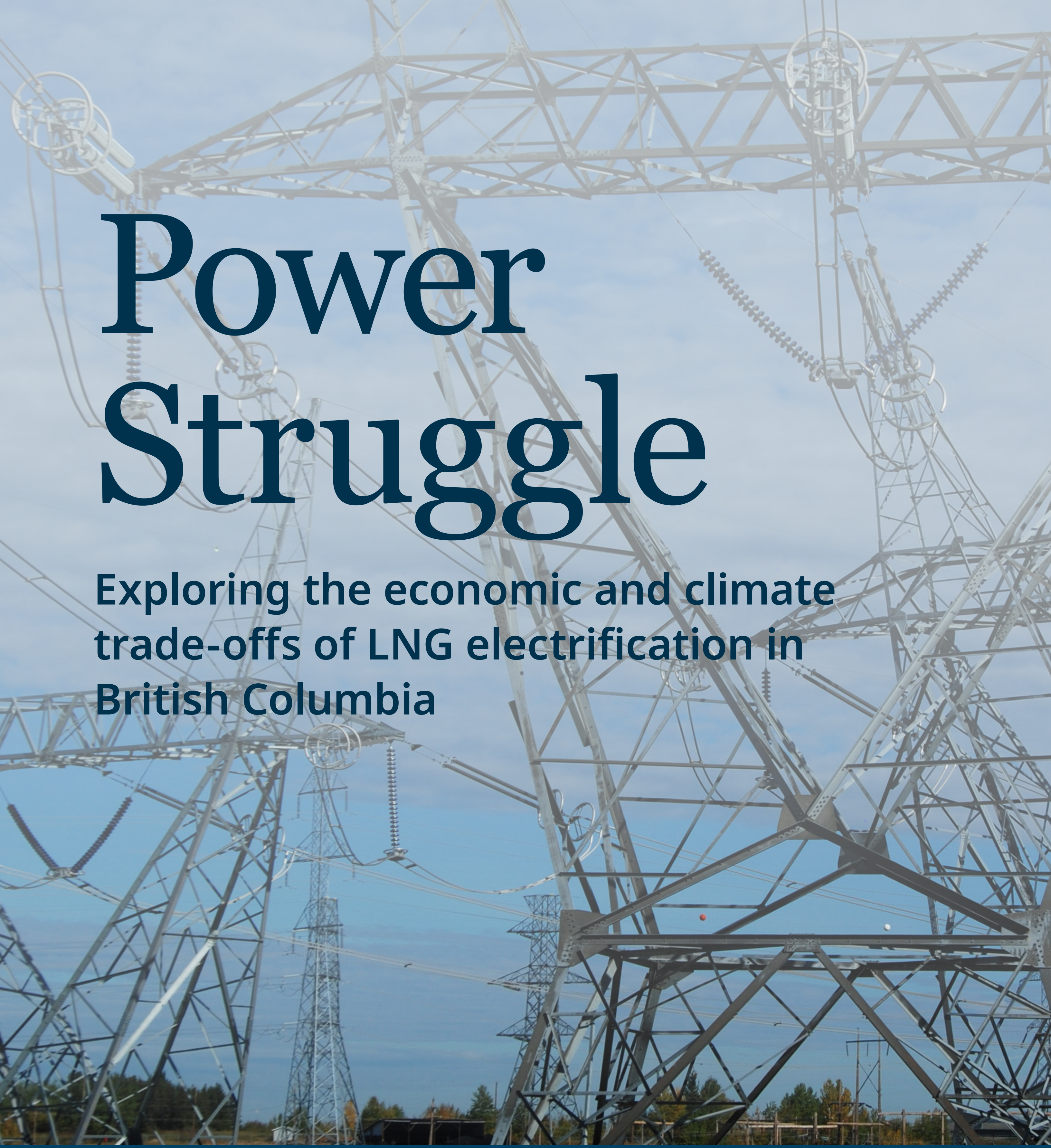

Power Struggle

Exploring the economic and climate trade-offs of LNG electrification in British Columbia

December 2025

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PEMBINA Institute

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ISBN 1-897390-89-0

Recommended citation: Noel, Will, Ian Sanderson and Janetta McKenzi. Power Struggle: Exploring the economic and climate trade-offs of LNG electrification in British Columbia. The Pembina Institute, 2025.

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Acknowledgements

The Pembina Institute acknowledges that the work we steward and those we serve span across many Nations. We respectfully recognize and affirm these unceded ancestral territories of the xʷməθkʷəy̓əm (Musqueam), Sḵwx̱wú7mesh (Squamish), and səlilwətaɬ (Tsleil-Waututh) Nations. We respectfully acknowledge the presence of many diverse First Nations, Inuit, and Métis Peoples on these lands.

These acknowledgements are some of the beginning steps on a journey of several generations. We share them in the spirit of truth, justice, reconciliation, and to contribute to a more equitable and inclusive future for all of society.

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Executive summary

British Columbia is entering a pivotal moment in its energy transition. Having recently announced a second round of clean power procurements, the province must now decide how to allocate its growing supply of renewable electricity to its growing economy. This report explores the trade-offs of prioritizing the electrification of liquefied natural gas (LNG) terminals — and the associated upstream extraction activities — relative to emerging opportunities such as critical minerals, battery manufacturing, data centres and port electrification. Our analysis highlights several benefits of diversification from legacy sectors as Canada seeks to improve its economic resilience in this era of nation building. We find that:

1. **The benefits of diversification are significant**, generating more than double the GDP and creating more than triple the jobs relative to investing exclusively in LNG expansion, as explored in our *Mixed Growth* and *New Foundations* scenarios.
2. **The economic benefits of LNG development are most substantial during construction.** Once LNG facilities start to operate, financial benefits shift from local economies to global markets through companies and shareholders. In contrast, diversified investment across emerging and energy-transition aligned industries deliver strong, sustained economic benefits throughout their lifetime. Critical mineral mines require significant amounts of labour while producing raw materials. Downstream manufacturing uses these materials to produce high-value, exportable goods, generating skilled jobs and consistently boosting local economies.
3. **During construction, battery manufacturing plants and data centres still outcompete most LNG terminals in both GDP and jobs per unit of installed electricity demand**, with significantly shorter construction timelines and higher value-added outputs.

Our results strongly suggest that **over-investment in LNG development risks crowding out high-growth clean industries while locking B.C. into a sector with uncertain long-term viability.** LNG projects still need to be accountable for their emissions — but as provincial and federal governments are deciding where to allocate public dollars for the most impact, our analysis finds that prioritizing LNG over other sectors does not lead to the best results for B.C.

Clean electricity is a valuable resource that is in high demand. Strategic allocation toward sectors with long-term growth potential, aligning with global investment trends, will ensure both economic and environmental benefits. It is imperative that B.C. consider the full opportunity cost of LNG expansion when evaluating future investments.

1. Introduction

British Columbia is growing its supply of renewable electricity through both recent and upcoming clean power procurements and the commissioning of Site C hydroelectric dam. At the same time, there is abundant competition for access to that low carbon electricity, indicated by the 29 submissions to BC Hydro's call for expressions of interest for future power.[1] One major source of new electricity demand could be from proposed liquefied natural gas (LNG) terminals.

B.C. recently completed its first shipment of LNG from the first phase of the LNG Canada project, with five more LNG terminals at various stages of development and final investment decision. All of these projects have discussed some level of electrification to lower the emissions associated with the liquefaction of natural gas. It is clear that expanding the demand for electricity for LNG directly competes with other industrial electricity uses.

B.C. must carefully consider how to prioritize its clean electricity supply in a way that benefits future economic growth. Devoting large amounts of clean electricity and public financial support to new LNG projects could slow investment in emerging and energy transition-aligned industries such as critical minerals mining and battery manufacturing. It could also hinder the province's progress on electrifying other parts of its economy, such as transportation and buildings. Meanwhile, LNG projects are receiving subsidies to electrify. For example, the B.C. government recently committed $200 million to building electricity infrastructure required to electrify Cedar LNG.[2] Given the significant deficit facing the B.C. government in 2025, it is crucial that public support be directed to industries and projects that give the greatest return for British Columbians in terms of gross domestic product (GDP), jobs, and low-carbon growth.

This report outlines the opportunities for industrial electrification as Canada seeks to improve its economic resilience. Our findings indicate that taking a diversified approach, rather than prioritizing the LNG sector with power and financing, leads to the best outcome of financial benefit, lowest risk of stranded assets, and cleaner industrial activities.

Using British Columbia as a case study, we analyze the opportunity costs — what you give up when you choose one option over another — of committing clean electricity to the LNG sector. To do this, we have constructed three scenarios with varying degrees of diversification between LNG and emerging sectors based on the availability of clean electricity. Diversified scenarios deliver substantial gains, producing over double the GDP and more than triple the jobs

[1] BC Hydro, "North Coast B.C. Expression of Interest." https://www.bchydro.com/energy-in-bc/projects/north-coast-bc-electrification/express-interest.html

[2] Government of British Columbia, "B.C., Haisla Nation take action to power Cedar LNG with renewable electricity," news release, July 29, 2025. https://news.gov.bc.ca/releases/2025ECS0033-000728

compared with LNG Focused. Meanwhile, the LNG Focused scenario records the smallest GDP and employment impacts, with growth concentrated in upstream activities rather than terminal operations.

B.C. is at a pivotal moment: substantial LNG development is already underway, yet the next wave would more than double current capacity. Expansion on this scale could lock in emissions, infrastructure, and economic dependence on LNG just as global energy systems are shifting toward cleaner alternatives.

2. Opportunity analysis of industrial electrification

This section outlines our analysis of industrial electrification opportunities for B.C. Where possible, we estimate the electricity demand, environmental impacts or benefits (if any), and economic opportunities of each type of project.

For consistency and ease of comparison, employment numbers are reported in terms of total jobs which, unless otherwise stated, are assumed to include direct, indirect, and induced jobs. Where necessary, employment statistics from other sources have been converted (e.g., from job-years, full-time equivalent or jobs per year) to match this notation. Further details of our analysis, including inputs, data sources and assumptions, can be found in Appendix A.

2.1 Liquefied natural gas

With the completion of LNG Canada Phase 1 in July 2025, B.C. was able to export its first shipment of LNG. Two smaller projects, Cedar LNG and Woodfibre LNG, are now under construction, bringing total committed export capacity to 19.1 million tonnes per annum (MTPA). Three additional LNG proposals are awaiting final investment decisions (FID), which together could add 29 MTPA of export capacity to B.C. The most notable of these projects is Phase 2 of the LNG Canada project and Ksi Lisims LNG, which have both been placed on the major projects list for fast-tracking by the Major Projects Office.[3]

[3] Major Projects Office (Canada), "Projects for further review." https://www.canada.ca/en/privy-council/major-projects-office/projects/national.html

Table 1. Summary of LNG projects in B.C.

