

Powering the Clean Energy Transition

Net-zero electricity in Canada

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Key Takeaways

- Canada's electricity sector is changing, with greenhouse gas emissions now 60% lower than in 2005 after a near-complete phase-out of coal-fired power generation.
- Clean power generation¹ can provide cheap, clean, and reliable electricity, reducing costs for households and businesses while reliably meeting their energy needs.
- Canada's vast renewable energy resources, from solar power in the Prairies to Atlantic Canada's offshore wind, will create economic opportunities nationwide.
- With coordinated policies across provincial and federal governments, Canada can build a sustainable power grid for the benefit of all.

A Bigger, Cleaner Power Grid

Canada's clean energy transition will require electrification across all sectors, and that electricity must be net-zero (Net-Zero Advisory Body, 2023). The near-complete phase-out of coal-fired electricity generation has already contributed to a 60% reduction of greenhouse gas (GHG) emissions² in the power sector since 2005 (Environment and Climate Change Canada [ECCC], 2024, p. 12). Now only 47 Mt of CO₂e remain to be mitigated to reach net-zero GHG emissions (ECCC, 2024);³ however, this must be achieved while doubling (or even tripling) electricity generation by 2050 if Canada's other sectors are to reach net-zero too (Canada Electricity

¹ We use the term "clean power generation" to mean electricity generated by non-GHG-emitting sources.

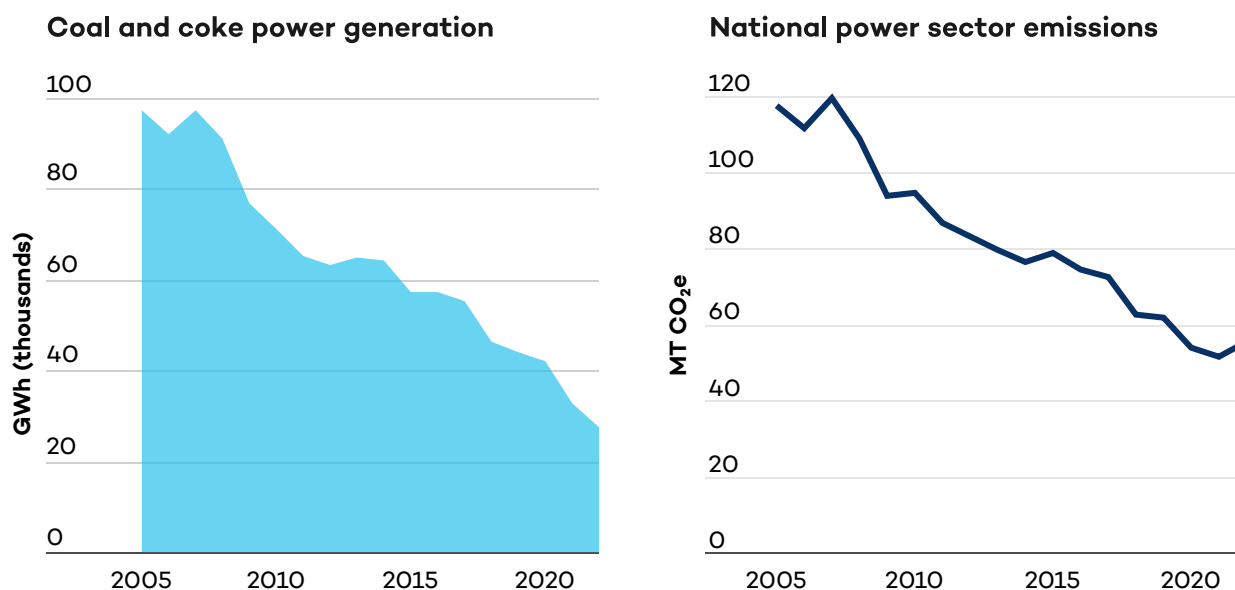
² Measured as carbon dioxide equivalent (CO₂e).

