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Squaring the Circle

Reconciling LNG expansion with B.C.'s climate goals

Jan Gorski and Jason Lam

May 2023

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The Pembina Institute respectfully acknowledges that we are on the unceded traditional territories of the xʷməθkʷəy̓əm (Musqueam), Sḵwx̱wú7mesh (Squamish), and səlilwətaɬ (Tsleil-Waututh) Nations and these lands are now home to many diverse urban First Nations, Inuit, and Metis peoples.

We remember and acknowledge all the survivors of residential schools, including those who crossed into the spirit world while away from their families and homes. We remember and acknowledge all missing and murdered Indigenous women, girls, and relatives.

We humbly ask for patience and guidance as we learn and grow together, while not letting this delay meaningful change. These acknowledgements are some of the starting steps on a journey of several lifetimes. We share these acknowledgements in honor of the lands, and in the spirit of truth, wellbeing, and contributing to a better pathway with and for Indigenous Peoples.

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Summary

British Columbia will soon have its first major liquefied natural gas (LNG) export terminal, with the anticipated completion of the first phase of the LNG Canada project in 2025. Woodfibre LNG is also on track to begin construction in 2023. In addition, four other export projects are proposed and awaiting decisions to proceed.

The production and export of LNG is an emissions intensive process. Emissions are generated in the upstream (where natural gas is produced), through the midstream (processing and transporting the gas by pipeline), and at the terminal (where it is liquefied and exported). As such, for LNG projects to fit within B.C.'s 2030 climate targets, the policies announced in the recent energy action framework are critical.

Without the framework, under currently implemented policy, our modelling shows that if LNG Canada Phase 1 and Woodfibre LNG — the only two projects on track to be built — proceed, emissions from B.C.'s oil and gas sector will be almost double the government's 2030 sectoral target. If all four additional projects proceed, total emissions could reach more than three times the sectoral target.

To meet the 2030 oil and gas sector target, our modelling shows the vast majority of emissions reductions will need to come from extensive electrification of LNG terminals and in upstream natural gas production. However, this will put significant pressure on B.C.'s clean electricity grid. If only LNG Canada and Woodfibre LNG proceed, about 13 TWh of additional electricity will be required to electrify the terminal and upstream processes. This is 2.5 times greater than what is generated by B.C.'s Site C hydroelectric dam.

Thus, policies and initiatives announced in B.C.'s energy action framework are critical for the province to meet its 2030 oil and gas sector emissions target. The scale of proposed LNG development in B.C. presents a challenge for the province as it seeks to meet its climate targets due to the need to build large amounts of new electricity infrastructure to do so.

Global demand for fossil fuels, including LNG, is expected to decline in the years ahead, while demand for clean energy sources will grow. Both LNG and industrial sectors will require clean electricity and B.C. must carefully consider how to prioritize that electricity in a way that benefits future economic growth. Devoting large amounts of clean electricity to LNG could drive away investment in growing clean industries such as critical minerals mining and green hydrogen production. It could also impact available capacity for the electrification for other parts of B.C.'s economy such as transportation, and buildings.

The policies in the framework are critical to aligning B.C.'s climate targets with its economic goals and to position the province to benefit from opportunities in the new energy economy. The BC Hydro task force in particular is needed to provide these sectors with access to clean electricity and prioritize its use.

The BC Hydro task force faces the challenge of reconciling electricity needs across B.C.'s clean energy economy. We recommend that:

1. The BC Hydro task force start planning new clean electricity generation and transmission infrastructure to decarbonize key economic sectors and meet 2030 climate targets.
2. The BC Hydro task force prioritize electricity use for projects in economic sectors which are expected to see long-term growth on the global path to net-zero, including new clean energy projects.
3. The B.C. government account for the availability of clean electricity when evaluating new LNG projects and their 2030 net-zero plans.
4. BC Hydro prioritize Indigenous partnerships and economic opportunities for Indigenous communities and governments in new electricity projects.

British Columbia at a turning point on LNG

British Columbia's premier has given clear signals that it intends to accelerate the pace of climate action and expand clean energy development. In March 2023, B.C. announced the energy action framework, aligning B.C.'s climate targets with its economic goals. It includes a new set of policies that will grow the clean economy and meet the province's climate obligations. The energy action framework includes the following:

- A regulatory emissions cap for the oil and gas industry to help B.C. meets its 2030 emissions reduction target for the sector.
- All future LNG facilities yet to be approved by B.C.'s environmental assessment process are required to be net-zero by 2030.
- Establishment of the Clean Energy and Major Projects Office to support clean economy investment and jobs.
- Creation of the BC Hydro task force to accelerate the electrification of B.C.'s economy.

The framework fills the gap in the 2021 CleanBC Roadmap to 2030 and will help the oil and gas sector achieve targets set in the roadmap. The regulatory cap on oil and gas emissions is an important step in helping the sector meets its 2030 emissions reduction target. The net-zero by 2030 requirement for future LNG projects looking to receive environmental approval sends a clear message about what the B.C. Government expects from the oil and gas sector.

The Clean Energy and Major Projects Office will help B.C. prioritize growth in the clean economy, advancing future industrial development that is consistent with a net-zero future. The BC Hydro task force will be critical for determining how to scale up clean electricity generation and transmission infrastructure, and ensuring electricity needs in all sectors of the economy will be met.

These policies can all work together to help meet B.C.'s 2030 oil and gas sector target of 33-38% reduction in greenhouse gas emissions below 2007 levels.[1] This translates to a total annual emissions allowance of 8.6-9.3 megatonnes (Mt) by 2030. For context, the sector's emissions were 12.8 Mt in 2020. Detailed emissions data for the oil and gas sector in 2007 and 2020 are summarized in Table 5.

[1] Government of British Columbia, *CleanBC Roadmap to 2030,* 51. https://www2.gov.bc.ca/assets/gov/environment/climate-change/action/cleanbc/cleanbc_roadmap_2030.pdf

Before the announcement of the energy action framework, LNG production was simply incompatible with the CleanBC plan. The only policies currently in place are the methane regulations and a carbon pricing system that is undergoing redevelopment. The existing methane regulations were designed to reduce methane emissions from upstream oil and gas production by 45% below 2014 levels by 2025. In addition, the province has started consultation on more stringent methane regulations, with a goal of reducing methane emissions from oil and gas by 75% by 2030, and to near-zero by 2035. B.C. has also committed to increase the price on carbon to $170/t CO_2e by 2030 and stated an intention to revise its carbon pricing system.