	LNG Canada		Woodfibre LNG	Tilbury Phase 2 Expansion	Cedar LNG	Ksi Lisims LNG
	Phase 1	Phase 2				
Location	Kitimat		Squamish	Delta	Kitimat	Gitlaxt'aamiks
Capacity (MTPA)	14	14	2.1	Phase 1A: 0.9 Phase 2: 3.5	3	12
Status	Operational	Awaiting FID (Major Project)	Under Construction	Awaiting FID	Under Construction	Awaiting FID (Major Project)
Start year	2025	2030	2027	2028	2027	2028

Data source: Pembina Institute[4]

Modelling by the Conference Board of Canada shows that these projects contribute $2.5 billion in GDP during construction and $829 million per year once operational. Labour requirements vary significantly based on the size and location of the project. It is reported that LNG Canada Phase 1 created 40,000 direct job–years over six years of construction.[5] Meanwhile smaller terminals such as Woodfibre require less than two thousand workers over two years of construction.[6] LNG terminals require relatively few employees once operational, generating 500 jobs for a large LNG terminal, such as LNG Canada Phase 1,[7] down to 100 for smaller projects such as Woodfibre.[8]

TO meet B.C.'s current 2030 climate targets, these projects should be electrified. The Pembina Institute has recently done an extensive analysis on the amount of electricity these projects will require to electrify, finding full electrification of a single terminal requires 1,000 to 3,200 GWh of electricity. Another consideration is the upstream effects if these projects are constructed. For example, to meet the balance of the CleanBC gas sector emissions target for 2030, an additional 25,000 GWh would be required for electrification of new upstream gas production, assuming 60% of new capacity was built out in B.C.[9] This would be equivalent to building four additional Site C dams just to produce this additional natural gas.

[4] Jan Gorski and Jason Lam, *Squaring the Circle: Reconciling LNG expansion with B.C.'s climate goals* (Pembina Institute, 2023), 26-27. https://www.pembina.org/reports/squaring-the-circle-state-of-lng-2023.pdf

[5] LNG Canada, "The Path to First Cargo," January 20, 2025. https://www.lngcanada.ca/news/the-path-to-first-cargo/

[6] Stefan Pauer and Jana Elbrecht, *An Uncertain Future* (Clean Energy Canada, 2024), 6-7. https://cleanenergycanada.org/wp-content/uploads/2024/03/Report_LNG-Macrh2024.pdf

[7] *An Uncertain Future,* 6-7.

[8] Government of Canada. "Investing in Liquefied Natural Gas." https://natural-resources.canada.ca/energy-sources/fossil-fuels/investing-liquefied-natural-gas

[9] *Squaring the Circle*, 12-14

2.2 Critical minerals

British Columbia has reserves of 18 of Canada's 34 critical minerals and is Canada's largest copper and only molybdenum producer.[10] These minerals are essential for many of the technologies required to decarbonize the economy including electric vehicles (EVs), battery storage, renewables and electricity grid infrastructure. Global demand for critical minerals is projected to grow significantly out to 2040, particularly for lithium (fivefold) and copper (double), leading to potential shortfalls in supply.[11] B.C. has an abundance of copper and could be a leading supplier globally as countries look to secure supply from stable trading partners.

The Mining Association of British Columbia recently commissioned a report to forecast the economic impacts of 16 proposed critical mineral mining projects. These projects represent an estimated $36 billion in near-term investment and $11 billion in tax revenues. The average project is expected to boost GDP by $0.6 billion and add over 5,000 jobs within B.C. in its first year of development. Over the life of a mine (24 years, on average), GDP impacts are projected to be $20.4 billion while providing the B.C. economy with 101,715 job–years (5,590 jobs created over the lifespan of the project). The benefits of a critical mineral mine extend beyond B.C., adding $4.4 billion to other regions in the Canadian economy and 33,000 indirect and induced jobs.[12, 13]

A major competitive advantage for B.C. mines is they are comparatively low-emissions operations due to their use of renewable electricity. This results in emissions intensities that are 68% lower than the global average.[14] As the sector looks to expand, demands for clean electricity have been growing. For example, the mining sector generated most of the submissions of interest in BC Hydro's North Coast expansion project.[15] Significant opportunities still remain to

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[10] B.C.'s share of critical minerals was 16 out of 31 in 2024:Ministry of Energy, Mines, and Low Carbon Innovation (British Columbia), *B.C. Critical Minerals Strategy: Phase 1* (2024). https://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/criticalminerals .

The critical mineral list was updated in 2025: Government of Canada, "Canada's critical minerals." https://www.canada.ca/en/campaign/critical-minerals-in-canada/critical-minerals-an-opportunity-for-canada.html

[11] International Energy Agency, *Global Critical Minerals Outlook* (2025), 7. https://www.iea.org/reports/global-critical-minerals-outlook-2025

[12] Mansfield Consulting Inc., *Critical Minerals Economic Impact Study* (2023). https://mining.bc.ca/wp-content/uploads/2024/01/Mansfield_Critical_Minerals_Economic-Impact-Report_FINAL_2024_01_06.pdf

[13] For an examination of the job and training supports needed to expand the critical minerals sector in B.C., see our report: Megan Gordon and Mercer Pommer, *Key Elements: Nurturing a critical minerals workforce with lessons from British Columbia, Alberta and Ontario* (Pembina Institute, 2025). https://www.pembina.org/pub/key-elements

[14] Calvin Trottier-Chi, "Canada's Energy Transition Will Demand $16 Billion Worth of Critical Minerals by 2040," *440 Megatonnes,* August 9, 2024. https://440megatonnes.ca/insight/canada-critical-minerals-clean-energy-transition/

[15] BC Hydro, "North Cost B.C. Expression of Interest." https://www.bchydro.com/energy-in-bc/projects/north-coast-bc-electrification/express-interest.html

reduce emissions from the mining sector through electrification of equipment and transportation vehicles. As of 2022, only 33% of the sector's energy mix came from electricity.[16]

2.3 Lithium battery plants

Canada recently overtook China for top spot in BloombergNEF's battery supply chain rankings thanks to the abundance of raw materials, industry and infrastructure, and ESG ranking.[17] Globally, the market for lithium-ion batteries is expected to grow 25% annually to 2030 as the demand for everything from electric vehicles to grid storage ramps up.[18] With B.C.'s rich supply of critical minerals, there is a significant opportunity for battery production within the province to meet this growing demand.

The industry would also be well-served by the province's abundance of clean electricity and competitive industrial utility rates for clean- and high-tech companies. These facilities provide high skilled and high-paying job opportunities. This will also provide the opportunity to leverage expertise being developed at the new Battery Innovation Centre located at UBC Okanagan.[19]

By integrating the mining and production of batteries in B.C., the province can capture a significant portion of the value generated by the battery supply chain. Manufacturing using low-carbon raw materials with clean electricity could allow B.C. to produce some of the lowest-carbon batteries in the world.[20]

Energy consumption by battery plants varies greatly based on grid intensity, plant size, and type of batteries being manufactured. Today's batteries require 30 to 55 kWh of electricity per kWh_{cell} (kWh of battery cell capacity) when considering only the factory production.[21] Plant size varies from small (1 GWh_{cell}) to gigafactories with a production capacity greater than 90 GWh_{cell}, such

[16] Ross Linden-Fraser, "Digging into Emissions from the Mining Industry," *440 Megatonnes*, April 4, 2024. https://440megatonnes.ca/insight/digging-emissions-mining-industry-canada/

[17] BloombergNEF, "China Drops to Second in BloombergNEF's Global Lithium-Ion Battery Supply Chain Ranking as Canada Comes Out on Top," February 5, 2024. https://about.bnef.com/insights/commodities/china-drops-to-second-in-bloombergnefs-global-lithium-ion-battery-supply-chain-ranking-as-canada-comes-out-on-top/

[18] McKinsey & Company, "Battery 2030: Resilient, sustainable, and circular," January 16, 2023. https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/battery-2030-resilient-sustainable-and-circular

[19] UBC Okanagan, "New Battery Innovation Centre to Supercharge B.C. Clean Energy Innovation: Provincial government contributes $2 million to battery innovation at UBC Okanagan," news release, July 29, 2024. https://news.ok.ubc.ca/2024/07/29/new-battery-innovation-centre-to-supercharge-b-c-clean-energy-innovation/

[20] Clean Energy Canada, *Canada's New Economic Engine* (2022), 17. https://cleanenergycanada.org/report/canadas-new-economic-engine/

[21] F. Degen, M. Winter, D. Bendig and J Tübke, "Energy consumption of current and future production of lithium-ion and post lithium-ion battery cells," *Nature Energy* 8, 1285 (2023). https://doi.org/10.1038/s41560-023-01355-z

as the Volkswagen battery cell factory in Ontario.[22] We estimate that a plant with an annual production of 10 GWh_{cell} would consume upwards of 550 GWh per year.

Modelling by Clean Energy Canada shows a domestic EV battery supply chain could contribute $19 billion to the Canadian economy annually by 2030, supporting up to 110,000 direct and indirect jobs.[23]

Another key insight is that battery material and cell manufacturing provide five times the GDP impact of mining extraction, highlighting the significant opportunity to capture a greater portion of the battery manufacturing value chain. To analyze the impact on B.C. specifically, we have estimated the potential GDP impact of a 10 GWh plant in the province. A plant of this size could generate $1.39 billion in GDP, with $0.5 billion coming directly from the plant. This would create upwards of 600 direct jobs and a total of 2,700 jobs.[24]

2.4 Data centres

Growth in digitalization, and especially artificial intelligence, has led to a surge of data centre investment that is expected to continue accelerating. And, as computation demand increases, the energy required to run those data centres will likely increase in tandem. For example, new "hyperscale" data centres — those used by Amazon, Google and Meta to store large amounts of data and run calculations "on the cloud" — have power demand of 100 MW or more: ten to twenty times larger than average data centres.[25] Recent forecasts estimate that between now and 2030, coal and natural gas will meet up to 40% of new electricity demand in data centres globally, increasing emissions by 1.6 to 2.7 times current levels (~180 Mt CO_2e).[26] Given its existing and growing supply of affordable low-emissions electricity, and its mild climate (favourable for cooling), B.C. is a prime candidate for data centre development with low environmental impact. For example, emissions from a data centre connected to the B.C. power grid would be about 96% lower than one that is primarily powered by natural gas.[27]

Data centres are classified into tiers based on the level of reliability that their customers require, ranging from Tier I (99.671% uptime or <29 hours of downtime per year) to Tier IV (99.995%

[22] Volkswagen Canada, "The St. Thomas Battery Cell Gigafactory is on the way," April 21, 2023. https://www.vw.ca/en/electric-vehicles/ev-hub/ev-news/st-thomas-gigafactory.html

[23] *Canada's New Economic Engine*, 5.

[24] Based on Clean Energy Canada estimates for build out of cell manufacturing. *Canada's New Economic Engine*.

[25] Thomas Spencer and Siddharth Singh, "What the data center and AI boom could mean for the energy sector," *Internation Energy Agency*, October 18, 2024. https://www.iea.org/commentaries/what-the-data-centre-and-ai-boom-could-mean-for-the-energy-sector

[26] International Energy Agency, *Energy and AI* (2025), 18,87. https://www.iea.org/reports/energy-and-ai

[27] Assuming a combined cycle natural gas plant with an average emissions intensity of 420 t/GWh

uptime or < 26 minutes of downtime per year), where higher levels of reliability come with increased equipment costs. For example, Tier I data centres have no backups for any of their critical equipment (i.e. power, IT, or cooling systems), while Tier IV are fully redundant, having two or more of each critical system.[28] This report analyzes the benefits of developing a 100 MW Tier III data centre, which strikes a reasonable balance between cost and reliability (<2 hours of downtime per year). This is the most common tier of data centre used by businesses globally.[29] Our analysis shows that construction of a $928 million facility would generate an estimated $668 million in GDP and 3,160 direct jobs, with operations providing an additional $120 million in GDP and 580 jobs per year. At current lease rates,[30] 100 MW of data centre IT capacity would see up to $289 million in annual pre-tax revenue.