³ "Net-zero" means that CO₂e emissions are reduced to zero or that any residual emissions are offset by additional, verifiable, and permanent CO₂e removals.



Advisory Council [CEAC], 2024; Harland et al., 2024). While the transformation of Canada’s electricity grids in Canada has been impressive, there is still work to do.

Figure 1. Coal-fired power generation and power sector emissions in Canada (2005–2022)



Source: Canada Energy Regulator, 2023.

These dual tasks of expansion and decarbonization are clearly feasible (Canadian Climate Institute [CCI], 2022a; CEAC, 2024; Thomas & Green, 2022) and offer economic opportunities across Canada (see also Box 1).

Renewables Across Canada

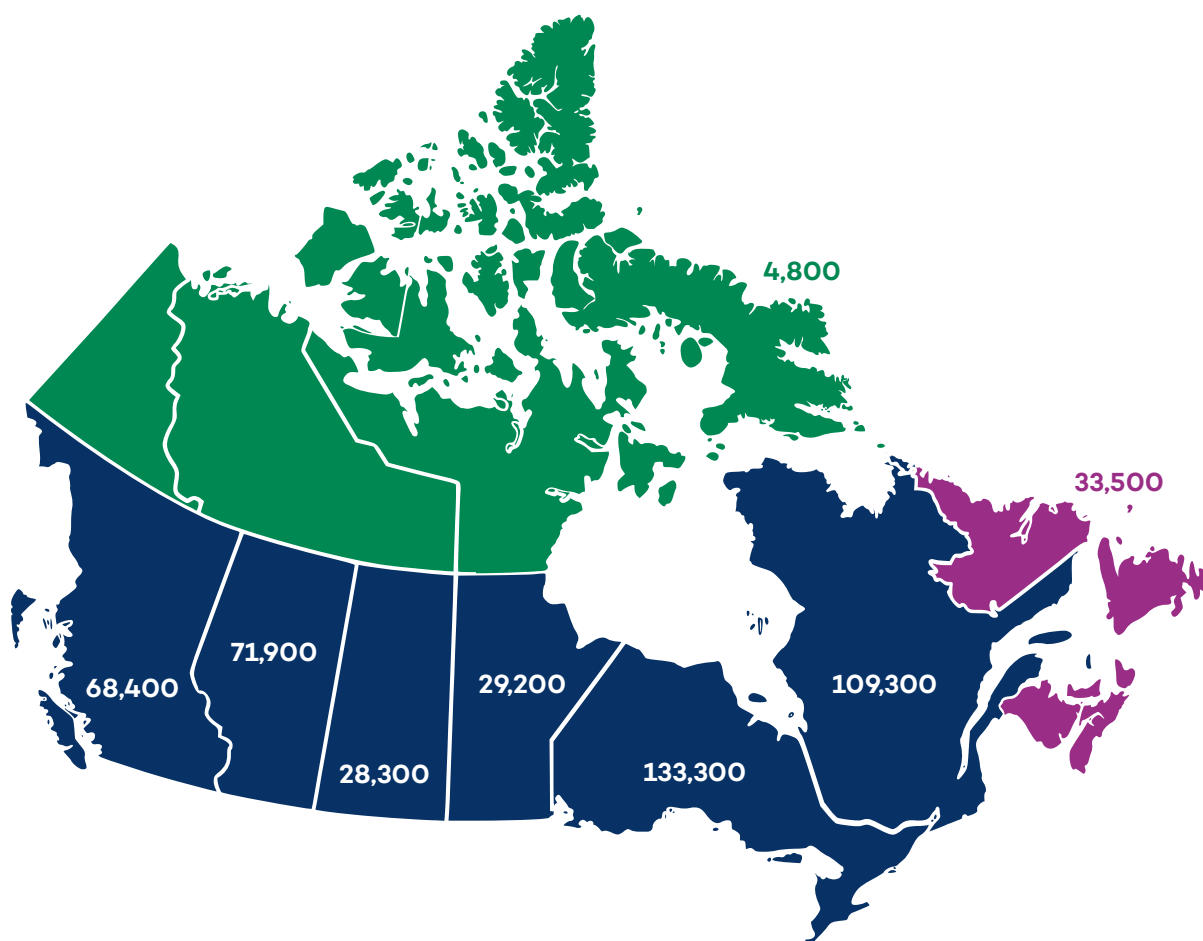
- Nationwide, wind and solar photovoltaic are the fastest growing sources of electricity—with capacity having already increased by more than 12,000 MW and 6,000 MW, respectively, between 2007 and 2022 (Natural Resources Canada, 2024).
- Hydro-Quebec plans to add 10,000 MW of new wind capacity and 4,000 MW of new hydroelectric capacity by 2035 (CEAC, 2024).
- Alberta already represented more than 75% of new solar and wind capacity installed in Canada in 2022 (Noel, 2023), and there are vast renewable energy resources available for further growth (Clean Energy Canada, 2023).
- In Atlantic Canada, there could be functionally unlimited offshore wind resources, more than enough to meet these provinces’ energy needs (Nicholson, 2023). Excess wind power could then support growing clean electricity demand in inland provinces like Ontario and Quebec while sustaining jobs in Atlantic Canada (Nicholson, 2024).