Shifting trajectories in the global energy system

As the province makes plans to push towards its emission reductions goals and support the approaching clean economy, it is also experiencing mounting pressure to expand the production and export of liquefied natural gas (LNG). This is largely driven by the fact that, at present, global demand for LNG is high due to a supply crunch for natural gas precipitated by global dynamics including Russia's invasion of Ukraine in early 2022.

This demand spike, however, must be understood within the broader context of the shift towards low-carbon economies and clean energy production. The International Energy Agency (IEA) has determined that the current increased demand and heightened prices of LNG will be short-lived as countries rapidly scale up their clean energy production and seek to limit their reliance on fossil fuel imports. For instance, in April 2022, Germany introduced a broad set of energy reforms with the dual purpose of meeting climate targets and phasing out Russian oil and gas imports. This included 35 billion euros earmarked for funding renewable electricity. Japan, among the top LNG importers in the world, is aiming to reduce its dependency on imported fossil fuels by increasing both nuclear and renewable energy generation. Its decreasing reliance on LNG imports could be expedited if the recently approved Green Transformation plan is implemented.[2]

In addition, the IEA has clearly stated that natural gas should not be seen as a 'bridge fuel' between coal (which many countries are currently transitioning away from) and renewables.[3] The existence of mature, cheaper, clean energy technologies will largely displace the use of coal as a fuel source in the medium and long term.

[2] Dan Woynillowicz, "All That Glitters Isn't Gold," *Polaris Strategy + Insight*, February 14, 2023. https://polarisstrategy.ca/2023/02/14/all-that-glitters-isnt-gold/

[3] Janetta McKenzie, Nick Schumacher, "Big lessons for Canada's energy sector in this year's World Energy Outlook report: Fossil fuel demand set to decline this decade," *Pembina Institute,* November 4, 2022. https://www.pembina.org/blog/big-lessons-canadas-energy-sector-years-world-energy-outlook-report

On LNG specifically, IEA projections show that, even in the least ambitious Stated Policies (STEPS) scenario (which only accounts for the impact of climate policies that have already been implemented by governments), there is already sufficient LNG capacity from existing or under-construction projects, worldwide, until at least 2035. If the pace of climate action continues to accelerate—with governments following through on announced policies (APS) and/or their commitments to achieve net zero (NZE)—then the world already has more LNG capacity than will be needed.

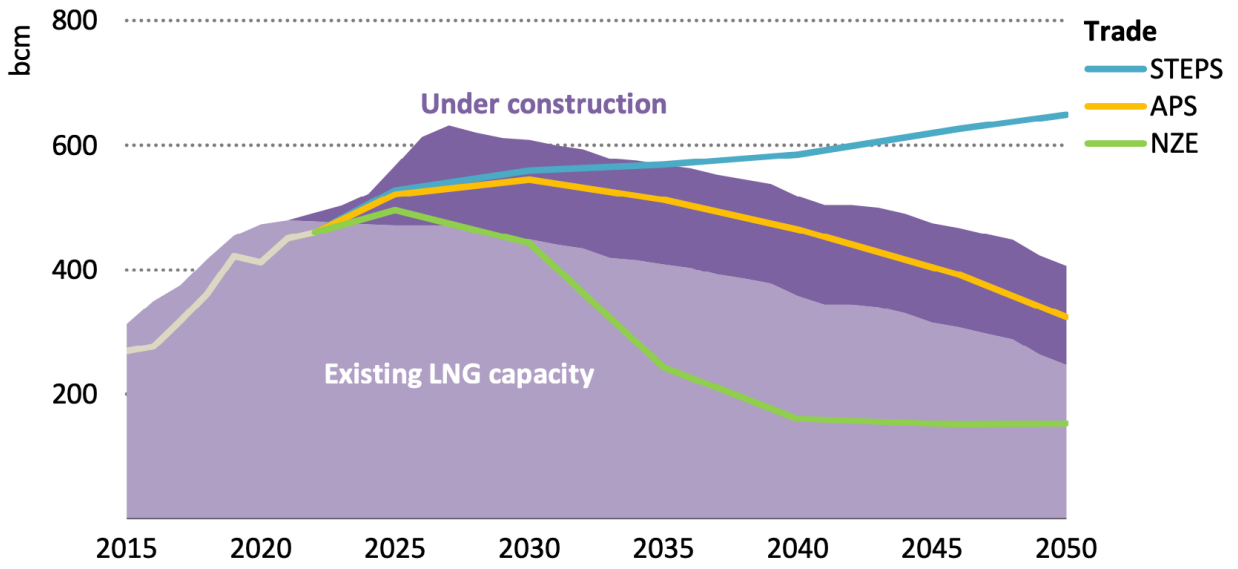

Figure 1. Existing and under construction LNG capacity and total inter-regional LNG trade by scenario, 2015-2050

Source: IEA[4]

Against this backdrop, the B.C. government must consider the scale of expansion in its LNG sector in the upcoming years and design policies that will guide investment in its economy towards growth sectors.

In this report, we explore the implications of current and proposed LNG projects on B.C.'s climate targets, the unintended consequences on the economy and the electrification of other key growth sectors, and therefore the economic trade-offs of LNG expansion.

[4] IEA, *World Energy Outlook 2022*, Figure 8.8. https://www.iea.org/reports/world-energy-outlook-2022

Current status of LNG export projects in B.C.

To export LNG to the global market, specialized terminals are required. The upfront costs to build these terminals run into the billions of dollars, and they must operate at capacity for multiple decades to provide a return on the investment.

In B.C., only one small LNG terminal is currently operating: the Fortis Tilbury LNG facility, which mainly provides LNG for ferries and for local use as backup fuel for heating.[5] Currently, the only other project under construction is LNG Canada Phase 1, which has a projected completion date in 2025. Five other projects (including LNG Canada Phase 2) are in various stages of development, as shown and summarized below in Table 1. It is worth noting that in 2014, there were at least 20 active LNG export proposals in B.C., but many have either been cancelled or are no longer being actively pursued.[6]

Figure 2. Location of proposed and planned LNG export projects in B.C.

[5] Fortis BC, "Tilbury Phase 1 LNG Expansion project," 2022. https://talkingenergy.ca/project/tilbury-phase-1-lng-expansion-project

[6] Brent Jang, "LNG coalition faces uncertain future after leader quits, proposals wane," *The Globe and Mail,* December 15, 2022. https://www.theglobeandmail.com/business/article-canadian-lng-alliance-president-resigns/

Table 1. Summary of proposed and planned LNG projects in B.C.