There are, however, several potential drawbacks to hosting data centre installations. For example, a 100 MW data centre uses around 750 GWh of electricity per year — approximately the same amount as a city the size of Edmonton[31] — posing a significant risk of gas lock-in if available clean electricity resources are insufficient. And, depending on the chosen cooling infrastructure (i.e. air cooling versus evaporative) a data centre of this size could consume up to 1.4 billion litres of water per year.[32] Finally, data centre operations have been shown to increase consumer electricity costs, as ratepayers foot the bill for new or upgraded transmission infrastructure required to meet the data centre's needs.[33]

2.5 Ports

Ports typically rely almost exclusively on fossil fuels for energy. For example, fossil fuels, primarily diesel, accounted for 97% of energy used across the Port of Vancouver in 2015,

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[28] Data centre uptime is sometimes discussed in terms of nines, where 99% uptime is "two nines" and 99.999% uptime is "five nines". CoreSite, "Breaking down data center tier level classifications." https://www.coresite.com/blog/breaking-down-data-center-tiers-classifications

[29] Digital Reality, "What are data center tiers?" https://www.digitalrealty.com/resources/articles/introduction-to-data-center-tiers

[30] CBRE Group, Inc. "North America Data Center Trends H1 2024," August 19, 2024. https://www.cbre.com/insights/reports/north-america-data-center-trends-h1-2024

[31] City of Edmonton, "Green Electricity Community Wide Procurement," 2019, 3. https://www.edmonton.ca/sites/default/files/public-files/GreenElectricity-CommunityWideProcurement.pdf?cb=1753797140

[32] Based on a water usage effectiveness of 1.8 L/kWh. Jacob Roundy, "How do data centers use and manage water?" *Tech Target,* July 24, 2025. https://www.techtarget.com/searchdatacenter/tip/How-to-manage-data-center-water-usage-sustainably

[33] Marc Levy, "As electric bills rise, evidence mounts that data centers share blame. States feel pressure to act," *The Associated Press,* August 8, 2025. https://apnews.com/article/electricity-prices-data-centers-artificial-intelligence-fbf213a915fb574a4f3e5baaa7041c3a

resulting in over 1 Mt CO_2e emissions annually.[34] Electrification offers a significant opportunity to reduce emissions from ports, while improving local air quality and increasing cost competitiveness by limiting fuel costs for ships at berth and onsite cargo handling equipment. There are several ways to electrify ports, including electrifying ground vehicles and equipment, providing shore electricity for docked ships, and electrifying harbour vessels.

The Vancouver Fraser Port Authority and BC Hydro have collaborated on a roadmap to electrifying the port that is also aligned with BC Hydro's ability to supply clean electricity. They project that under this plan, annual GHG emissions would be reduced by 0.25 Mt CO_2e by 2035. This requires a maximum electrical demand increase of 84 MW by 2035 across the region, with an anticipated cost of $1.13 billion. Parts of this roadmap have already been implemented with cold ironing in place for two container terminals, preventing more than 0.04 Mt CO_2e.[35] Vehicle electrification is in progress and is anticipated to be completed by 2030. Other aspects of the plan including electrifying marine vessels, such as tugs, are still in pre-commercial development.

Electrification projects require a diverse range of skilled workers to construct new electricity and communication structures, build out electrical grids, manufacture storage batteries, and modify ships. Modelling of the job impacts of electrifying U.S. ports shows a total of 31,670 total jobs across 15 different sectors.[36] Electrification projects would further add to the important role ports play in the local and national economy.[37]

2.6 Grid interties

In 2024, BC Hydro imported 2,556 GWh of electricity from Alberta — equivalent to 4% of B.C.'s annual electricity demand — while exporting only 314 GWh. [38, 39] Currently, the two provinces share a single transmission interconnection (intertie), located in the southern portion of the

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[34] Vancouver Fraser Port Authority and BC Hydro, *Port of Vancouver Electrification Roadmap 2030: A strategy for advancing electrification opportunities across port activities* (2019). https://sustainableworldports.org/wp-content/uploads/Port-of-Vancouver-Electrification-Roadmap-2030.pdf

[35] Port of Vancouver, "Building a zero-emission port by 2050," November 5, 2021. https://www.portvancouver.com/article/building-zero-emission-port-2050

[36] David Wooley, Betony Jones, Alyssa Cheung and Jerold Brito, "Maritime Port Clean Energy Infrastructure Jobs Study," *Berkeley Public Policy* (2021). https://oceanconservancy.org/wp-content/uploads/2021/09/Maritime-Port-Clean-Energy-Infrastructure-Jobs-Study.pdf

[37] InterVISTAS Consulting Inc., *Port of Vancouver 2021 Economic Impact Study: Executive Summary* (2024). https://www.portvancouver.com/sites/default/files/2024-08/2021-Port-of-Vancouver-Economic-Impact-Study-EXEC-SUMMARY-25Jun2024.pdf

[38] BC Hydro, "2024 Actual Flow Jan-Dec." https://www.bchydro.com/energy-in-bc/operations/transmission/transmission-system/actual-flow-data/historical-data.html

[39] BC Hydro, "2024 Balancing Authority Load Jan-Dec." https://www.bchydro.com/energy-in-bc/operations/transmission/transmission-system/balancing-authority-load-data/historical-transmission-data.html

provinces, which can transfer up to 1,200 MW from B.C. to Alberta and 1,000 MW from Alberta to B.C.

The economic and environmental benefits of expanding B.C.–Alberta interconnection capacity have been explored previously. For example, a 2023 analysis by Navius Research found that B.C.'s GDP would increase by $816 million per year if the intertie capacity between Alberta and B.C. was doubled.[40] Similarly, our own analysis found that doubling the B.C.–Alberta intertie would cost around $3 billion, resulting in an increase in net-exports from Alberta to B.C. of around 1,800 GWh per year and an average savings of $54 million per year for B.C. consumers. And, with most exports from Alberta occurring during periods of high wind or solar generation, there would be limited emissions associated with this new influx of electricity.[41] Further, the construction of an intertie of this size would generate an estimated 2,200 direct jobs.[42]

2.7 Hydrogen

Over the past decade, hydrogen has been explored as a clean, versatile energy carrier in certain contexts. Proponents of hydrogen tout its ability to reduce emissions economy-wide by replacing (or being blended into) fossil fuel inputs, such as natural gas for residential space heating or diesel for long-haul trucking. In 2021 the B.C. government released its hydrogen strategy, outlining its aspirations to reduce the province's emissions through deploying hydrogen across various economic sectors, including transportation, industry and synthetic fuels, and blending into the natural gas network.[43] However, a recent freedom of information release indicates that several B.C.-based hydrogen projects have been cancelled or put on hold, suggesting the province's hydrogen ambitions may be at risk.[44]

The future use cases of hydrogen are compared in the Hydrogen Ladder, which ranks them from necessary to uncompetitive. Low carbon hydrogen is the top contender in only a handful of industries where it is required as an input for an industrial process, such as fertilizer (ammonia)

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[40] Sam Harrison, *The value of interprovincial transmission for a net-zero future* (Navius Research, 2023), 8-12. https://www.naviusresearch.com/wp-content/uploads/2023/05/Electricity-camp-presentation-Sam-Harrison-2023-05-26-public.pdf

[41] Will Noel and Binnu Jeyakumar, *Zeroing In: Pathways to an affordable net-zero grid in Alberta* (Pembina Institute, 2023), 24. https://www.pembina.org/reports/zeroing-in.pdf

[42] Assuming a job-factor of 5.05 direct jobs per million dollars spent and a construction timeline of five years. Michael Goggin, "Transmission and Jobs" *Americans for a Clean Energy Grid* July 24, 2020. https://www.cleanenergygrid.org/transmission-and-jobs/

[43] Government of British Columbia, *B.C. Hydrogen Strategy: A sustainable pathway for B.C.'s energy transition* (2021), 19. https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/electricity-alternative-energy/electricity/bc-hydro-review/bc_hydrogen_strategy_final.pdf

[44] Jason Proctor, "B.C.'s hopes for a hydrogen economy are under threat. Here's why," *CBC News*, March 27, 2025. https://www.cbc.ca/news/canada/british-columbia/hydrogen-energy-projects-paused-foi-1.7492961

and methanol production, hydrogenation, and certain oil refining activities (e.g. hydrocracking and desulphurization).[45]

Unsurprisingly, these findings align with current global hydrogen demand, which remains concentrated in refining (45%), ammonia (33%) and methanol (17%) production, and steel manufacturing (5%).[46] Outside these applications, it is unclear if or when clean hydrogen will play a key role in decarbonization, especially considering the rapid cost declines of renewable electricity generation (wind and solar) and battery energy storage technologies over the past decade.[47,48] As such, our analysis only explores those opportunities that align with the Ladder's findings and are relevant to the B.C. economy, namely refining and ammonia. We find that while there are emissions reduction opportunities from pursuing hydrogen in these contexts, costs are high enough that current policy mechanisms are unlikely to prompt investment.

2.7.1 Refining

British Columbia has two operational oil refineries, located in Parkland and Burnaby, with a combined output capacity of 67,000 barrels per day. They produce fuels such as gasoline, diesel, and jet fuel. As part of their refining processes, these facilities consume a combined 11,200 tonnes of hydrogen per year, produced on-site through steam reforming,[49] and emitting an estimated 0.13 Mt CO_2e per year of operation.

Our analysis suggests that the hydrogen demand of both oil refineries could be met by a 65 MW electrolyzer, consuming 541 GWh of electricity per year and reducing emissions by over 95%. The construction of the $157 million facility could create an estimated 444 direct jobs and a total of 660 jobs while contributing up to $96 million in GDP. Operations of the facility would cost an additional $71 million per year, generating 245 direct jobs, 360 total jobs, and $61 million in GDP. However, over its 20-year lifespan, we estimate this project would cost between $501 and $567 per tonne of CO_2e avoided — approximately five to six times the current carbon price of $95/tonne.

[45] Nathan Johnson et al. "Realistic Roles for Hydrogen in the Future Energy Transition," *Nature Reviews Clean Technology* 1 (2025), 357. https://doi.org/10.1038/s44359-025-00050-4

[46] International Energy Agency, *Global Hydrogen Review 2024,* 28-32. https://www.iea.org/reports/global-hydrogen-review-2024

[47] Lazard, *Levelized Cost of Energy+* (2025), 14. https://www.lazard.com/media/eijnqja3/lazards-lcoeplus-june-2025.pdf

[48] Euan Graham and Nicolas Fulghum, *Global Electricity Review 2025* (Ember, 2025), 29. https://ember-energy.org/app/uploads/2025/04/Report-Global-Electricity-Review-2025.pdf

[49] Zen and the Art of Clean Energy Solutions, *British Columbia Hydrogen Study* (2019), 105. https://www2.gov.bc.ca/assets/gov/government/ministries-organizations/zen-bcbn-hydrogen-study-final-v6.pdf

2.7.2 Ammonia

Trigon Pacific Terminals is in the process of expanding its operations in Prince Rupert, B.C., doubling its terminal capacity with infrastructure designed to handle ammonia exports.[50] In February 2025, Trigon signed an agreement with a South Korean-based Economic Zone Authority to allow for the export of up to 2 million tonnes of ammonia per year.[51] Given that B.C. does not currently have any internal manufacturing capacity, the ammonia would have to be shipped in by rail from Alberta, resulting in up to 4.4 Mt CO_2e per year of emissions from its manufacturing and transport.

