Western Canadian Gas Exports

OPPORTUNITIES AND RISKS IN A LOW-CARBON WORLD

An Independent Study Prepared for the First Nations Climate Initiative

Robert J. Johnston, Ph.D.

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First Nations Climate Initiative

FNCI commissioned this phase one report in order to identify realistic pathways for western Canadian LNG to contribute to decarbonization efforts in Asian countries. Dr. Johnston has delivered on this objective in a compelling and thoughtful manner. Thank you, Dr. Johnston for completing the task as ably and quickly as you have. The objective for phase two of our work in this area is to activate as many of these pathways as we can; to make them real rather than simply opportunities or potential outcomes. To this end we are looking for partners with other indigenous Nations and levels of government, the private sector and civil society organizations. Our scoping efforts for phase two are already underway and we plan to deliver results in 2024. The imperatives of climate action and real reconciliation with indigenous people in Canada require our immediate collective action.

—First Nations Climate Initiative

Western Canadian Gas Exports: Opportunities and Risks in a Low-carbon World
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LIST OF ABBREVIATIONS

APS	Announced Pledges Scenario (International Energy Agency)
ASEAN	Association of Southeast Asian Nations
bcf	billion cubic feet
bcm	billion cubic metres
BNEF	Bloomberg New Energy Finance
Btu	British thermal unit
CBAM	Carbon Border Adjustment Mechanism
CCS	carbon capture and storage
CCUS	carbon capture, utilization, and storage
COP	Conference of the Parties (UN Framework Convention on Climate Change)
CSIS	Center for Strategic and Environmental Studies
DRI	direct reduced iron
EAF	electric arc furnace
EDF	Environmental Defense Fund
EPA	Environmental Protection Agency (U.S.)
ESG	environmental, social, and governance
ETS	emissions trading system
FNCI	First Nations Climate Initiative
GASSA	Global Agreement on Sustainable Steel and Aluminum
GHG	greenhouse gas
GIIGNL	International Group of Liquefied Natural Gas Importers
GW	gigawatt
GX	green transformation
IEA	International Energy Agency
IEEJ	Institute of Energy Economics, Japan
IMEO	International Methane Emissions Observatory
IMO	International Maritime Organization
IRENA	International Renewable Energy Agency
ITMO	internationally transferred mitigation outcomes
JETP	Just Energy Transition Partnership
JKM	Japan Korea Marker
KWh	kilowatt hour
LNG	liquefied natural gas
MMBtu	million British thermal units
MTOE	million tonnes of oil equivalent
MTPA	million tonnes per annum
NGO	non-governmental organization
NZE	Net Zero Emissions by 2050 Scenario (International Energy Agency)
OGMP	Oil and Gas Methane Partnership
OPEC	Organization of the Petroleum Exporting Countries
RMI	Rocky Mountain Institute
RNG	renewable natural gas
STEPS	Stated Policies Scenario (International Energy Agency)
TES	total energy supply
WEO	World Energy Outlook

Author's Note and Introduction

Is the export of Canadian liquefied natural gas a sure-fire way to ignite our national economy, while simultaneously making significant contributions to global energy security, lower GHG emissions, and indigenous economic reconciliation? Or is it more likely to make the problem of climate change worse rather than better, worsen environmental conditions in traditional indigenous lands and sensitive ecosystems, and tie up capital in projects that might soon face obsolescence in a world rapidly transitioning to zero-emissions energy?

One can find rigorous and well-thought arguments on both sides of this debate, which is impassioned and linked to competing visions of Canada's economic, environmental, and energy future. Policymakers at the provincial and federal levels have and will continue to survey the landscape of expert opinion, research, and modelling in search of answers as to whether additional LNG projects are in the public interest for Canada.

This study will seek to assess the prospects for Western Canadian LNG from a global, Asia-oriented perspective. Certainty will likely remain elusive. The trajectory of the energy transition and myriad factors such as population growth, energy intensity of economic output, levelized cost of energy technologies competing with gas, geopolitical and trade dynamics, and other considerations makes predictions a risky venture. The same is true for domestic considerations for the LNG sector around permitting, community support, workforce availability, inflation, fiscal terms, and financing, to name some of the key challenges.