	LNG Canada		Woodfibre LNG	Tilbury Phase 2 Expansion	Cedar LNG	Ksi Lisims
	Phase 1	Phase 2				
Proponent	Shell, PETRONAS, PetroChina Company Limited, Mitsubishi Corporation, and Korea Gas Corporation		Woodfibre LNG Limited, a subsidiary of Singapore-based Pacific Oil & Gas Limited	FortisBC	Haisla Nation and Pembina Pipeline Corporation	Nisga'a Nation, Rockies LNG and Western LNG
Capital cost	$25 to 40 billion		$5.1 billion	$3 to 4 billion	$1.8 to 2.5 billion	$8.3 to 9.0 billion
Capacity (MTPA)	14	14	2.1	Phase 1A: 0.9 Phase 2: 3.5	3 to 4	12
Project status	Under construction	Final investment decision expected before 2025	Construction to begin in 2023	Environmental assessment decision expected in early 2023	Final investment decision expected in fourth quarter of 2023	Undergoing environmental assessment review
Lifetime	At least 25 to 40 years		At least 25 years	40 to 60 years	20 to 40 years	Minimum 30 years

Data sources: see Appendix C

Impact of B.C.'s oil and gas cap on B.C.'s oil and gas emissions and electricity needs

Not all LNG projects are created equal

The major emissions associated with LNG production are the production and transport of the natural gas in the upstream, and the liquefaction process at the export terminal. Technology choices and production practices therefore have a significant effect on emissions intensity across the LNG supply chain. Opportunities include eliminating vented and fugitive methane emissions, venting of formation CO_2 during natural gas production, and using electricity instead of natural gas to power processes at the LNG terminal and upstream natural gas production facilities (i.e. to power equipment to extract, process, and transport natural gas).

At LNG terminals, using electricity from clean energy sources is an especially important opportunity to minimize emissions, given that most emissions come from the terminal's power processes. These power processes include the non-compression load (the power needed for pumps, air coolers, lighting, and space heating) and the main gas compression load (the power needed for the main liquefaction process).

The proposed LNG Canada Phase 1 and Woodfibre LNG terminals plan to use electricity to a significant degree to reduce emissions and impacts on local air quality. LNG Canada Phase 1 is planning to use electricity to power non-compression load only, and to use natural gas turbines for compression load. Woodfibre LNG is planning to go one step further for electrification and use grid electricity to power both the compression and non-compression loads.

LNG projects can also be powered almost entirely with natural gas, resulting in far greater emissions than would result if the project were to use electricity (which is particularly low-carbon in B.C. where much of the electricity comes from hydroelectric power) to meet all or a portion of its needs.

In this section, we have modelled scenarios for expanded LNG development both under currently implemented policies and under recently announced policies aimed at achieving B.C.'s 2030 target for oil and gas sector emissions.

Scenario 1: Without the oil and gas cap, B.C.'s oil and gas emissions will be at least double the sector target in 2030

The B.C. government recently announced new policies to fill the gap in meeting its 2030 oil and gas sector target, including a regulatory cap on oil and gas sector emissions. Prior to that, the province had committed to adopting more stringent methane regulations, increasing the price on carbon and updating its carbon pricing system. In this scenario, we examine how critical these new policies are to B.C.'s 2030 sector target.

The only policies currently in place are methane regulations and a carbon pricing system that will soon be updated. The methane regulations came into effect in 2020, with the goal of reducing methane emissions from upstream oil and gas production by 45% below 2014 levels by 2025. B.C. has also committed to increase the price on carbon to $170/t CO_2e by 2030 and stated an intention to revise its carbon pricing system.

In this section, we examine the impact of planned and proposed LNG projects on the emissions trajectory of B.C.'s oil and gas sector, with only policies currently implemented. Considering the current status of the different LNG projects listed above, our **baseline development assumption is that only LNG Canada Phase 1 and Woodfibre LNG actually become operational**, as they are the only two projects that have either started construction or are on track to start construction. We have, however, included all other projects separately, to show the scale of emissions if these also go ahead. Detailed assumptions for the modelled scenarios are outlined in the Appendices.

As shown in Figure 3 and Table 2, under the above conditions, B.C.'s oil and gas emissions will greatly exceed the upper end of its 2030 oil and gas sector-specific cap (8.6-9.3 Mt). This is true even in the case of our baseline development assumption, where only LNG Canada Phase 1 and Woodfibre LNG become operational.

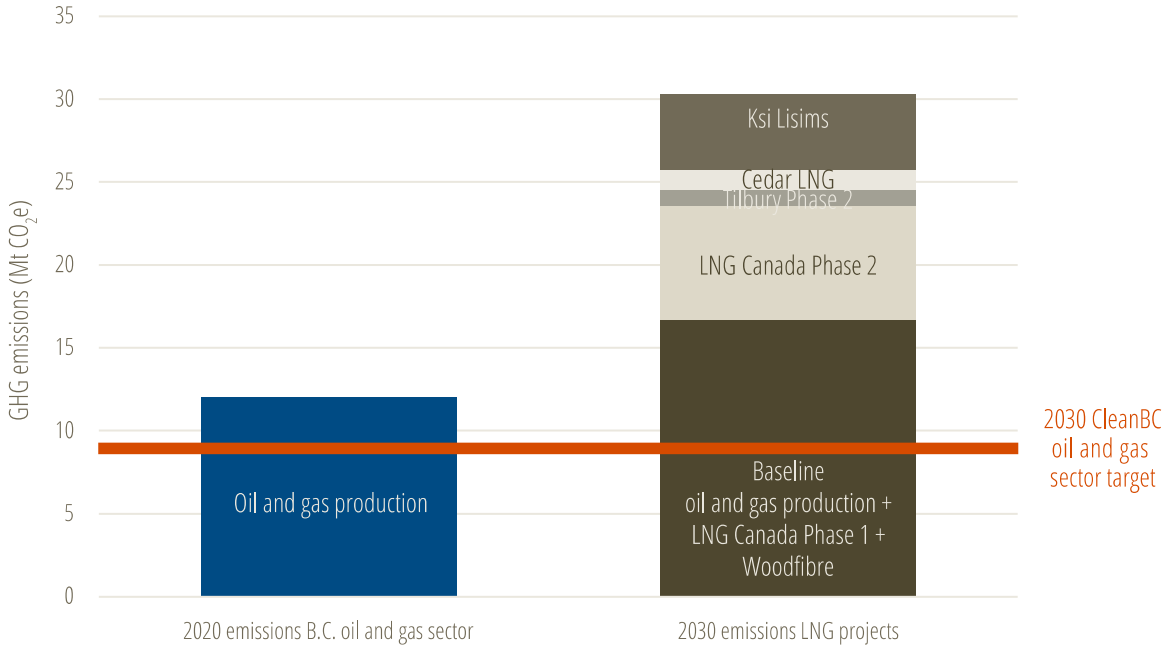

Figure 3. B.C. oil and gas sector emissions in 2030 will be at least twice as high as the sector target under current policy