Our analysis shows that offsetting one-tenth of this demand would require a 234 MW green-hydrogen-based ammonia production plant, consuming 1,950 GWh of electricity per year, reducing emissions by up to 10%. Construction of the $683 million facility would create an estimated 2,200 direct jobs, generating $430 million in GDP, with an additional 900 direct jobs and $231 million in GDP for every year of operation. Over the 20-year lifespan of the project, we estimate an average production cost of $1.68 per kg, which is more than quadruple the current market price for ammonia in Northeast Asia.[52]

[50] Trigon Pacific Terminals, "Projects: Berth Two Beyond Carbon." https://web.archive.org/web/20250425090628/https://www.trigonbc.com/projects/

[51] Radha Agarwal, "Northern BC terminal partners with South Korean authority to advance ammonia fuel project," *The Northern View*, February 19, 2025. https://thenorthernview.com/2025/02/20/northern-bc-terminal-partners-with-south-korean-authority-to-advance-ammonia-fuel-project/

[52] Assuming a currency conversion rate of 0.73 between U.S. and Canadian dollars. Business Analytiq, "Ammonia Price Index: Ammonia price June 2025 and outlook." https://businessanalytiq.com/procurementanalytics/index/ammonia-price-index/

3. Comparison of sector impacts

To illustrate the demands of electrifying LNG and the opportunity costs this would impose on the B.C. economy, we have modelled various scenarios of electrification and development of other sectors with significant GDP and low carbon growth potential as identified in Section 2: critical minerals mining, battery manufacturing, data centres. These three sectors are poised to grow globally in the coming decades, representing an opportunity for B.C. with limited stranded asset risk — but they also require access to low-emitting electricity, not on-site gas generators, to be aligned with clean growth objectives.

Our comparative analysis is broken into two parts. First, we unpack the effects of construction on the B.C. economy, analyzing the economic impacts of building new LNG terminals versus the emerging and energy-transition aligned sectors. Second, we compare the annual economic and emissions implications of three representative electrification pathways with increasing levels of diversification.

Estimates for the economic impact of each sector have been estimated using input-output multipliers published by Statistics Canada to estimate the direct, indirect, and induced effects on GDP and jobs from an exogenous change in final demand for the output or input of a given industry. This is a widely used method for estimating economic impacts and an effective way to compare results across different sectors. See Appendix A for details.

For this analysis, we have included the following LNG projects: LNG Canada Phase 1 (operational impacts only), LNG Canada Phase 2, Ksi Lisims LNG, Woodfibre LNG, Tillbury Expansion Phase 2, and Cedar LNG.

3.1 Economic impacts of construction

The benefits of building LNG terminals have been widely touted for providing thousands of jobs and boosting GDP.[53] Our analysis shows that other sectors offer similar, if not greater benefits while diversifying the workforce and providing jobs in emerging sectors. On average, a single critical mineral mine offers similar GDP impacts per unit of installed electricity demand (i.e. the megawatts of grid capacity required to electrify the project) as five LNG terminals combined (Figure 1).[54] Lithium battery plants and data centres also have a greater contribution to GDP per megawatt on average than the LNG terminals being considered.

[53] Government of British Columbia, "LNG Canada," 2023. https://www2.gov.bc.ca/gov/content/industry/natural-gas-oil/lng/lng-projects/lng-canada

[54] We have not included LNG Canada Phase 1 as construction was completed in June 2025.

Similar outcomes are found when looking at job creation.[55] Construction activities for a typical critical mineral mine are expected to create nearly 23 direct jobs per megawatt of demand: approximately 92% the impact of LNG Canada Phase 2 and almost as much as Cedar and Woodfibre combined. Battery plants and data centres generate more jobs on a per MW basis than most LNG terminals but also have shorter construction periods due to their smaller sizes.

Construction economic impacts of port electrification were found to be small and are not included in the results presented here. Grid intertie expansion was also not included here as it is not (exclusively) a source of electricity demand as the other industries are.

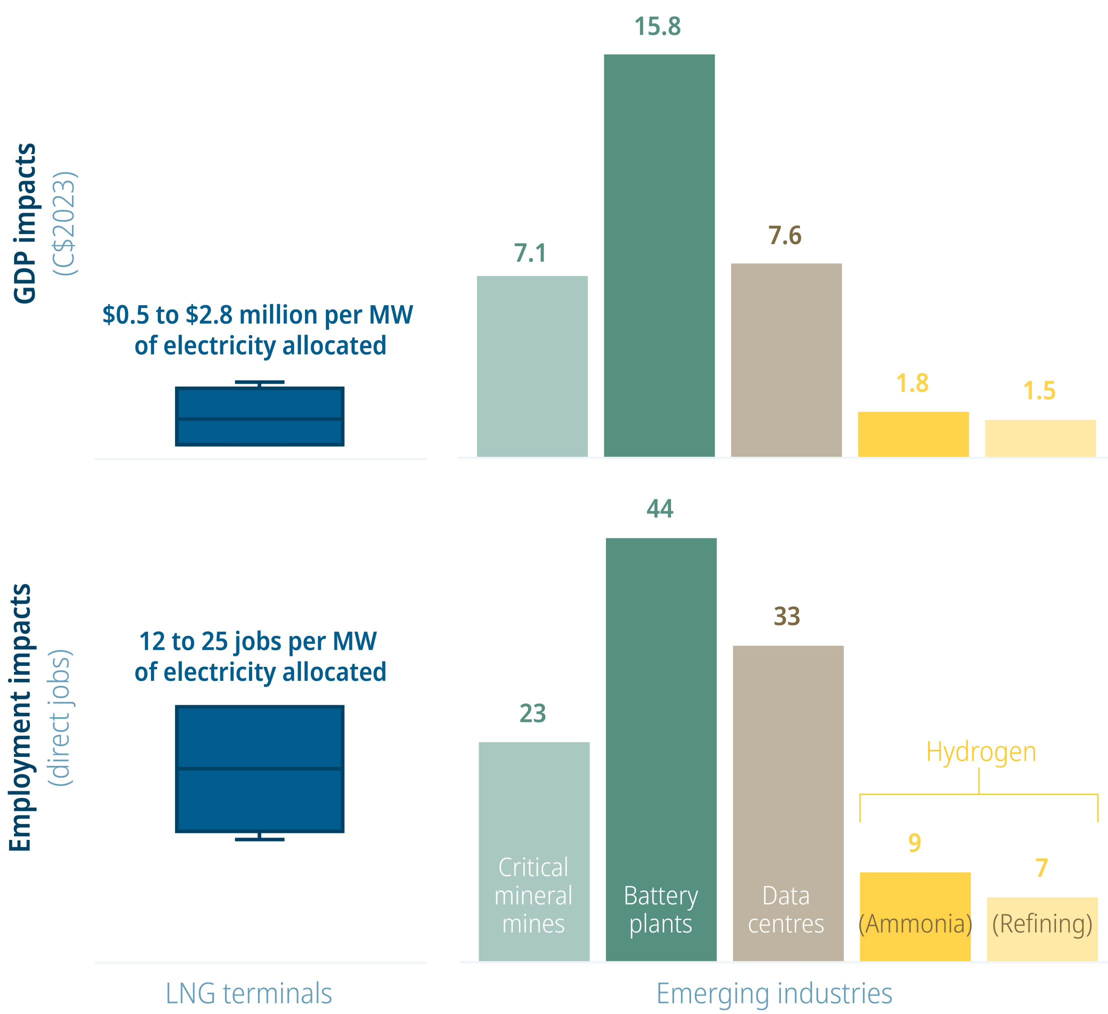

Figure 1. GDP and employment impacts of LNG terminal construction versus development of other industries

[55] Except for Tilbury Phase 2 expansion, which appears to be an outlier. Numbers are based on modelling published by Fortis BC. FortisBC, *Tilbury Phase 2 LNG Expansion Project – Detailed Project Description* (2022), 10-64. https://www.projects.eao.gov.bc.ca/api/public/document/61d61dc5733ef50022683d05/download/FortisBC_Tilbury_DPD_Final_Jan2022.pdf

3.2 Economic and emissions impacts of operations

In this section, we present three different scenarios of electrification of LNG and different combinations of the development of industries outlined in the previous section. Descriptions of the chosen scenarios are presented below, followed by a comparison of annual operations impacts. We find that a diversified approach to clean electricity allocation — rather than a focus on LNG — has the best outcome for B.C. in terms of GDP impacts and job creation, while staying within the limits of available grid capacity.

3.2.1 Scenarios

Build-out of new sectors in each scenario is limited by the additional electricity generation available from the 2024 and 2025 calls for power, Site C Hydroelectric Dam, and future build out of an intertie with Alberta (Figure 2).[56]

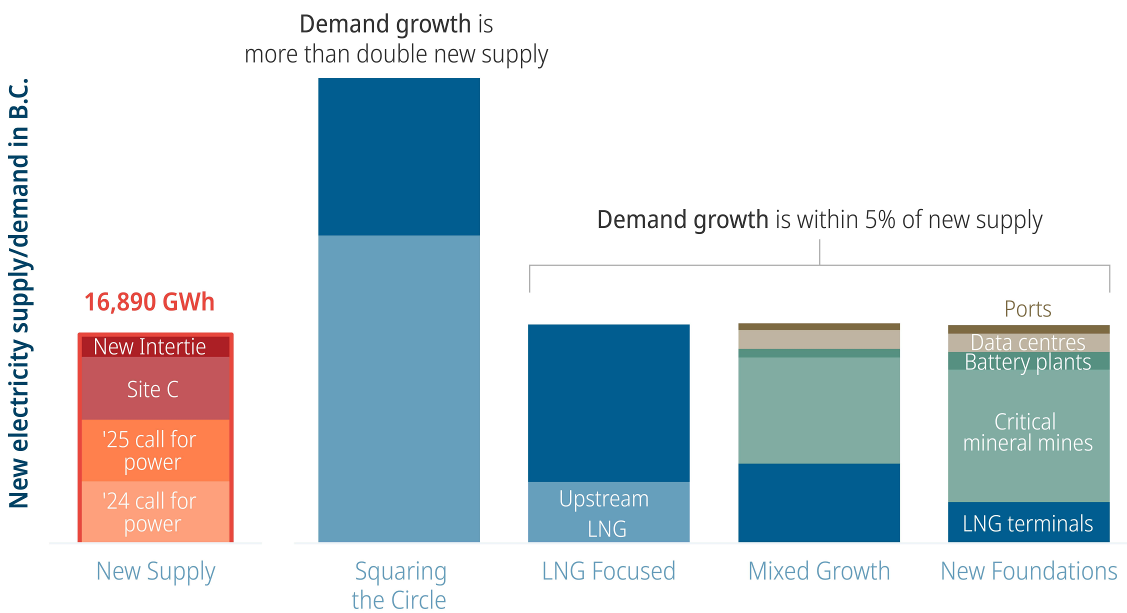

Figure 2. Electricity supply and demand balance for future scenarios

Building off the analysis in our 2023 *Squaring the Circle* report, the *LNG Focused* scenario explores the impact of dedicating all additional electricity generation towards electrifying new LNG terminals and partially electrifying upstream LNG, as there is insufficient supply to fully electrify (see Figure 2). As highlighted in its name, this scenario is the most bullish on

[56] A fourth scenario consistent with our analysis in *Squaring the Circle* is presented in Figure 2, showing the electricity demand of electrifying both LNG terminals and upstream activities. However no further exploration of this scenario is presented as demand growth far outweighs new supply. Jan Gorski and Jason Lam, *Squaring the circle: Reconciling LNG expansion with B.C.'s climate goals* (Pembina Institute, 2023), 14. https://www.pembina.org/pub/squaring-circle

expanding B.C.'s LNG sector, leaving no leftover clean electricity to diversify the economy in the coming decades. The *Mixed Growth* scenario presents a more diversified approach, with less aggressive LNG electrification leaving electricity for other sectors. Finally, the *New Foundations* scenario illustrates the potential benefits of limiting LNG development to projects already under construction, while redirecting available clean electricity toward diversifying the economy. While our analysis includes all the sectors discussed in Section 2, impacts were largest for critical minerals mining, battery manufacturing, data centres and ports, and only these results are illustrated here. We assume intertie expansion occurs in all scenarios, so we have not included it in the economic comparison.