- In Canada’s northern territories, off-grid wind and solar present huge potential for distributed energy in rural and Indigenous communities (Clean Energy Canada, 2023, p. 25).

With widespread renewable resources come widespread sustainable jobs. These jobs range from the technicians and engineers who design, implement, and maintain renewable energy generation projects to project managers and construction workers. Much like in the fossil fuel sector, the impact on employment goes beyond direct employment opportunities, as renewable power hubs support related service industries and otherwise boost local economies. Unlike the fossil fuel sector, however, renewable energy hubs will be distributed widely across the country, spreading jobs, wealth, and investment to communities nationwide.

Figure 2. Estimated clean energy supply jobs in 2050 by province/region, assuming a net-zero Canadian economy



Source: Clean Energy Canada, 2023.

Note: While Clean Energy Canada’s modeling includes jobs for clean energy supply generally, in a net-zero economy most energy will be supplied in the form of electricity, and thus the numbers can still be considered indicative of the scale of jobs expected to grow from decarbonizing and expanding Canada’s power sector.



Renewable power in Atlantic Canada

Dan Roscoe, a proud Nova Scotian, sees a bright future for his province powered by renewable energy. As the CEO of Roswall Development, he is currently spearheading the Mersey River Wind project—33 new wind turbines that will generate nearly 150 MW of electricity for Nova Scotia.

He says eager customers are already lining up. Whether it's a seafood facility exporting fish to Europe or government buildings aiming to create green leases, Roscoe's commercial customers see clean power generation as an obvious choice. As he explains: "They benefit from clean electricity, a reduced carbon footprint, a financial hedge, and a green product that lowers emissions—along with the bragging rights that come with it."

Roscoe sees clean power as the economic future of not only his own business but his province, too: "From a climate perspective and a business development perspective, if we want to attract business to Nova Scotia, it is going to need clean energy, if you are going to build any facility anywhere in the world, it has to be future compliant."

The same, of course, can be said of the rest of Canada as renewable power offers opportunities to create wealth and jobs across the country: "Right now, we have two to three oil-producing provinces, but we can have 10 renewable-producing provinces."

Day-to-Day Benefits for Canadians



Clean Power Can Lower Canadians' Energy Costs

Lower Prices for Households

Technical experts at the CCI (2023) and CEAC (2024) have found that a net-zero electricity grid would reduce average energy costs for Canadians. The CCI finds that "average household energy spending—on energy bills and the equipment that that energy powers—will decrease by 12 per cent between now and 2050 under a net zero transition" (CCI, 2023, p. 7). CEAC estimates that a net-zero grid would save Canadian households CAD 15 billion annually by 2050, with 70% of households saving an average of CAD 1,500 per year (CEAC, 2024). There are several reasons for these consumer cost savings, discussed below.