Table 2. GHG emissions in 2030 under current policy scenario

LNG development	Emissions (Mt CO_2e)		
	Upstream	Terminal	Total
Baseline oil and gas production + LNG Canada Phase 1 + Woodfibre LNG	13.8	2.2	16.7[7]
LNG Canada Phase 2	4.7	2.1	6.8
Tilbury Phase 2	0.7	0.3	1.0
Cedar LNG	0.9	0.3	1.2
Ksi Lisims	2.7	1.9	4.6
Total emissions if all projects go ahead			**30.3**
CleanBC 2030 target			**8.6 to 9.3**

According to our modelling, the baseline development assumption (LNG Canada Phase 1 and Woodfibre LNG only) will see B.C.'s oil and gas emissions rise to over 16 Mt CO_2e in 2030. Any

[7] Baseline scenario total includes all emissions from the oil and gas sector, including oil production and refining.

additional projects approved and operational by 2030 would generate even more emissions, up to a maximum of about 30 Mt, or more than three times the sectoral cap on oil and gas emissions that B.C. has committed to.

Some of the natural gas needed for new projects may be produced outside B.C. (for example, in Alberta), resulting in lower overall emissions for B.C. However, even in this case, B.C.'s 2030 sector emissions target would still be greatly exceeded if additional projects proceed. Additionally, any natural gas production in Alberta would generate emissions and make it harder for Alberta to meet its own obligations to cap and cut oil and gas sector emissions, as required by the federal oil and gas cap.

Electricity requirements for partial electrification of terminals

In the case of our baseline development assumption (where LNG Canada Phase 1 and Woodfibre LNG are the only projects that become operational), and where these projects have partial electrification at terminals (but none in upstream production), 1,883 GWh/year of electricity is required in 2030. For reference, this is equivalent to more than 35% the annual generation from BC Hydro's Site C dam hydroelectric project, which is to be completed in 2024 and would otherwise generate enough clean electricity annually to power about 450,000 homes.[8]

If LNG Canada Phase 2 were to go ahead, again with partial electrification at the terminal, it would consume the equivalent of almost all the remaining available electricity capacity at Site C. The individual impact on electricity demand of each additional LNG project with partial electrification is shown in Table 3.

[8] BC Hydro, "Site C Clean Energy Project." https://www.bchydro.com/energy-in-bc/projects/site_c.html

Table 3. Electricity needs if terminals are partially electrified (under current policies) in 2030

LNG development	Terminal electricity requirement (GWh/year)
Baseline oil and gas production + LNG Canada Phase 1 + Woodfibre LNG	1,883[9]
LNG Canada Phase 2	526
Tilbury Phase 2	957
Cedar LNG	1,461
Ksi Lisims	1,640
Total electricity required for all projects	**6,467**

Scenario 2: Under stronger policies B.C. may face an electricity shortage by 2030

Under this scenario, we assume new methane regulations and the announced oil and gas cap are implemented by the provincial government and are successful in achieving the 2030 target for oil and gas sector emissions. We assume these policies would result in emissions reductions as follows:

- At least 75% reduction in methane emissions from 2012 levels by 2030[10]
- Formation CO_2 emissions in the upstream reduced by 80% using carbon capture, utilisation and storage technology (CCUS)
- Flaring of natural gas in the upstream reduced by 80%
- Full electrification of LNG terminals and partial electrification of upstream natural gas production

The impact of these measures on emissions is shown in Figure 4, which examines a pathway to meeting B.C's 2030 oil and gas target if only LNG Canada Phase 1 and Woodfibre are built. As this graph demonstrates, it is large-scale electrification — of both the upstream natural gas production and transport, and the terminals — that accounts for most of the emission

[9] LNG Canada Phase 1 and Woodfibre LNG's electricity requirements are 788 GWh/year, and 1,095 GWh/year respectively in 2030.

[10] Government of Canada, "Proposed regulatory framework for reducing oil and gas methane emissions to achieve 2030 target," November 10, 2022. https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/reducing-methane-emissions/proposed-regulatory-framework-2030-target.html

reductions (approximately 5.1 Mt out of 7.4 Mt). Most of it would occur in the Northeast Montney region, where natural gas is extracted.