These scenarios are meant to broadly illustrate the potential economic benefit other sectors could provide. This can be applied as well outside of the sectors we have chosen as part of this analysis. This is particularly relevant for battery manufacturing, which we use to represent downstream manufacturing utilizing critical minerals. Other alternatives could include material processing or electronic component manufacturing.

Table 2. Summary of scenarios

	LNG Focused	Mixed Growth	New Foundations
LNG electrification			
Upstream LNG	Partial	None	None
LNG Canada Phase 1			Partial
LNG Canada Phase 2	Full	Partial	(Not built)
Woodfibre LNG			Full
Tilbury Phase 2 Expansion		Full	(Not built)
Cedar LNG			Full
Ksi Lisms	Full	Partial	(Not built)
Diversified sector development			
Critical Minerals (production capacity)	No development	400,000 tonnes (~4 new mines)	500,000 tonnes (~5 new mines)
Battery Plants (manufacturing capacity)		20 GWh_{cell} (~2 facilities)	40 GWh_{cell} (~4 facilities)

Data Centres (computation capacity)		200 MW (~2 data centres)	
Ports electrified		Vancouver	Vancouver and Prince Rupert

3.2.2 Economic impacts

Here we illustrate the economic impacts for an average annual year of operations for each scenario outlined. We frame the comparison in terms of the opportunity cost; that is, the GDP and jobs lost from other sectors if all clean electricity is allocated to LNG development. This analysis suggests that the opportunity cost of committing 100% of the clean electricity available to LNG development (i.e. *LNG Focused*) would be over $5.5 billion in GDP and 7,000 direct jobs per year of operation. This does not consider the added benefits of diversifying the economy and fostering new and growing sectors aligned with the clean energy transition as opposed to LNG's uncertain future.[57] The benefits of diversification are significant in both the *Mixed Growth* and *New Foundations* scenario, generating more than double the GDP and creating close to triple the jobs relative to *LNG Focused*. The *LNG Focused* scenario delivers the lowest GDP and jobs impacts of the three scenarios, with most of the GDP growth coming from upstream rather than the terminals themselves.[58]

LNG projects generate most of their economic impacts during the construction phase, particularly when it comes to job creation. Once operational, value capture shifts from local economies to global markets as benefits accrue to companies and shareholders. Meanwhile, the other sectors considered generate relatively higher levels of GDP during operation. Critical mineral mines require significant amounts of labour while producing valuable raw materials, boosting GDP impacts. Battery plants produce high-value goods that can be exported while generating skilled labour jobs which boosts local economies.

[57] International Institute of Sustainable Development, "Why Liquefied Natural Gas Development in Canada is Not Worth the Risk," June 4, 2024. https://www.iisd.org/articles/deep-dive/lng-expansion-canada-not-worth-risk

[58] We have assumed royalties were included in the GDP figures from the CBC report. We estimate them to be approximately $413 million based on the projects we have considered.

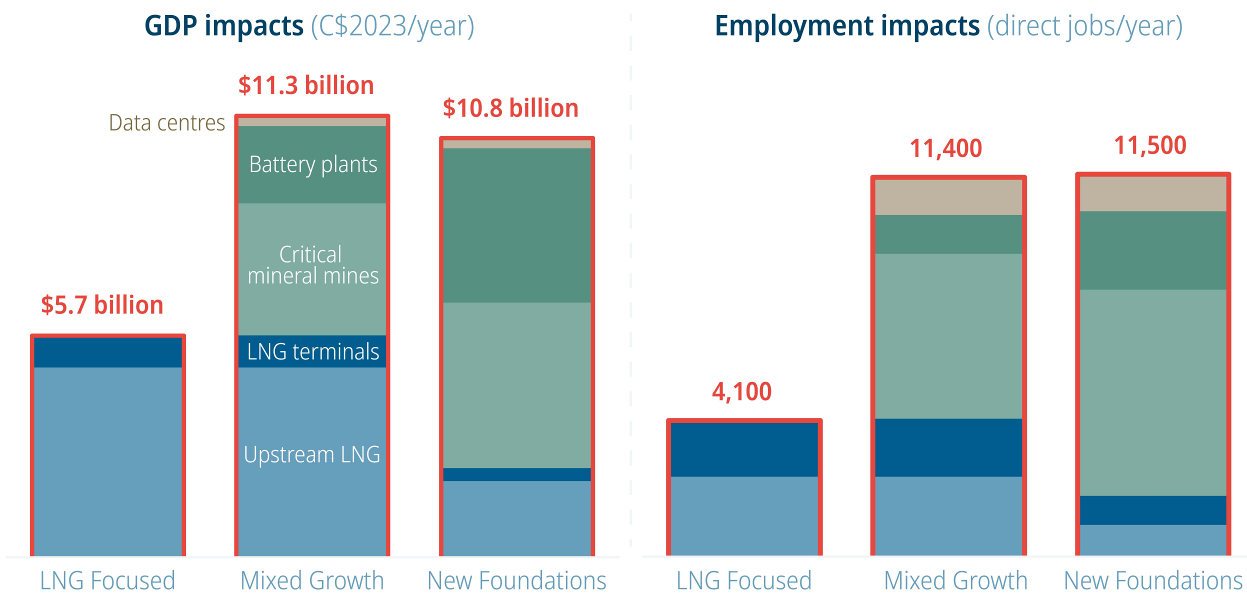

Figure 3. Annual GDP and employment impacts from operations across scenarios

3.2.3 Emissions impacts

Emissions across the scenarios are generated predominantly by upstream natural gas development, especially when it is not electrified (Figure 4). Unsurprisingly, the *New Foundations* scenario results in the lowest overall emissions (upstream LNG plus other sectors) at 18 Mt CO_2e per year, primarily driven by the assumption that several LNG terminals — and the associated upstream capacity — are not realized. However, somewhat counterintuitively, the *Mixed Growth* scenario has the highest overall emissions at 30 Mt CO_2e per year, making it ~4 Mt CO_2e higher than the *LNG Focused* scenario. This difference stems from a combination of factors; we assume no electrification of upstream LNG activities (+0.6 Mt CO_2e) and only partial electrification of LNG Canada Phase 2 (+1.3 Mt CO_2e) and Ksi Lisms (+1.7 Mt CO_2e). Instead, the *Mixed Growth* scenario dedicates this electricity to four critical mineral mines (+0.48 Mt CO_2e), two battery manufacturing facilities (+0.1 Mt CO_2e), two data centres (+0.03 Mt CO_2e) and the Port of Vancouver (-0.25 Mt CO_2e), resulting in significantly higher economic outcomes (Figure 3).

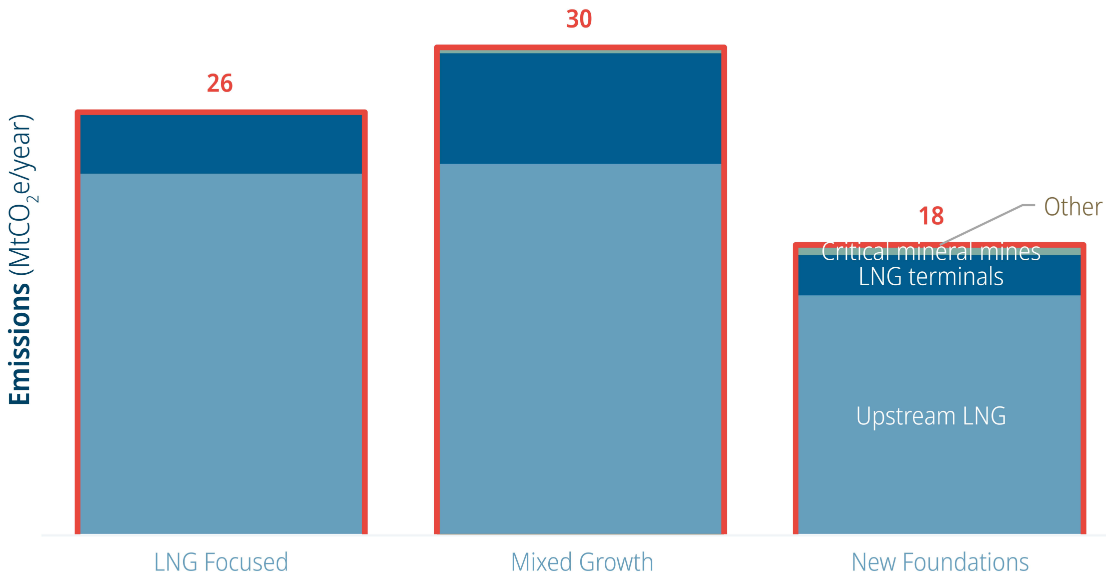

Figure 4. Annual operating emissions across scenarios

Results of our analysis show that heavy diversification would result in the most favourable economic and environmental outcomes. However, if B.C. is to continue developing its LNG sector alongside other opportunities (i.e. *Mixed Growth)*, this work highlights the need for further emissions reductions in the oil and gas sector beyond electrification — such as flaring and methane reduction — to mitigate climate risks and ensure B.C. LNG remains competitive in an increasingly climate-conscious global market. Maintaining and improving B.C.'s methane regulations are critical to addressing upstream emissions, as is strong industrial carbon pricing to prompt investment in decarbonization, including carbon capture and storage, across B.C.'s industrial sectors including natural gas production. For instance, our previous analysis finds that carbon capture deployed at natural gas sites in the North Montney could reduce stationary combustion and venting emissions by 1.6 Mt CO_2e/year.[59]

[59] Matt Dreis, *Decarbonizing British Columbie's Upstream Gas* (Pembina Institute, 2025), 14. https://www.pembina.org/pub/decarbonizing-british-columbias-upstream-gas

4. Conclusions

This report has shown that a **focus on LNG comes with significant opportunity costs.** Sectors like critical minerals, battery manufacturing, and data centres offer greater GDP and job creation than LNG projects. Diversifying across various sectors offers significant GDP and job impacts over and above those delivered by LNG alone.

This suggests that **prioritizing clean electricity for LNG development risks crowding out other emerging sectors** that could — if powered by B.C.'s low-emitting electricity — be key GDP- and job-creators, while staying aligned with clean growth objectives. The government of British Columbia has opportunities to address this:

1. **Public financing decisions should take into account the risks of over-investing in LNG, at the expense of industries with more benefits to British Columbians.**
    - Critical minerals mines provide a significant opportunity for GDP and jobs growth while directly competing with LNG for transmission connection and workers. Developing this sector could also be coupled with development of a battery supply chain (among other electronics manufacturing), greatly increasing economic impacts.
    - Diversification offers more than economic gains — it spreads risk across emerging and energy-transition aligned sectors and lowers the chance of stranded assets by reducing reliance on volatile global LNG markets, where demand is uncertain and supply is projected to rise sharply.[60]
2. **An electricity allocation plan can provide certainty and opportunity for emerging sectors**. The recent Energy Statutes Amendment Act tabled would be a step towards a framework that prioritizes distribution of clean electricity to economic sectors that deliver the greatest benefit to British Columbians.[61] However, this act has prioritized the development of natural resources while limiting electricity available to other sectors that our report shows provide greater impacts on a per-MW basis. Instead, we suggest that sectors be evaluated equally for their economic impacts and decarbonization potential.