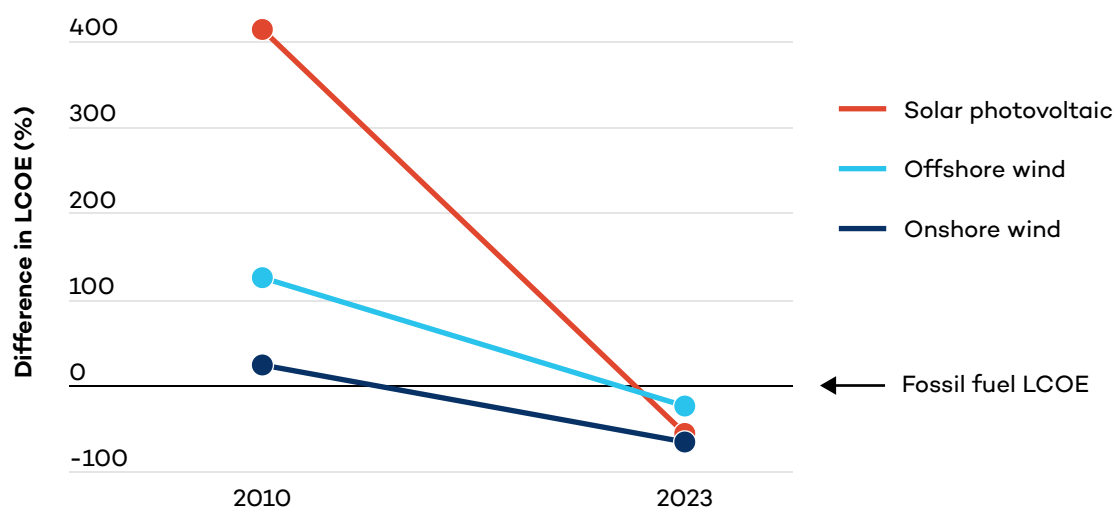
Low Energy Costs

Globally, onshore wind and solar are already cheaper sources of power than new fossil fuel alternatives across their lifespan, and costs continue to fall rapidly as these new technologies expand and develop (Ayres & Zamora, 2024; International Energy Agency [IEA], 2024b). Recent data from the International Renewable Energy Agency shows that 81% of newly commissioned



renewable power generation in 2023 was cheaper than fossil fuel alternatives (Ayres & Zamora, 2024). Cost savings like this have meant that renewable power generation saved the global power sector up to USD 409 billion between 2000 and 2023 (Ayres & Zamora, 2024). In Canada, the Pembina Institute’s modelling of New Brunswick, Nova Scotia, and Alberta shows that a non-emitting power grid can provide the same energy services at a lower cost than natural gas-reliant alternatives (Gorski & Jeyakumar, 2019, 2022).

Figure 3. Change in global weighted average levelized cost of electricity (LCOE) for solar and wind compared to fossil fuels, 2010-2023



Source: Ayers & Zamora, 2024.

High Energy Efficiency

An expanded power grid would also unlock huge efficiency gains across the country, as “for most needs (heating and vehicles), electricity can be 2 to 4 times more efficient than the energy sources it will replace” (CEAC, 2024; see also IEA 2024b). So, even if electricity *rates* increase in some parts of the country as the grid absorbs the cost of new infrastructure, consumer *costs* can still decrease as less energy is used (CCI, 2023; CEAC, 2024). These cost savings can be multiplied when paired with demand-side management. For example, Nova Scotia’s recent investment of CAD 173 million in demand-side management is expected to save ratepayers CAD 542.8 million over the lifetime of the plan (Nova Scotia Utility and Review Board, 2022, p. 8).