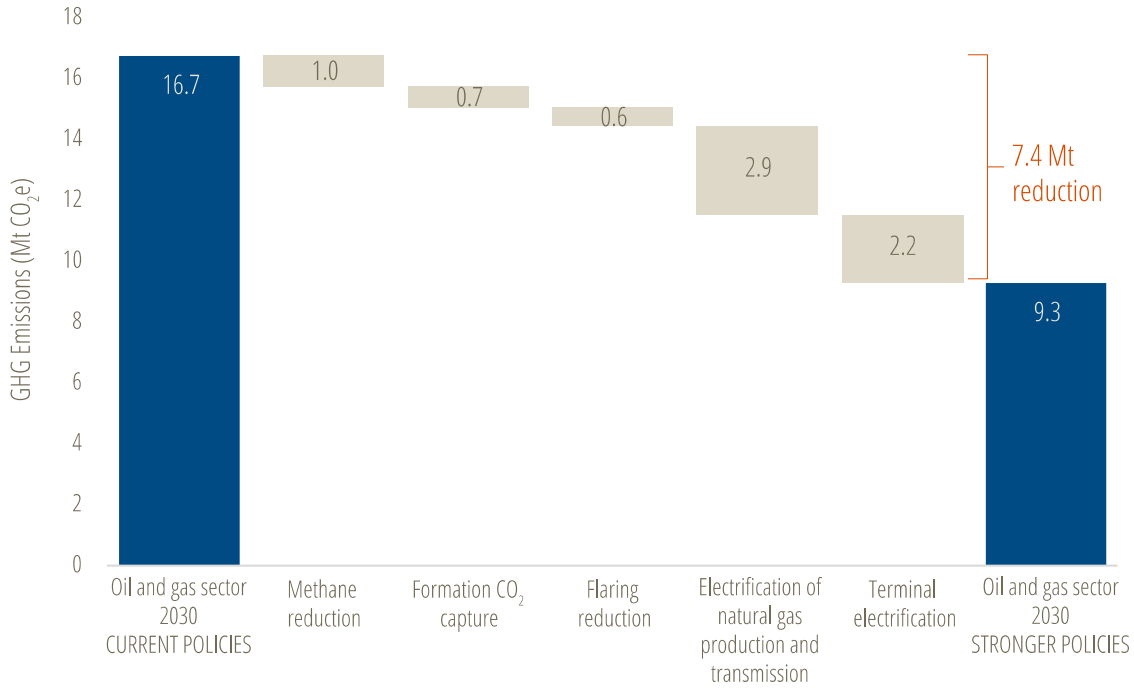

Figure 4. GHG reduction opportunities for the baseline development assumption (LNG Canada Phase 1 and Woodfibre LNG only)

With the exception of LNG Canada Phase 1, all active projects in B.C. have stated their intention to fully electrify their LNG terminals. And with the new energy action framework, all future LNG projects will need to be net-zero by 2030, providing further incentive for terminals to be fully electrified. This shows B.C. leading the way in establishing a new best practice for LNG export projects as the oil and gas industry tries to find a place for itself in a low-carbon future. However, more projects, and thus more electrification, will require yet more electricity.

Required electricity generation capacity under a stronger policy scenario with large-scale electrification

In our baseline development assumption, where only LNG Canada Phase 1 and Woodfibre LNG become operational; and where Woodfibre LNG is fully electrified, and LNG Canada Phase 1 remains partially electrified, approximately 12,500 GWh/year of clean electricity is required to meet the upper end of the 2030 sectoral target (9.3 Mt of CO_2e). This is equivalent to 2.5 times the electricity generated by Site C. Any other projects approved and operational by 2030 would require even more electricity to meet B.C.'s sectoral target. Table 4 shows the additional electricity needed for other projects.

Tilbury Phase 2 and Ksi Lisims have not yet received environmental approval and, as a result, will be required to meet the new net-zero by 2030 condition to receive approval from the B.C. government. This applies only to emissions from the terminal; not the production, processing and transport of natural gas. In this scenario, we assume that the terminals would be fully electrified and would need approximately 0.6 Mt CO_2e of carbon offsets to be net-zero.

Table 4. GHG emissions and electricity needs in 2030 (under stronger policies and electrification)

LNG project	LNG terminal emissions (Mt CO_2e)	Electricity needed (GWh/year)			No. of Site C dam equivalents needed
		Upstream (partially electrified)	Terminal (fully electrified)	Total	
Baseline oil and gas production + LNG Canada Phase 1 + Woodfibre LNG	2.2	10,629	1,883[11]	12,512	2.5
LNG Canada Phase 2	0.8	10,164	3,204	13,368	2.6
Tilbury Phase 2	0.3	1,900	957	2,857	0.6
Cedar LNG	0.3	2,293	1,461	3,754	0.7
Ksi Lisims	0.2	4,957	5,256	10,213	2.0
Total					**8.4**

[11] LNG Canada Phase 1 and Woodfibre LNG's electricity requirements are 788 GWh/year, and 1,095 GWh/year respectively in 2030.

Will LNG Canada Phase 2 be electric?

LNG Canada has received approval from the B.C. government for both Phase 1 and Phase 2 of the project, but there is no requirement for either phase to be electrified under this approval. The B.C. government has stated that any future LNG projects seeking approval will be net-zero by 2030. However, this requirement does not apply to already approved projects such as LNG Canada Phases 1 and 2.

LNG Canada Phase 2 has stated an intention to fully electrify the terminal but has not yet announced a final investment decision. CEO Jason Klein recently said that Phase 2 will have to use natural gas-powered turbines initially if it reaches the final investment decision stage, due to the lack of transmission infrastructure to connect the terminal to BC Hydro's electrical grid. The terminal would switch over to electrically-driven compressors once the electrical infrastructure is available.[12]

LNG Canada Phase 1, with partial electrification at the terminal, will significantly increase B.C.'s GHG emissions and, if Phase 2 proceeds without full electrification, the impact will be even greater.

[12] Rod Nickel and Nia Williams, "Natural gas, not electricity, to power Canada's first LNG plant, increasing carbon footprint," *CBC,* January 17, 2023. https://www.cbc.ca/news/canada/british-columbia/canada-lng-power-constraints-electriciy-1.6717358

The electricity gap

With the new energy action framework, the B.C. government recognizes the importance of widespread electrification for reducing emissions and meeting Canada's climate goals. Nonetheless, there are many sectors besides LNG where clean electricity will be required to support emissions reductions in the upcoming years. For example, already established sectors such as transportation (with the adoption of electric vehicles) and buildings (space and water heating) will need increased electrification. Other growing industrial sectors that will support the future clean economy, such as critical minerals mining and green hydrogen production, will also need clean electricity.

BC Hydro has outlined in its 2021 Integrated Resource Plan that it currently has a surplus of power until 2029. In its reference scenario, total electricity demand is projected to grow by 5,875 GWh from 2020 to 2030.[13] BC Hydro expects the main sectors contributing to the growth in electricity demand to be transportation, buildings, and the oil and gas sector, but does not account for possible growing clean industrial sectors.[14] The oil and gas sector accounts for 4,300 GWh of this demand growth by 2030 in the reference scenario.

However, as outlined above, our model suggests that 12,512 GWh/year will be needed for just LNG Canada Phase 1 and Woodfibre LNG to ensure emissions fit within the 2030 target. For contrast, even BC Hydro's most ambitious electrification scenario only estimates an additional 11,741 GWh/year will be needed by 2030 from 2020 to electrify the oil and gas sector (though it's not clear what LNG projects are developed and how much electricity is needed from terminals vs natural gas production and transport). This means that even BC Hydro's most ambitious scenario model does not have sufficient electricity to meet the oil and gas emissions sector target, and this is still only in the case that LNG Canada Phase 1 and Woodfibre LNG are the only projects that become operational.

BC Hydro has recently acknowledged that its 2021 Integrated Resource Plan needs to be updated due to the energy action framework announcement.[15]

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[13] BC Hydro, "BC Hydro 2021 Integrated Resource Plan Application." December 2021.