[60] *An Uncertain Future*.

[61] Government of British Columbia, "New legislation powers economy with clean energy, North Coast Transmission Line," news release, October 20,2025. https://news.gov.bc.ca/releases/2025ECS0044-001032

Appendix A. Opportunity analysis inputs and assumptions

A.1 Methodology

A.1.1 Input-output modelling

We have estimated the economic impacts of each sector in this analysis using an input-output analysis approach. This methodology uses input-output multipliers published by Statistics Canada to estimate the direct, indirect, and induced effects on GDP and jobs from an exogenous change in final demand for the output or input of a given industry. This is a widely used method for estimating economic impacts and an effective way compare results across different sectors.

For some sectors we have utilized existing reports that use this methodology. For the remainder we have conducted our own analysis. All assumptions and modelling inputs are presented by sector in the remainder of this appendix.

A.1.2 Limitations

Input-output models and analysis are useful for clear, comparable multiplier analysis, but there are limitations to the methodology and the results produced.[62] Estimates are generally broad, order-of-magnitude indicators rather than precise estimates. This has been accounted for by use the same methodology across each sector and focusing the analysis on the differences between scenarios. Consequently, the results should be interpreted as showing the relative variance among scenarios, not as exact estimates of nominal economic impacts.

[62] T. Gunton, C. Gunton, C. Joseph, and M.Pope, "Evaluating Methods for Analyzing Economic Impacts in Environmental Assessment," *Knowledge Synthesis Report prepared for Social Science and Humanities Research Council of Canada* (2020). https://remmain.rem.sfu.ca/papers/gunton/sshrc_cea_Report_Final_March_31_2020.pdf

A.2 General inputs and assumptions

A.2.1 Economic multipliers

Table 3. Economic indicator multipliers for within British Columbia, 2021

Industry [Industry Code]	GDP at market prices (per dollar of output)				Jobs (per million dollars of output)			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Oil and gas extraction (except oil sands) [BS211110]	0.738	0.094	0.039	0.871	0.116	0.797	0.262	1.175
Electric power generation, transmission and distribution [BS221100]	0.781	0.137	0.113	1.031	1.303	1.266	0.753	3.322
Water, sewage and other systems [BS221300]	0.513	0.316	0.154	0.983	1.970	2.948	1.027	5.945
Non-residential building construction [BS23B000]	0.468	0.232	0.212	0.912	3.736	1.954	1.410	7.100
Electric power engineering construction [BS23C300]	0.421	0.229	0.154	0.804	1.826	1.851	1.027	4.704
Other engineering construction [BS23C500]	0.334	0.271	0.199	0.804	2.383	1.971	1.323	5.677
Repair construction [BS23D000]	0.573	0.170	0.242	0.985	7.013	1.633	1.609	10.255
Basic chemical manufacturing [BS325100]	0.355	0.307	0.146	0.808	1.143	2.003	0.974	4.120
Industrial machinery manufacturing [BS333200]	0.444	0.150	0.176	0.770	2.621	1.211	1.169	5.001
Other electrical equipment and component manufacturing [BS335900]	0.317	0.178	0.239	0.734	3.613	1.483	1.588	6.684
Telecommunications [BS517000]	0.619	0.150	0.121	0.890	2.178	1.255	0.804	4.237
Other information services [BS519000]	0.485	0.246	0.228	0.959	2.870	2.145	1.517	6.532

Financial investment services, funds and other financial vehicles [BS52A000]	0.320	0.483	0.242	1.045	2.403	3.254	1.612	7.269
Rental and leasing services (except automotive equipment) [BS532A00]	0.576	0.192	0.180	0.948	3.505	2.006	1.201	6.712
Office administrative services [BS561100]	0.714	0.159	0.241	1.114	4.691	1.583	1.605	7.879
Repair and maintenance (except automotive) [BS811A00]	0.593	0.187	0.257	1.037	7.658	1.696	1.710	11.064

Source: Statistics Canada[63]

Table 4. Gross domestic product deflator for Canada, Q1 2020 to Q1 2025

Year	GDP deflator index, seasonally adjusted			
	Q1	Q2	Q3	Q4
2020	114.85	113.70	116.15	118.33
2021	121.33	124.30	125.53	128.00
2022	132.38	136.61	134.89	134.93
2023	134.31	135.03	137.43	139.31
2024	138.92	140.37	141.25	142.53
2025	143.45	-	-	-

Source: International Monetary Fund via Federal Reserve Bank of St. Louis[64]

A.2.2 Industrial electricity cost

Industrial electricity prices are estimated using BC Hydro Large General Service Rate.[65] In July 2025, business customers with a peak demand greater than 150 kW (or an annual consumption greater than 550 MWh) are billed:

- Basic (fixed) charge of 29.81 ¢/day

[63] Statistics Canda, "Table 36010-0595-01 Input-output multipliers, provincial and territorial, detail level." https://doi.org/10.25318/3610059501-eng

[64] International Monetary Fund, "Gross Domestic Product Deflator for Canada," retrieved from FRED, Federal Reserve Bank of St. Louis," 2025. https://fred.stlouisfed.org/series/NGDPDSAIXCAQ

[65] BC Hydro, "General Service Business Rates: Large general service rate." https://app.bchydro.com/accounts-billing/rates-energy-use/electricity-rates/business-rates.html

- Demand charge of $13.75/kW
- Energy charge of 6.75 ¢/kWh

Using the above inputs, we estimate the electricity costs for a facility as:

$$\text{Electricity Cost} = (\text{Fixed charge})(365\ \text{days/year}) + (\text{Demand charge})(\text{Peak electricity demand}) + (\text{Energy charge})(\text{Annual electricity demand})$$

A.2.3 Industrial natural gas cost

Industrial natural gas prices are estimated using the FortisBC General Firm Service natural gas rate.[66] In July 2025, businesses consuming more than 5,000 GJ/year of natural gas are billed:

- Basic (fixed) charge of $469.40/month
- Demand charge of $34.02/peak daily GJ/month
- Variable charge of $6.46/GJ

Using the above inputs, we estimate the natural gas costs for a process as:

$$\text{Natural gas cost} = (\text{Fixed Charge})(12\ \text{months/year}) + (\text{Demand charge})(\text{Peak daily gas consumption})(12\ \text{months/year}) + (\text{Variable charge})(\text{Annual gas consumption})$$

A.2.4 Emissions factors

For the purpose of this report, we assume the following emissions intensity factors:

- Electricity: 18 tCO_2e/GWh [67]
- Natural gas: 1,966 $kgCO_2e/m^3$ [68]
- Diesel: 2,681 gCO_2e/L [69]

[66] Fortis BC, "Business natural gas rates: Rate 5." https://www.fortisbc.com/accounts/billing-rates/natural-gas-rates/business-rates#tab-3

[67] Environment and Climate Change Canada, "Canada's Official Greenhouse Gas Inventory" 2025, Annex 13. https://data-donnees.az.ec.gc.ca/data/substances/monitor/canada-s-official-greenhouse-gas-inventory/C-Tables-Electricity-Canada-Provinces-Territories?lang=en

[68] Environment and Climate Change Canada, "Emissions factors and reference values: Version 2.0" 2024. https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/output-based-pricing-system/federal-greenhouse-gas-offset-system/emission-factors-reference-values.html

[69] "Emissions factors and reference values: Version 2.0"

A.3 Sector-specific inputs and assumptions

A.3.1 Liquefied natural gas

Table 5 provides detailed information about the five LNG projects considered as part of this analysis.

Table 5. Summary of LNG projects included in this analysis

	LNG Canada		Ksi Lisims LNG[70]	Woodfibre LNG	Tilbury Phase 2 Expansion[71]	Cedar LNG[72]
	Phase 1	Phase 2				
Location	Kitimat		Will Milit, near Prince Rupert	Woodfibre, near Squamish	Delta	Kitimat
Proponent	Shell, PETRONAS, PetroChina Company Limited, Mitsubishi Corporation, and Korea Gas Corporation		Nisga'a Nation, Rockies LNG and Western LNG	Woodfibre LNG Limited, a subsidiary of Singapore-based Pacific Oil & Gas Limited	FortisBC	Haisla Nation and Pembina Pipeline Corporation
Estimated capital cost	$25 to 40 billion[73]		$8.3 to 9.0 billion	$5.1 billion[74]	$3 to 4 billion[75]	$1.8 to 2.5 billion
Capacity (MTPA)	14	14	12	2.1	Phase 1A: 0.9 Phase 2: 3.5	3 to 4

70 Ksi Lisims LNG, *Natural Gas Liquefaction and Marine Terminal Project: Detailed Project Description* (BC EAA 2018, IAA 2019) (2022). https://www.projects.eao.gov.bc.ca/api/public/document/626856e03b4cc60022207c7a/download/Ksi%20Lisims%20DPD%2020220425.pdf

71 *Tilbury Phase 2 LNG Expansion Project – Detailed Project Description*

72 Stantec Consulting Ltd., *Detailed Project Description: Cedar LNG Project - Liquefaction and Export Terminal,* prepared for Cedar LNG (2019). https://iaac-aeic.gc.ca/050/documents/p80208/133319E.pdf

73 Natural Resources Canada, "Canadian LNG Projects." https://natural-resources.canada.ca/energy-sources/fossil-fuels/canadian-liquified-natural-gas-projects

74 Nia Williams and Arunima Kumar, "Canada's Enbridge to invest $1.5 billion in Pacific Energy's Woodfibre LNG project," *Reuters*, July 29, 2022. https://www.reuters.com/business/energy/canadas-enbridge-partners-with-pacific-energy-woodfibre-lng-2022-07-29/

75 The Canadian Press, "FortisBC eyes expansions after inking deal to send LNG by container to China," July 17, 2019. Available at https://www.theglobeandmail.com/business/industry-news/energy-and-resources/article-fortisbc-eyes-expansions-after-inking-deal-to-send-lng-by-container-to/

Associated pipeline project	670 km of new pipeline linking Dawson Creek to Kitimat — Coastal GasLink (TransCanada Corp.)		Enbridge Westcoast Connector Gas Transmission TC Energy Prince Rupert Gas Transmission	47 km of new pipeline linking the existing FortisBC network near Coquitlam to Woodfibre — Eagle Mountain–Woodfibre Gas (FortisBC)	FortisBC pipeline infrastructure	Connected to Costal GasLink pipeline
Start year	2025	2030	2027	2027	2028	2027
Lifetime	At least 25 to 40 years[76]		Minimum 30 years	Minimum 25 years	40 to 60 years	20 to 40 years
Choice of power source	Phase 1: Natural gas turbines for compression load Phase 2: Currently unclear; full electrification possible in the future Grid electricity for non-compression load		Grid electricity for both compression and non-compression loads If grid electricity is not available, self-generation with natural gas	Grid electricity for both compression and non-compression loads BC Hydro infrastructure exists adjacent to the proposed site; will only require an upgraded electric substation	Grid electricity for both compression and non-compression loads Will use only electrically driven compressors	Grid electricity for both compression and non-compression loads Environmental assessment was approved with electricity used for compression loads; self-generation no longer being pursued

