify, prioritize, and fund local infrastructure projects in affected communities
- Providing equitable access to permanent jobs with good pay and opportunities for advancement, particularly for women, Indigenous people, and other groups with historically limited participation in the traditional energy sector
- Providing accessible and culturally appropriate opportunities for participation in decision-making processes for communities that have been disproportionately impacted by the environmental and health impacts of heavily polluting electricity generation

These measures are necessary to ensure that Canada achieves a reliable, equitable and affordable transition to a clean electricity sector. As Canada strives towards a net-zero economy, we need to invest wisely in transitioning the physical infrastructure as well as the human capital. This is key to ensuring the social, political and ethical sustainability of Canada's path to meeting its climate objectives.