[14] BC Hydro, "BC Hydro's Electrification Plan" September 2021. https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/regulatory-planning-documents/integrated-resource-plans/current-plan/2021-irp-tac-info-sheet-electrification-20201220.pdf

[15] BC Hydro, "BC Hydro submitting further information on Signposts Update" March 23, 2023. https://docs.bcuc.com/Documents/Proceedings/2023/DOC_70691_B-31-BCH-response-Signposts-further-Information.pdf

Further, our analysis shows that if all proposed LNG projects are built and electrified to meet the province's emissions target, more than 40,000 GWh/year would be needed in 2030 for B.C.'s oil and gas sector alone. A comparison between the amount of electricity demand growth needed to electrify all these projects and BC Hydro's projected total electricity demand growth for the oil and gas sector is shown in Figure 5.[16]

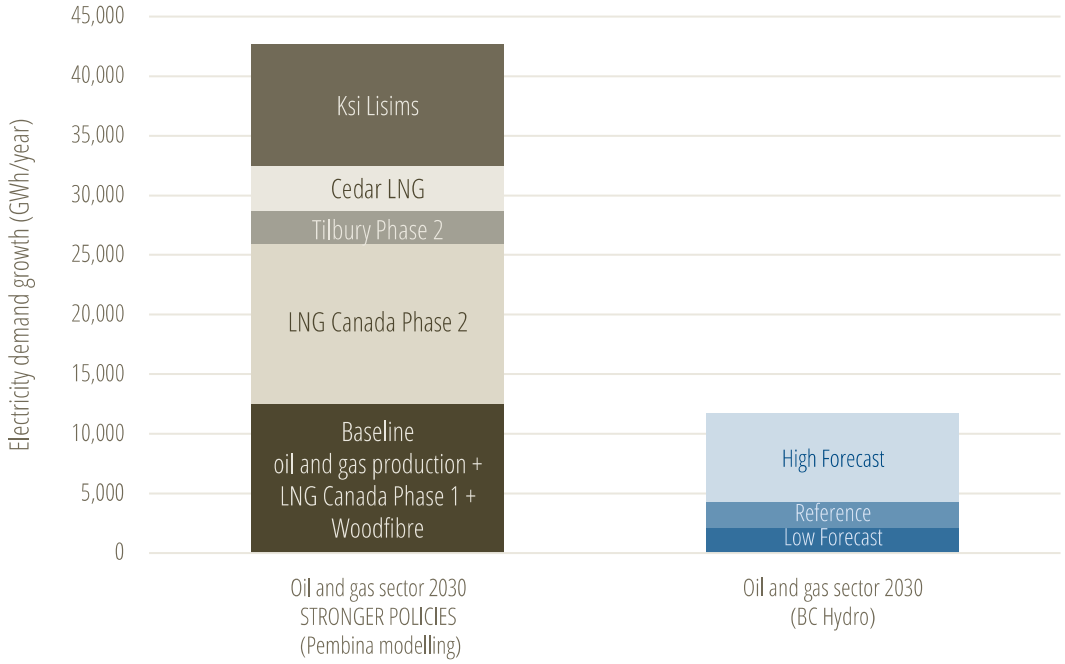

Figure 5. BC Hydro needs a realistic plan to meet electricity needs of the oil and gas sector and proposed LNG projects in 2030

In light of the above, the recently announced BC Hydro task force has a critical role to determine how to plan for future electricity generation needs in the province. And the task force will need to determine how to prioritize clean electricity use in a way that supports B.C.'s emissions reduction goals for all sectors of the economy while not precluding investment and economic growth in other emerging clean industries that will also rely on clean grid capacity. Meanwhile, the new Clean Energy and Major Projects Office is necessary to ensure B.C. seizes the opportunities of the clean economy by prioritizing the advancement of these projects.

[16] Canada Energy Regulator, "Canada's Energy Future 2020: Energy Supply and Demand Projections to 2050" *Canada's Energy Future Data Appendices,* October 25, 2017. https://doi.org/10.35002/zjr8-8x75

B.C. at a crossroads on LNG

The recently announced oil and gas cap fills a policy gap to meeting the province's 2030 oil and gas sector target. Our analysis shows that without this policy the target would certainly be exceeded. Emissions will be at least twice as high as the target in 2030, even if only LNG Canada Phase 1 and Woodfibre LNG — the only two projects currently on track to be built — proceed without the cap.

Our modelling shows that a large portion of emissions reduction opportunities in the oil and gas sector comes from electrification of terminals and the upstream. As such, for B.C. to meet its 2030 oil and gas emissions reduction target, it will need to build significant new electricity generation to electrify LNG terminals and upstream natural gas production facilities. This remains the case even if only LNG Canada Phase 1 and Woodfibre LNG become operational. Thus, the scale of proposed LNG development in B.C. presents a challenge for the province as it seeks to meet its climate targets and build new electricity infrastructure to do so.

Global demand for fossil fuels, including LNG, is expected to decline in the years ahead, while demand for clean energy sources will grow. Both LNG and industrial sectors will require clean electricity and B.C. must carefully consider how to prioritize that electricity in a way that benefits future economic growth. Devoting large amounts of clean electricity to LNG could drive away investment in growing clean industries such as critical minerals mining and green hydrogen production. It could also impact available capacity for the electrification for other parts of B.C.'s economy such as transportation, and buildings.

This is why the recently announced Clean Energy and Major Projects Office and the BC Hydro task force are critical for supporting the province as it moves towards achieving its 2030 climate goals. The Clean Energy and Major Projects Office can ensure B.C. seizes the opportunities of the clean economy while the BC Hydro task force can determine how to effectively prioritize the province's electricity needs.

We recommend that:

1. The BC Hydro task force start planning new clean electricity generation and transmission infrastructure that will be needed to decarbonize key economic sectors and meet 2030 climate targets.
2. The BC Hydro task force prioritize electricity use for projects in economic sectors which are expected to see long-term growth on the global path to net-zero, including new clean energy projects.

3. The B.C. government account for the availability of clean electricity when evaluating new LNG projects and their 2030 net-zero plans.
4. BC Hydro prioritize Indigenous partnerships and economic opportunities for Indigenous communities and governments in new electricity projects.

Appendix A. Methodology and assumptions

A summary of the scenarios is provided in Table 6.

Policy assumptions

The current policies scenario includes only the existing policy methane regulations, which are designed to reduce methane emissions by 45% from 2014 levels by 2025. The impact of carbon pricing was not included in the analysis because the province only recently announced it will be updated (the B.C. government committed to increase the price on carbon to $170/t CO_2e and revise its carbon pricing system in the recently released 2023 budget). The government has promised to conduct consultations on this carbon price.