Economic impacts

We reference input-output modelling completed by the Conference Board of Canada (CBoC) for estimates of the GDP impacts within B.C. of developing LNG terminals. This modelling provides the total impacts under a scenario that sees the build out of 56 MTPA of LNG across six LNG facilities. We have matched the projects we consider in this report to those modelled based on their capacity and location. We then apportioned GDP impacts based on each project's share of

[76] Tarika Powell, *2019 Update: Mapping BC's LNG Proposals* (Sightline Institute, 2019), 8. https://www.sightline.org/research_item/maps-british-columbia-lng-proposals/

total capacity. For job impacts we have referenced Clean Energy Canada's[77] recent report which provides direct employment in B.C. for construction and operation of the cited LNG terminals.[78]

Table 6. Matched projects to CBoC analysis

Conference Board of Canada	Capacity (MTPA)	Build date	Pembina matched project	Share of output
LNG Canada Phase 1	14	2020	LNG Canada Phase 1	25%
LNG Canada Phase 2	14	2023	LNG Canada Phase 2	25%
Northwestern facility	4	2024	Cedar LNG	7%
Lower mainland Facility	2.1	2025	Woodfibre LNG	4%
Lower mainland Facility	4	2027	Tilbury Phase 2 Expansion	7%
Northwestern Plant	12	2024	Ksi Lisims LNG	21%
Northwestern Plant - Expansion	6	2029	Not included	11%

Data source: Conference Board of Canada[79]

Upstream impacts induced by the development of LNG terminals are also included as part of this analysis. To align with the B.C. government's assumptions, we assumed that 60% of natural gas supply for this project would come from new incremental production in B.C. GDP impacts are estimated using input-output multipliers from Statistics Canada.

[77] *An Uncertain Future*.

We note one correction from the report which states the total number of direct construction jobs for Tilbury LNG of 6,000 FTE as an annual figure. It should instead be 1,200 direct FTEs per year of construction.

Tilbury Phase 2 LNG Expansion Project – Detailed Project Description, 10-64.

[78] We note that the CBoC report provides job impacts, however we deem these to be overestimated based on other reports we have referenced and industry disclosures of expected job impacts.

[79] Bryan Gormley, *A Rising Tide: The Economic Impact of B.C.'s Liquefied Natural Gas Industry* (Conference Board of Canada, 2020). https://www.conferenceboard.ca/wp-content/uploads/woocommerce_uploads/reports/10763_IB_Rising-Tide.pdf

Table 7. Upstream LNG: assumptions and output calculation

Parameter	Value
Total LNG expansion (MTPA)	50.10
B.C. LNG expansion (Bcf/d) [a]	3.96
B.C. upstream capacity required (Bcf/d) [b]	4.30
B.C. annual LNG output (GJ) [c]	1,545,966,128
Output (2021 C$) [d]	$5,134,808,234

[a] Assuming a conversion factor of 1 MTPA per 0.132 Bcf/d[80]

[b] Assuming a shrink factor of 8%[81]

[c] Assuming a conversion factor of 1,094,093 GJ per Bcf of natural gas[82]

[d] Assuming a natural gas price of $3.15/GJ in 2021 Canadian dollars[83]

Emissions

The LNG emissions intensity under the large-scale electrification scenario reflects data from approval documents for each project. The LNG terminal electricity requirements reflect data from approval documents for each project where available; terminals are assumed to run 24 hours a day and 365 days a year. Currently, all projects except for LNG Canada Phase 1 are intending to be fully electrified. As such, our modelling reflects LNG Canada Phase 1 as being only partially electrified, as there have not been any statements made about future electrification of Phase 1 facilities.

An engine thermal efficiency of 35% was used to calculate the electricity needed to replace fuel combustion sources with electrified alternatives.[84] Transmission losses of 6% were assumed, calculated based on data from the Canada Energy Futures.[85]

80 Natural Resources Canada, "Conversion factors and common units to be used for North American Cooperation on Energy Information." https://natural-resources.canada.ca/climate-change/conversion-factors-common-units-used-north-american-cooperation-energy-information

81 Brian Songhurst, *LNG Plant Cost Reduction 2014-2018* (The Oxford Institute for Energy Studies, 2018), 24. https://doi.org/10.26889/9781784671204

82 Canada Energy Regulator, "Energy Conversion Tables." https://apps.cer-rec.gc.ca/Conversion/conversion-tables.aspx

83 Alberta Energy Regulator, "AECO-C Price." https://www.aer.ca/data-and-performance-reports/statistical-reports/alberta-energy-outlook-st98/prices-and-capital-expenditure/natural-gas-prices/aeco-c-price

84 Alberta Energy Regulator, *2018 Alberta Upstream Oil & Gas Methane Emissions Inventory and Methodology*, 51. https://www.aer.ca/documents/ab-uog-emissions-inventory-methodology.pdf

85 Canada Energy Regulator, "Canada's Energy Future 2023 Data Appendices." https://apps.cer-rec.gc.ca/ftrppndc/dflt.aspx?GoCTemplateCulture=en-CA

Table 8. LNG: emissions analysis

LNG Terminal	Upstream emissions[a] (Mt CO_2e/year)		Terminal emissions (Mt CO_2e/year)
	Not electrified	Electrified	
LNG Canada Phase 1 + Woodfibre + baseline B.C. Oil & gas production	13.8	10.7	2.2
LNG Canada Phase 2	4.7	3.6	0.8 - 2.1 [b]
Ksi Lisims LNG	2.7	2.1	0.2 - 1.9 [b]
Tilbury Phase 2	0.7	0.5	0.3
Cedar LNG	0.9	0.7	0.3

[a] Assumes a 22% emissions reduction from electrification of upstream activities[86]

[b] Depending on if the terminal is partially or fully electrified[87]

A.3.2 Critical minerals

Economic impacts

For the economic impacts of critical minerals mines we have utilized a recent study from Mansfield Consulting.[88] The study includes fourteen proposed new critical mineral mines and two existing critical mineral mines for which major extensions have been proposed in B.C. and utilizes an input-output modelling approach.

Table 9. Critical mineral mine: economic impacts from development or extension

	Average economic impacts from development or extension over 3 years ($million)			Jobs
	Output	GDP	Labour income	
Direct	$2,286	$893	$661	6,274
Indirect	$1,087	$587	$379	5,127
Induced	$718	$466	$187	3,927
Total	$4,091	$1,946	$1,227	15,328

[86] *Squaring the Circle*, 10-13.

[87] *Squaring the Circle,* 10-14.

[88] Mansfield Consulting, *Critical Minerals Economic Impact Study,* prepared for the Mining Association of British Columbia (2023). https://mining.bc.ca/wp-content/uploads/2024/01/Mansfield_Critical_Minerals_Economic-Impact-Report_FINAL_2024_01_06.pdf

Data source: Mansfield Consulting

Table 10. Critical mineral mine: economic impacts from operation

	Average economic impacts from operations over lifespan ($million)			Jobs
	Output	GDP	Labour income	
Direct	$25,195	$11,489	$4,838	29,857
Indirect	$9,977	$5,644	$2,998	43,689
Induced	$5,140	$3,351	$1,335	28,169
Total	$40,312	$20,484	$9,171	101,715

Data source: Mansfield Consulting

Emissions

To assess annual emissions from a new critical mineral mine, we use an average emissions intensity from Canada's critical mineral sector, assuming that the amount of electrification at the new mines will match that of existing ones (e.g. no electrified mining trucks).

Table 11. Critical minerals: emissions analysis

Parameter	Value
Critical mineral mining emissions intensity[a] (Mt CO_2e/Mt)	1.2 [a]
Assumed annual production of new mine (Mt)	0.1
Total emissions (Mt CO_2e/year)	0.12

[a] Includes copper, nickel, lead and zinc ore mining. Source: Canadian Climate Institute [89]

A.3.3 Lithium battery plants

Economic impacts

To model the economic impact of a 10 GWh lithium battery plant we have utilized an input-output analysis. Battery manufacturing falls under North American Industry Classification System (NAICS) code BS335900 other electrical equipment and component manufacturing. Total output is estimated using a reference price for lithium-ion battery packs of US$115/kWh

[89] Eyab Al-Aini, *Mining Decarbonization: Enhancing Canada's low-carbon advantage in the global critical minerals race* (Canadian Climate Institute, 2025), 6. https://climateinstitute.ca/wp-content/uploads/2025/05/Mining-decarbonization.pdf

(C$157.50/kWh) from market data,[90] resulting in an annual output of $1,397 million (in 2021 C$). We reference Clean Energy Canada's report for jobs created under cell manufacturing as this aligns more closely with real-world estimates for job impacts.[91]

Emissions

Table 12. Battery manufacturing: emissions analysis, 10 GWh capacity

Parameter	Value
Electricity consumption (GWh) [a]	352
Natural gas consumption (m^3) [b]	26,811
Electricity emissions (Mt CO_2e)	0.06
Natural gas emissions (Mt CO_2e)	< 0.01
Total emissions (Mt CO_2e/year)	0.06

[a] Assuming an energy requirement of 44 kWh per kWh of cell production[92] and an 80% load factor

[b] Assuming a thermal demand of 20 kWh per kWh of cell production[93] and a 90% thermal efficiency

A.3.4 Data centres

Economic impacts

The capital cost of data centres depends on the level of redundancy of the design, typically referred to as "Tiers" (see Section 2.4). Using a calculator developed by Schneider Electric, we estimate the capital cost of small (1 to 5 MW) data centres ranging from Tier I to Tier IV below.

[90] BloombergNEF, "Lithium-Ion Battery Pack Prices See Largest Drop Since 2017, Falling to $115 per Kilowatt-Hour: BloombergNEF," press release, December 10,2024. https://about.bnef.com/insights/commodities/lithium-ion-battery-pack-prices-see-largest-drop-since-2017-falling-to-115-per-kilowatt-hour-bloombergnef/

[91] *Canada's New Economic Engine*.

[92] "Energy consumption of current and future production of lithium-ion and post lithium-ion battery cells."

[93] Nelson Bunyui Manjong et al., "Exploring raw material contributions to the greenhouse gas emissions of lithium-ion battery production," *Journal of Energy Storage* 100 (2024), 113566. https://www.sciencedirect.com/science/article/pii/S2352152X24031529

Table 13. Data centre: capital costs for various sizes and levels of redundancy

Capacity (MW)	Cost ($/MW)			
	Tier I	Tier II	Tier III	Tier IV
1	7.29	8.68	13.92	15.55
2	7.00	8.33	13.28	14.83
3	6.81	8.10	12.82	14.32
4	6.69	7.95	12.54	13.99
5	6.59	7.82	12.30	13.72

Data source: Schneider Electric[94]

Using the *trendline* function in Excel, we then fit a logarithmic curve to each of the above cost curves to estimate the capital cost of data centres larger than 5 MW (the max available in the calculator):

$$\text{Tier I Data Centre Cost per MW of capacity} = -0.436 * \ln(\text{Capacity}) + 7.2937$$

$$\text{Tier II Data Centre Cost per MW of capacity} = -0.534 * \ln(\text{Capacity}) + 8.6875$$

$$\text{Tier III Data Centre Cost per MW of capacity} = -1.011 * \ln(\text{Capacity}) + 13.94$$

$$\text{Tier IV Data Centre Cost per MW of capacity} = -1.142 * \ln(\text{Capacity}) + 15.576$$

We elected to model a 100 MW Tier 3 data centre. Using the equations above and assuming a similar cost breakdown as in the Schneider Electric calculator, we calculate the capital cost of construction.