Stable Pricing

Renewable power sources, such as hydro, wind, and solar, do not rely on internationally traded fuels like oil and gas. A clean power grid, therefore, can be less vulnerable to rapid price spikes caused by commodity supply shocks beyond Canada’s control, such as those that followed Russia’s invasion of Ukraine in 2022 (CCI, 2023; Kelly, 2024). Low-cost wind and solar generation can be locked in by long-term power purchasing agreements that give grid



operators cost certainty, resulting in more stable rates for consumers (Christensen & Dusyk, 2022). Removing the price uncertainty inherent to fossil fuels enables businesses and households to efficiently plan, invest, and budget for their energy needs while freeing governments from spending millions in taxpayer money to protect consumers from sudden price spikes via emergency subsidies (IEA, 2024a). Moreover, when households generate their own renewable energy—through rooftop solar—they can effectively hedge against future fossil fuel price spikes while generating tax-free savings on their electricity bills by selling excess power back to the grid (Chung, 2024).

Managing Transitions

Some research suggests certain households in Canada may see minor cost increases under a clean power grid, mostly in locations that currently have high rates of natural gas use; however, such risks can easily be offset by smart policy decisions (e.g., CEAC, 2024). With lower energy costs across the economy and fewer subsidies required to offset the effects of fossil fuel price spikes, government support can be directed to the small percentage of households that are vulnerable to cost increases, ensuring that a clean power grid brings energy cost savings nationwide (Martin et al., 2024).



Clean Power Can Be Reliable

Reliable Technologies

As a baseline, Canada benefits from vast hydroelectric resources that can be used to offer firm, dispatchable power generation that is available almost all the time (CCI, 2022b). Modelling shows that new renewables, such as wind and solar, can meet the rest of expected demand directly when paired with storage technologies, demand-side management techniques, and electricity-sharing infrastructure (interties) between provinces (Thomas & Green, 2022). The reliability and efficiency of these technologies have improved significantly in recent years (Ayres & Zamora, 2024; CEAC, 2024). The cost of battery storage projects, for example, declined by 89% globally from 2010 to 2023 as technologies improved and manufacturing capacity expanded (Ayres & Zamora, 2024). Interties between provincial grids, meanwhile, are already an effective option to efficiently share clean electricity supplies across the country, but they require interprovincial agreement and coordination. This is one area where the federal government can play a pivotal role in coordinating with provinces and territories (CEAC, 2024).

Energy Security

Because clean power grids rely less on imported (or otherwise globally traded) fuels like oil and gas, Canadian governments can have more control over the cost and supply of electricity, even in times of international tensions or economic instability (IEA, 2022). This means that a well-designed renewable-based power grid not only protects consumers from sudden spikes in electricity costs but also enhances Canada's energy independence, making the country more resilient in an increasingly volatile fossil fuel economy (IEA, 2024b). This is not to say that clean



power projects will not be impacted by global economic shocks—renewable supply chains will often still be global in scope—but rather that the operating costs of such projects, and thus the availability of affordable power for consumers, will be far less sensitive to developments beyond Canada’s control (Christensen & Dusyk, 2022; IEA, 2024b).



Clean Power Will Reduce Local Pollution

Healthier Communities

Coal-fired power plants are especially polluting—emitting high concentrations of sulphur dioxide, nitric oxide, and nitrogen dioxide (Canadian Public Health Association, 2021). These pollutants are linked to heart and lung conditions, with young children and the elderly at disproportionate risk (Canadian Public Health Association, 2021). In 2014, it was estimated that Canada’s 14 coal-fired power plants caused 160 premature deaths and 140 hospital admissions, costing the Canadian economy CAD 800 million per year (Canadian Public Health Association, 2021). While natural gas power generation is less polluting than coal, nitric oxide and nitrogen dioxide are still emitted (Canadian Public Health Association, 2021). Switching to clean power generation—which does not emit such pollutants—can lead to significant health benefits for communities exposed to fossil fuel pollution (Canadian Public Health Association, 2021; Global Climate and Health Alliance, 2022).