The stronger policy scenario assumes additional policies are implemented to meet the oil and gas sector target, including more stringent methane regulations and an updated carbon pricing system. The province recently started consultation on more stringent methane regulations, but these have not been implemented yet.

Electrification

The LNG intensity under the large-scale electrification scenario reflects data from approval documents for each project.

The LNG terminal electricity requirements reflects 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 in both scenarios 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. In addition, unless the LNG terminal only described its power source to be electricity and was fully electrified with no alternative power sources considered, partial electrification was assumed in the current policies scenario.

An engine thermal efficiency of 35% was used to calculate the electricity needed to electrify emissions from fuel combustion sources.[17] Transmission losses of 6% were assumed, calculated based on data from the Canada Energy Futures.[18]

Shale tool calibration

The Government of B.C.'s 2020 Provincial Greenhouse Gas Emissions Inventory was used to calibrate the shale gas tool to match with the inventory's GHG 2020 data. Formation CO_2 emissions were adjusted to reflect a shift in production from the Horn River basin to the Montney, which is not captured in the GHG inventory.

Pipeline emissions correction

Emissions associated with the Coastal Gaslink pipeline were adjusted to account for additional compressor stations required to move higher volumes of gas based on project data (LNG Canada and Cedar both plan to use the pipeline to ship natural gas to the terminals).[19] A pipeline correction factor was not applied to the other LNG projects as they are not planning to use Coastal Gaslink and the resulting emissions would be considered conservative.

CCUS

The use of CCUS could also be used as an alternative to electrification for meeting the CleanBC sector cap, but was not considered as a mitigation option in the analysis due to modelling constraints.

LNG development scenarios

Baseline development assumption includes the baseline oil and gas production for B.C. along with LNG Canada Phase 1, which is already under construction, and Woodfibre LNG, which has issued a notice to proceed to construction.[20]

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

[18] Canada Energy Regulator, "Canada's Energy Future 2020." https://www.cer-rec.gc.ca/en/data-analysis/canada-energy-future/2020/

[19] TransCanada, *Greenhouse Gas Emissions Technical Data Report.* https://projects.eao.gov.bc.ca/api/public/document/58868fbce036fb0105768692/download/2F%20GHG%20Emissions%20Technical%20Data%20Report.pdf

[20] Steven Chua, "WLNG says it has given the 'final green light' for construction," *Coast Reporter*, April 21, 2022. https://www.squamishchief.com/local-news/wlng-says-it-has-given-the-final-green-light-for-construction-5283923

Methane emissions

The analysis uses the 100-year GWP of 34 as provided by the Intergovernmental Panel on Climate Change (IPCC) in its Fifth Assessment Report (AR5), in contrast with government analysis which uses an outdated GWP of 25. However, our analysis does not account for recent studies which show that B.C.'s methane emissions are 80% higher than current government estimates.[21]

Natural gas supply

All LNG projects were assumed to require incremental natural gas production, except for LNG Canada Phase 1. 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. Some of the natural gas supplied for the potential future LNG terminals could come from Alberta, but this would not change the conclusion of this report.

Mitigation measures to meet B.C.'s 2030 oil and gas sector target

We assumed that emissions from conventional oil production decline from 0.4 Mt CO_2e in 2020 to 0.2 Mt CO_2e in 2030, in line with the Canada Energy Regulator's projected production decline of conventional light crude in B.C. We also assumed that refining demand and refining emissions would decline from 0.7 Mt in 2007 to 0.5 Mt in 2030 in line with the sector target for transportation (27% reduction below 2007 by 2030). 2020 refining emissions were at 0.5 Mt already, so no further decline to 2030 was assumed.

[21] David Tyner and Matthew Johnson. "Where the Methane Is—Insights from Novel Airborne LiDAR Measurements Combined with Ground Survey Data," *Environmental Science and Technology* 55, no. 14 (2021). https://pubs.acs.org/doi/10.1021/acs.est.1c01572

Table 5. Oil and gas sector emission targets

Sectors and sub-sectors	Emission target (Mt)	
	2007	2020
Upstream Oil and Gas	13.1	12.2
Natural Gas Production and Processing	11.1	10.2
Conventional Oil Production	0.8	0.4
Oil and Natural Gas Transmission	1.2	1.5
Downstream Oil and Gas	0.8	0.6
Petroleum Refining	0.7	0.5
Natural Gas Distribution	0.1	0.1
Total	**13.9**	**12.8**

Source: Government of British Columbia[22]

Table 6. Summary of policy scenario assumptions

	Current policies	Stronger policies (large-scale electrification)
Methane	45% reduction in emissions from 2014 levels by 2025	75% reduction in emissions from 2012 levels by 2030
Upstream electrification	none	enough electrification of upstream production to meet balance of CleanBC gas sector target for 2030
Formation CO_2	no CCUS	80% of emissions captured with CCUS
Flaring	no reduction	80% of emissions reduced
LNG electrification	Project-specific intensities were chosen based on individual project descriptions. Unless the terminal only described its power source to be electricity and was fully electrified, partial electrification was assumed. Assumed LNG intensity (t-CO_2e/t-LNG): LNG Canada Phase 1: 0.15	LNG Canada Phase 1 is assumed to be partially electrified; all others will be fully electrified. Assumed LNG intensity (t-CO_2e/t-LNG): LNG Canada Phase 1: 0.15 LNG Canada Phase 2: 0.059 Woodfibre LNG: 0.04

[22] Government of British Columbia, "Provincial greenhouse gas emissions inventory." https://www2.gov.bc.ca/gov/content/environment/climate-change/data/provincial-inventory

	LNG Canada Phase 2: 0.15 Woodfibre LNG: 0.04 Tilbury Phase 2 Expansion: 0.09 Cedar LNG: 0.08 Ksi Lisims: 0.155	Tilbury Phase 2 Expansion: 0.09 Cedar LNG: 0.08 Ksi Lisims: 0.021

Appendix B. LNG supply chain emissions

The GHGs that accompany the LNG supply chain in B.C. consist primarily of methane (CH_4), which is the predominant component of natural gas itself, and carbon dioxide (CO_2). There are four main emissions sources in this supply chain.[23]

Combustion

Natural gas is burned to power equipment to process and transport the gas, releasing CO_2. In addition to sources that already exist in B.C.'s natural gas sector, future LNG terminals could be a major new location of natural gas combustion if they are powered with natural gas.