Table 14. Data centre: capital cost calculations for construction, 100 MW Tier III

Component	Cost ($million)
IT materials	371.37
Construction	232.10
Design/engineering	111.41

94 Schneider Electric, "Data Center Capital Cost Calculator." https://www.se.com/ww/en/work/solutions/system/s1/data-center-and-network-systems/trade-off-tools/data-center-capital-cost-calculator/

Project management	74.27
Building	139.26

Operating costs are estimated using an assumed total cost of ownership of $120,000 per rack of IT equipment, project lifecycle of 10 years, power density of 4 kW per rack,[95] and a cost breakdown of 1% system monitoring, 15% maintenance, and 15% for the land lease.[96] Electricity costs are based on a load factor of 86%.[97] Using these assumption, the annual operating cost breakdown for a 100 MW Tier III data centre is as follows:

Table 15. Data centre: operating cost calculations, 100 MW Tier III

Component	Cost ($million/year)
System monitoring	3
Maintenance	45
Land lease	45
Electricity	52

Emissions

Table 16. Data centre: emissions analysis, 100 MW capacity

Parameter	Value
Electricity consumption (GWh)	753
Electricity emissions (Mt CO_2e)	0.01
Total emissions (Mt CO_2e/year)	0.01

A.3.5 Ports

Economic impacts

Economic impacts come from a 2024 InterVISTAS Consulting report on the Port of Vancouver.

[95] "Data Center Capital Cost Calculator."

[96] Neil Rasmussen, *Determining Total Cost of Ownership for Data Center and Network Room Infrastructure* (APC by Schneider Electric, 2020), 4. https://www.zones.com/images/pdf/apc_infrastruxure02_wp.pdf

[97] Isabelle Riu, Dieter Smiley, Stephen Bessasparis and Kushal Patel, *Load Growth is Here to Stay, but are Data Centers?: Strategically managing the challenges and opportunities of load growth,* (Energy and Environmental Economics, Inc., 2024), 18. https://www.ethree.com/wp-content/uploads/2024/07/E3-White-Paper-2024-Load-Growth-Is-Here-to-Stay-but-Are-Data-Centers-2.pdf

Table 17. Port of Vancouver: summary of economic impacts

	Impact (2021,$billions)	
Parameter	Canada	B.C.
Economic output	$32.7	$24.1
GDP contribution	$16.3	$11.8
Wages	$9.3	$7.1

Data source: Port of Vancouver[98]

Emissions

The emissions reductions from electrifying the Port of Vancouver are estimated at 0.25 Mt CO_2e annually.[99] Emissions reductions for the Port of Prince Rupert are estimated from this to be 0.06 Mt CO_2, assuming the port is approximately 23% the size of the Port of Vancouver.[100]

A.3.6 Grid interties

Economic impacts

Interties allow jurisdictions to trade electricity, with flows of electricity often resulting from an imbalance in price between regions. Using previous modelling results, we can estimate the electricity cost savings for B.C. from an expanded intertie as the difference in import savings between a scenario with the current intertie (importing less electricity at a lower price) and a scenario with an expanded intertie (more electricity at a higher import price, but still lower than the B.C. reference price).

98 InterVISTAS Consulting, *Port of Vancouver 2021 Economic Impact Study* (2024). https://www.portvancouver.com/sites/default/files/2024-08/2021-Port-of-Vancouver-Economic-Impact-Study-EXEC-SUMMARY-25Jun2024.pdf

99 *Port of Vancouver Electrification Roadmap 2030*.

100 Based on container volume, cargo tonnage, and cargo berths. Freightos, "Largest Ports in Canada," 2024. https://www.freightos.com/freight-resources/largest-ports-in-canada/

Table 18. Interties: modelled B.C. electricity import savings

Year	Volume of B.C. imports (MWh)		Average B.C. import price ($/MWh)		B.C. import savings[a] ($million)	
	Current Intertie	Expanded Intertie	Current Intertie	Expanded Intertie	Current Intertie	Expanded Intertie
2030	6,842,798	8,668,009	$7.37	$14.30	$429	$483
2031	7,151,739	8,369,735	$7.54	$14.44	$447	$465
2032	7,316,840	8,676,918	$7.59	$13.70	$457	$488
2033	7,388,565	8,803,549	$7.19	$12.97	$464	$502
2034	7,113,831	9,513,903	$5.48	$11.13	$459	$560
2035	7,117,929	9,642,354	$5.48	$11.17	$459	$567
Average (2030-2035)					$457	$511

[a] Calculated as the volume of imports multiplied by the difference in import price and the $70/MWh B.C. Hydro reference price[101]

Data source: University of Alberta modelling for Pembina Institute[102]

A.3.7 Hydrogen

The total electricity consumption of green hydrogen production via electrolysis (kWh/kg) is estimated using the lower heating value of hydrogen (33.3 kWh/kg),[103] assuming an electrolysis electrical efficiency of 70% and a compression energy of 3 kWh/kg.[104]

Economic impacts

The economics of constructing and operating a green hydrogen production facility are estimated as follows, using an assumed currency conversion of 0.73 US$/C$ where necessary.

[101] BC Hydro and Power Authority, *2021 Integrated Resource Plan: 2023 update* (2023), 22a. https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/regulatory-planning-documents/integrated-resource-plans/current-plan/integrated-resource-plan-2021.pdf

[102] *Zeroing In.*

[103] The Engineering Toolbox, "Higher Calorific Values of Common Fuels: Reference & data." https://www.engineeringtoolbox.com/fuels-higher-calorific-values-d_169.html

[104] Monterey Gardiner, *Energy requirements for hydrogen gas compression and liquefaction as related to vehicle storage needs* (U.S. Department of Energy, 2009), 2-3. https://www.hydrogen.energy.gov/docs/hydrogenprogramlibraries/pdfs/9013_energy_requirements_for_hydrogen_gas_compression.pdf?Status=Master

Table 19. Green hydrogen: economic inputs and assumptions for plant construction

Component	Cost[a] ($/MW)
Electrical connection	$100,388
Electrolyzer system	$504,734
Hydrogen compressor	$139,716
Balance of plant system	$1,324,927
Construction of housing for electrolyzer	$139,058
Computers & IT control	$49,064
Project admin, consulting, etc.	$164,384

[a] Includes a 40% reduction in capital costs from the Clean Hydrogen Investment Tax Credit[105]

Data source: Ruchi Gupta et al.[106]

Table 20. Green hydrogen: economic inputs and assumptions for plant operations

Component	Cost ($/MW)
Water	$5,467
Electricity	$575,594
Electrolyzer operations and maintenance	$124,168
Construction maintenance	$72,741
IT service	$20,548
Financial service	$22,603
Insurance and pension funding	$47,945
Legal, accounting, and other technical services	$109,589
Admin and support	$82,192
Land lease	$20,548

[105] Government of Canada, "Clean Hydrogen Investment Tax Credit: Calculating the credit." https://www.canada.ca/en/revenue-agency/services/tax/businesses/topics/corporations/business-tax-credits/clean-economy-itc/clean-hydrogen-itc/claiming-credit-ch-itc/calculate.html

[106] Ruchi Gupta et al., "Macroeconomic Analysis of a New Green Hydrogen Industry using Input-Output Analysis: The case of Switzerland," *Energy Policy* 183 (2023), 6. https://www.sciencedirect.com/science/article/pii/S0301421523003531

Communication	$2,055
Telecommunications	$4,795

Data source: Ruchi Gupta et al.[107]

Refining

The operating cost ($/kg) of the existing "grey" fossil-based hydrogen production, used in both of B.C.'s operating refineries, is the sum of non-energy related operating costs and the cost of electricity and natural gas used to run the process. Using assumptions and results from academic literature,[108] along with energy costs calculated above, we estimate the total operating costs for steam methane reforming as:

$$\text{Non-energy costs} = \frac{\text{4.5\% of capital expenditures}}{\text{Annual hydrogen production}}$$

$$\begin{aligned}\text{Energy cost} = (\text{HHV of Hydrogen})\big(&(\text{Natural gas consumption})(\text{Natural gas price})\\ &+ (\text{Electricity consumption})(\text{Electricity price})\big)\end{aligned}$$

$$\text{Operating costs} = \text{non-energy costs} + \text{energy costs}$$

Emissions

The emissions intensity of green hydrogen is assumed to range from 0 to 0.6 tCO_2e per kg of hydrogen produced, while grey hydrogen is assumed to range from 11.3 to 12.1 tCO_2e per kg.[109]

Ammonia

The most common method of producing ammonia is the Haber-Bosch process, which uses pressure, temperature, and an iron-based catalyst to combine hydrogen and nitrogen. Though typically fueled by natural gas with a grey hydrogen feedstock, Haber-Bosch plants can be electrified and fed with green hydrogen, significantly reducing their greenhouse gas emissions. A

[107] "Macroeconomic Analysis of a New Green Hydrogen Industry using Input-Output Analysis: The case of Switzerland," 7.

[108] Mark Droessler and Andrew Leach, "Green with Envy? Hydrogen production in a carbon constrained world." *Energy Policy* 186 (2024), 3-5. https://www.sciencedirect.com/science/article/pii/S0301421524000028

[109] Maddy Ewing et al., *Hydrogen on the Path to Net-zero Emissions: Costs and climate benefits* (Pembina Institute, 2020), 3. https://www.pembina.org/reports/hydrogen-climate-primer-2020.pdf

typical plant produces one to two kilotonnes of ammonia per day, consuming an average of 0.86 kWh of electricity for every kilogram of ammonia produced.[110]

Economic impacts

The economics of constructing and operating an electrified Haber-Bosch plant are estimated as follows, using an assumed currency conversion of 0.73 US$/C$ where necessary.

Table 21. Ammonia: economic inputs and assumptions, Haber-Bosch plant

Component	Cost
Capital cost [a]	\$213/kgNH_3/day
Operating cost	\$0.059/kgNH_3

[a] Includes a 15% reduction in capital costs from the Clean Hydrogen Investment Tax Credit[111]

Data source: Hydrogen Tech World[112]

Emissions

Green ammonia produced in B.C. is assumed to offset ammonia produced and transported via rail from one (or more) of Alberta's ammonia manufacturing facilities with emissions intensities ranging from 1.9 to 2.2 kgCO_2e per kg of ammonia produced.[113] Rail transportation emissions are estimated as 13.38 kgCO_2e per 1,000 rail tonne-kilometers.[114]

[110] Hydrogen Tech World, "Green Ammonia Production: harnessing green hydrogen," 2023. https://web.archive.org/web/20250619121610/https://hydrogentechworld.com/green-ammonia-production-harnessing-green-hydrogen

[111] "Clean Hydrogen Investment Tax Credit: Calculating the credit."

[112] "Green Ammonia Production: harnessing green hydrogen."

[113] Fertilizer Canada, *Ammonia Production Greenhouse Gas Emissions Benchmarking* (2023), 10. https://fertilizercanada.ca/wp-content/uploads/2023/10/Nitrogen-Benchmarking-Report-Final.pdf

[114] Railway Association of Canada, *Locomotive Emissions Monitoring Report* (2020), 32. https://www.railcan.ca/wp-content/uploads/2022/11/SPARK-RAC-LEM-REPORT-2022-EN8-1.pdf

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