Healthier Environments

Fossil fuel power generation also produces pollutants that remain in the local environment. For example, coal-fired power plants release mercury, a toxic, long-lasting pollutant that often contaminates waterways. Mercury poses significant health risks, particularly for young children, as it can impair cognitive function and motor skills when exposure occurs early in life or during fetal development from consuming contaminated fish (Canadian Public Health Association, 2021). In addition, nitrogen oxides contribute to ground-level ozone and acid rain, both of which negatively impact local ecosystems (Environmental Protection Agency, 2023). By switching to clean power generation, such local pollutants can be avoided.

Key Policies for Federal and Provincial Governments to Develop Canada’s Net-Zero Power Grid

To accelerate Canada’s transition to a clean electricity grid while ensuring Canadians across the country benefit from clean, cheap, and reliable power, coordinated and complementary policies across provincial and federal governments will be needed.



Federal Policies



Implementing clean electricity regulations

The federal government’s proposed clean electricity regulations set a national emissions standard, ensuring that power generation is—with some exceptions—net-zero across the country by 2035. While this regulation is currently drafted to allow for carbon offsets and thus does not phase out all emitting sources of power generation, it would take Canada most of the way to a clean power grid (Pivnick & Dion, 2023).



Facilitating interties

The federal government should coordinate with provincial governments to establish the necessary frameworks and funding arrangements to advance interprovincial grid connections, particularly between provinces with and without hydroelectric resources (CEAC, 2024; Lee et al., 2023; Thomas & Green, 2022).



Mobilizing investment

The federal government can and should support investments in clean technologies—generation, transmission, and storage—both directly and by creating financial incentives to attract private investment (CEAC, 2024; CCI, 2023; Lee et al., 2023). Federal investment will be especially important in territories and Indigenous communities (CEAC, 2024).

Provincial Policies



Timely and inclusive permitting processes

Provincial governments play a central role in regulating where and how new energy projects can be built. Timely permitting processes for clean energy projects will be essential to attracting private sector investment and accelerating project timelines (CEAC, 2024; Northey, 2023). The importance of these processes being inclusive of local stakeholders (including, for example, Indigenous rights holders) “cannot be overstated” to ensure clean power infrastructure has the local consent necessary for a smooth energy transition (Northey, 2023; see also Codrington & Brown 2024).



Developing clean power plans

Each province will need to develop—and ultimately implement—clean electricity transition plans aligned with rapid net-zero targets (CEAC, 2024; Codrington and Brown, 2024; McBain et al., 2024). Such plans should be developed in coordination with federal climate objectives and policies—notably the federal clean electricity regulations—to ensure a smooth transition.



Supporting low-income households

Provincial governments can design financial supports and electricity pricing mechanisms to ensure that low-income households and communities benefit from affordable electricity. This could include, for example, offering differential rates to consumers based on household income or peak energy usage (CCI, 2023).

Conclusion

A clean power grid is an investment that will show returns across the country. By expanding and decarbonizing Canada's electricity sector, Canadian governments can set the foundation for a successful energy transition between now and 2050, all while ensuring that Canadians will have access to clean, affordable, and reliable power for decades to come. No one level of government can complete this task on their own; federal, provincial, and territorial governments must cooperate and form agreements to make the most of Canada's vast renewable energy potential in terms of both the environmental and economic opportunities that it presents.