Formation carbon dioxide venting

CO_2 that is found in natural gas (referred to as formation CO_2) is separated from the gas at processing plants and vented to the atmosphere.

Methane emissions

Methane is vented from process equipment — such as pneumatic controllers, gas-driven pumps, dehydrators, and compressors — or during operations such as pipeline blow-downs, where gas is removed and vented from a section of pipeline for repair or maintenance. A new unaddressed source of emissions is unburned methane in the exhaust of compressors, known as compressor slip.[24] Methane is unintentionally released to the atmosphere at valves or fittings, along pipelines, and at storage tanks.

Flaring

Natural gas is burned to control pressure, to maintain a flare pilot light at a facility, or during well testing and completion.

[23] Adam Goehner and Matt Horne, *Wellhead to Waterline* (Pembina Institute, 2014). http://www.pembina.org/pub/2524

[24] David R. Tyner and Matthew R. Johnson, "Where the Methane Is—Insights from Novel Airborne LiDAR Measurements Combined with Ground Survey Data," *Environmental Science & Technology* 55, no. 14 (2021). https://pubs.acs.org/doi/10.1021/acs.est.1c01572

Appendix C. LNG project details

	LNG Canada		Woodfibre LNG	Tilbury Phase 2 Expansion[25]	Cedar LNG[26]	Ksi Lisims [27]
	Phase 1	Phase 2				
Location	Kitimat		Woodfibre, near Squamish	Delta	Kitimat	Wil Milit, near Prince Rupert, BC
Proponent	Shell, PETRONAS, PetroChina Company Limited, Mitsubishi Corporation, and Korea Gas Corporation		Woodfibre LNG Limited, a subsidiary of Singapore-based Pacific Oil & Gas Limited	FortisBC	Haisla Nation and Pembina Pipeline Corporation	Nisga'a Nation, Rockies LNG and Western LNG
Estimated capital cost	$25 to 40 billion[28]		$5.1 billion[29]	$3 to 4 billion[30]	$1.8 to 2.5 billion	$8.3 to 9.0 billion
Capacity (MTPA)	14	14	2.1	Phase 1A: 0.9	3 to 4	12

[25] FortisBC, *Tilbury Phase 2 LNG Expansion Project – Detailed Project Description (2022)*. https://www.projects.eao.gov.bc.ca/api/public/document/61d61dc5733ef50022683d05/download/FortisBC_Tilbury_DPD_Final_Jan2022.pdf

[26] 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

[27] Ksi Lisims, *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

[28] NRCAN, "Canadian LNG Projects." https://www.nrcan.gc.ca/energy/energy-sources-distribution/natural-gas/canadian-lng-projects/5683

[29] 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/

[30] The Canadian Press, "FortisBC eyes expansion of LNG plant." https://www.jwnenergy.com/article/2019/7/18/fortisbc-eyes-expansion-lng-plant/

				Phase 2: 3.5		
Shipping traffic	Up to 350 LNG Carrier visits per year at full buildout[31]		Up to 40 tanker visits per year[32]	Up to 90 LNG barge calls and up to 122 LNG carrier calls[33]	Up to 50 tanker visits per year	8 – 12 visits a year
Associated pipeline project	670 km of new pipeline linking Dawson Creek to Kitimat — Coastal GasLink (TransCanada Corp.)		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	Enbridge Westcoast Connector Gas Transmission TC Energy Prince Rupert Gas Transmission
Environmental assessment status	Approved with conditions		Approved with conditions	Environmental assessment decision expected in early 2023	Approved with conditions	Undergoing environmental assessment review
Final investment decision status	Under construction	Final investment decision expected before 2025	Construction to begin in 2023	Under review	Final investment decision anticipated in fourth quarter of 2023[34]	Under review
Start year	2025	2030	2027	2028	2027	2027

[31] B.C. Environmental Assessment Office, *LNG Canada Export Terminal Project: Assessment Report* (2015). http://www.ceaa.gc.ca/050/documents/p80038/101852E.pdf

[32] B.C. Environmental Assessment Office, *Woodfibre LNG Project: Assessment Report* (2015). https://projects.eao.gov.bc.ca/p/woodfibre-lng/docs?folder=134

[33] WesPac Midstream, *WesPac Tilbury Marine Jetty Project Tilbury Island, Delta, BC – Project Description CEAA Summary* (2015), 13. https://iaac-aeic.gc.ca/050/documents/p80105/101699E.pdf

[34] Cedar LNG, "Environment - Cedar LNG", accessed April 3, 2023. https://www.cedarlng.com/environmental-regulatory/

Lifetime	At least 25 to 40 years[35]		At least 25 years	40 to 60 years	20 to 40 years	Minimum 30 years
Emissions intensity (t CO_2e/t LNG)	0.15[36]	0.059	0.04[37]	0.09	0.08[38]	0.021 (fully electrified - before carbon offsets) 0.155 (Self-generate power - before carbon offsets)
Choice of power source	Phase 1: Natural gas turbines for compression load Phase 2: The choice of power source is currently unclear with full electrification possible in the future. Grid electricity for non-compression load		Grid electricity for both compression and non-compression loads Existing BC Hydro infrastructure is adjacent to the proposed site and will only require an upgraded electric substation to form the primary electric power supply point.	Grid electricity for both compression and non-compression loads The project will only use electrically driven compressors as natural gas driven compressor emissions were deemed unacceptable.	Grid electricity for both compression and non-compression loads The environmental assessment for the project has been approved with electricity being used for compression loads and self generation is no longer being pursued.	Grid electricity for both compression and non-compression loads If grid electricity is not available, will self-generate power with natural gas

[35] Tarika Powell, *2019 Update: Mapping BC's LNG Proposals* (Sightline Institute, 2019), 8. https://www.sightline.org/download/74360/?tmstv=1675367334

[36] JWN Energy, *Canada's LNG carbon footprint seen as better than best in class*, October 28, 2019. https://www.lngcanada.ca/news/canadas-lng-carbon-footprint-seen-as-better-than-best-in-class/

[37] Woodfibre LNG Limited, *Woodfibre LNG Facility GHG Emissions Comparison,* prepared by Mantle 314 (2020).

[38] B.C. Environmental Assessment Office, *Draft Assessment Report for Cedar LNG Project (Project)*, September 21, 2022. https://projects.eao.gov.bc.ca/api/public/document/632a6738b752160022a0882b/download/Cedar_Assessment%20Report%20Draft_2022-09-21.pdf