References

- Ayres, D., & Zamora, L. (2024). *Renewable power generation costs in 2023*. International Renewable Energy Agency. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2024/Sep/IRENA_Renewable_power_generation_costs_in_2023.pdf
- Canada Electricity Advisory Council. (2024). *Powering Canada: A blueprint for success*. <https://natural-resources.canada.ca/our-natural-resources/energy-sources-distribution/electricity-infrastructure/the-canada-electricity-advisory-council/powering-canada-blueprint-for-success/25863#a6>
- Canada Energy Regulator. (2023). *Canada's energy future 2023 (Data)*. <https://apps.cer-rec.gc.ca/frppndc/dfft.aspx?GoCTemplateCulture=en-CA>
- Canadian Climate Institute. (2022a). *Bigger, cleaner, smarter: Pathways for aligning Canadian electricity systems with net zero*. <https://climateinstitute.ca/wp-content/uploads/2022/05/Bigger-Cleaner-Smarter-May-4-2022.pdf>
- Canadian Climate Institute. (2022b). *The big switch: Powering Canada's net zero future*. <https://climateinstitute.ca/wp-content/uploads/2022/05/The-Big-Switch-May-4-2022.pdf>
- Canadian Climate Institute. (2023). *Clean electricity, affordable energy: How Federal and Provincial governments can save Canadians money on the path to net zero*. <https://climateinstitute.ca/wp-content/uploads/2023/06/Clean-Electricity-Affordable-Energy.pdf>
- Canadian Public Health Association. (2021). *Renewable energies factsheet*. <https://www.cpha.ca/renewable-energies-factsheet>.
- Christensen, L. T., & Dusyk, N. (2022). *Why Canada's energy security hinges on renewables*. International Institute for Sustainable Development. <https://www.iisd.org/system/files/2022-10/bottom-line-canada-energy-security.pdf>
- Chung, E. (2024). *Is it worth it to put solar panels on your home?* CBC News. <https://www.cbc.ca/news/science/rooftop-solar-cost-benefits-1.7303406>
- Clean Energy Canada. (2023). *A pivotal moment*. <https://cleanenergycanada.org/wp-content/uploads/2023/03/A-Pivotal-Moment-Report.pdf>
- Codrington, L., & Brown, G. (2024). *Optimizing Ontario: Regulatory solutions to sustainably meet growing demand*. Pembina Institute. <https://www.pembina.org/pub/optimizing-ontario>
- Environmental Protection Agency. (2023). *Human health and environmental impacts of the electric power sector*. <https://www.epa.gov/power-sector/human-health-environmental-impacts-electric-power-sector#:~:text=Electric%20power%20generation%20is%20a,mercury%2C%20cadmium%2C%20and%20arsenic>



- Environment and Climate Change Canada. (2024). *National inventory report 1990-2022*. Government of Canada. https://publications.gc.ca/collections/collection_2024/eccc/En81-4-2022-1-eng.pdf.
- Global Climate and Health Alliance. (2022). *Cradle to grave: The health harms of fossil fuel dependence and the case for a just phaseout*. <https://climateandhealthalliance.org/wp-content/uploads/2022/07/Cradle-To-Grave-Fossil-Fuels-Brief.pdf>
- Gorski, J., & Jeyakumar, B. (2019). *Reliable, affordable: The economic case for scaling up clean energy portfolios*. Pembina Institute. <https://www.pembina.org/reports/reliable-affordable.pdf>
- Gorski, J. & Jeyakumar, B. (2022). *Towards a clean Atlantic grid*. Pembina Institute. <https://www.pembina.org/reports/towards-a-clean-atlantic-grid.pdf>
- Harland, K., Gibson, S., Dion, J., Gajudhur, N., & Mifflin, K. (2024). *Heat exchange: How today's policies will drive or delay Canada's transition to clean, reliable heat for buildings*. Canadian Climate Institute. <https://climateinstitute.ca/wp-content/uploads/2024/06/Heat-Exchange-Report-Canadian-Climate-Institute.pdf>
- International Energy Agency. (2022). *Renewable power's growth is being turbocharged as countries seek to strengthen energy security*. <https://www.iea.org/news/renewable-power-s-growth-is-being-turbocharged-as-countries-seek-to-strengthen-energy-security>
- International Energy Agency. (2024a). *Strategies for affordable and fair clean energy transitions*. <https://iea.blob.core.windows.net/assets/86f2ba8c-f44b-494a-95cc-e75863cebf95/StrategiesforAffordableandFairCleanEnergyTransitions.pdf>
- International Energy Agency. (2024b). *World energy outlook 2024*. <https://www.iea.org/reports/world-energy-outlook-2024>
- Kelly, J. (2024). *How fossil fuels drive inflation and make life less affordable for Canadians*. International Institute for Sustainable Development. <https://www.iisd.org/articles/deep-dive/fossil-fuels-drive-inflation-canada>
- Lee, M., Brouillette, C., & Mertins-Kirkwood, H. (2023). *Spending what it takes*. Canadian Centre for Policy Alternatives. <https://climateactionnetwork.ca/wp-content/uploads/Spending-What-It-Takes.pdf>
- Martin, N., Bowie, D., Fakhoury, R., and Kabbara, M. (2024). *Household energy affordability in a net-zero future*. The Transition Accelerator. <https://transitionaccelerator.ca/wp-content/uploads/2024/11/EC-Household-Energy-Affordability-2024-1.pdf>
- McBain, S., Gunton, T., Mathieson, C., Kilian, M., Dreis, M., & Dyer, S. (2024). *All together now*. Pembina Institute. <https://www.pembina.org/sites/default/files/2024-07/All%20Together%20Now.pdf>.



- Natural Resources Canada. (2024). *About renewable energy in Canada*. <https://natural-resources.canada.ca/our-natural-resources/energy-sources-distribution/renewable-energy/about-renewable-energy-canada/7295>
- Net-Zero Advisory Body. (2023). *Compete and succeed in a net zero future*. https://cdn.prod.website-files.com/64ef3fd141170da059cb6d80/65172c0363ff6814d9e13c2fe2d538e427a10f032f50859e216a2293_NZAB_2022_Annual_Report_Final_-_EN-corr.pdf
- Nicholson, P. (2023). *Catching the wind: How Atlantic Canada can become an energy superpower*. Public Policy Forum. <https://ppforum.ca/publications/wind-energy-atlantic-canada/>
- Nicholson, P. (2024). *Atlantic offshore wind: A national clean energy resource*. Canadian Climate Institute. <https://climateinstitute.ca/atlantic-offshore-wind-national-clean-energy-resource/>
- Noel, W. (2023). *Alberta's renewable energy advantage: Renewables fuel economic growth, pay rural Alberta bills and underpin an affordable electricity system*. Pembina Institute. <https://www.pembina.org/blog/albertas-renewable-energy-advantage#:~:text=Between%20now%20and%202035%2C%20Alberta,cornerstone%20in%20Alberta's%20energy%20economy>
- Northey, R. (2023). *Expediting clean energy facilities in Canada: A framework for new fast-track permitting*. Canadian Climate Institute. <https://climateinstitute.ca/publications/expediting-clean-energy-facilities-in-canada/>
- Nova Scotia Utility and Review Board. (2022). *Decision on EfficiencyOne's demand side management plan 2023-2025 (M10473)*; Nova Scotia House of Assembly. September 6, 2022. <https://nsuarb.novascotia.ca/sites/default/files/M10473%20-%20Decision.pdf>
- Pivnick, E., & Dion, J. (2023). *Understanding the proposed clean electricity regulations (Part 1)*. Canadian Climate Institute. <https://climateinstitute.ca/understanding-the-proposed-clean-electricity-regulations-part-1/>
- Thomas, S., & Green, T. (2022). *Shifting power: Zero-emissions electricity across Canada by 2035*. David Suzuki Foundation. <https://david Suzuki.org/wp-content/uploads/2022/05/Shifting-Power-Zero-Emissions-Across-Canada-By-2035-Report.pdf>

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