With those cautions noted, we will seek to identify and objectively assess the factors that are shaping the outlook for Western Canadian LNG and the range of reasonable pathways over which that outlook is likely to evolve over time—particularly as the global economy continues its transition to climate change mitigation, including a rapidly increasing share for emissions-free and carbon neutral sources of energy.

We will focus on *Western Canada* as we believe projects on the East Coast of Canada face a longer and more challenging pathway to realization due to cost and head-to-head competition with EU-bound U.S. Gulf Coast LNG exports, which have surged since the beginning of the Russia-Ukraine war in March 2022.[1]

We will focus on a global perspective because the Canadian LNG sector is part of a gas market that has globalized through seaborne trade links and long-distance pipelines. The sector now has an interconnected dynamic where a threatened strike by Australian offshore LNG workers can spike gas prices in European markets over 10,000 miles away.[2] This is a different world for Canadian gas producers where prices have historically been shaped by weather patterns and industrial demand a few hundred miles down the pipe in the U.S. Midwest, but one that Canadian oil producers understand very well.

We will focus on Asia because the region's demand growth for all competing forms of energy will be the central factor in the market, technological and geopolitical forces determining not just winners and losers in LNG but in all likelihood the nature of the end game in efforts to tackle global climate change as well.

We also will assess the future potential of natural gas value chains in the Asian markets as they transition from unabated natural gas to abated gas, including blue hydrogen and ammonia, gas power generation and industrial combustion paired with carbon capture, and an increase in gas-on-gas competition where market share begins to shift to verifiably lower methane-intensity sources—i.e., those with the lowest fugitive emissions, venting, and flaring of methane and correspondingly lower life cycle greenhouse gas emissions.

As the above might suggest, the study will lean into the economic, policy, geopolitical, and market forces that the author has made the focus of his past work. But we must also account for changing technologies and business models around decarbonization, from the LNG value chain to new industries like blue ammonia or competing, emerging fuels and technologies from large-scale offshore wind to long duration battery storage.

During the writing of the study, several experts have been consulted both on and off the record. Ed Greenspon and the Public Policy Forum have been key creative partners on the topics covered in this report and we are grateful for our ongoing collaboration. Particular thanks are due to my Columbia Center on Global Energy Policy colleague Ira Joseph and to my former Eurasia Group colleague Herbert Crowther, who made essential contributions to this report as well as to the workshops, analysis, and presentations that led up to it. But the conclusions of the study are mine alone, not those of said experts or of my employers present and past.
Both Columbia University Center on Global Energy Policy and Eurasia Group have world-class experts who produce outstanding research on natural gas, climate change, and energy geopolitics which has shaped my thinking, but those organizations are not a part of this study.

It is also important to acknowledge that this study is not a deep dive into the domestic environmental, social, and regulatory issues around the Canadian LNG sector that have been and will continue to be exhaustively discussed elsewhere. Those issues are foundational to the outlook of the LNG sector and of great interest to potential LNG customers and providers of capital in Asia and elsewhere. Yet the opposite is also true—the outlook and perspectives of the LNG-importing governments, companies, investors, and environmental groups in Asia should be of great interest to Canadian policymakers weighing the fate of Canadian LNG projects as well.

Lastly, thanks are due to the First Nations Climate Initiative and its leadership, members, and supporters for commissioning this study. The FNCI plays a leading role in bringing together indigenous economic reconciliation, project development, and energy/climate policy discussion in a uniquely Canadian value proposition. Special thank you to FNCI Director Alex Grzybowski and First Nation leaders Chief Crystal Smith of the Haisla Nation, President Eva Clayton of the Nisga'a Nation, Chief Robbie Nelson of the Metlakatla Nation, and Chief Darlene Hunter of the Halfway River Nation for trusting me to produce this study and engage with their members.

Robert J. Johnston, Ph.D.
November 2023

Executive Summary and Key Findings

The goal of this report is to shed insight on both the significant potential opportunities associated with Western Canadian LNG and the broad range of challenges and questions that must be accounted for if the projects are to achieve commercial viability and long-term resilience in a low-carbon economy.

To do so, three core questions are considered: (1) the growth outlook for LNG in Asian markets that are the most likely offtake for Western Canadian LNG; (2) the competitive landscape among other LNG suppliers targeting this market; and (3) the potential for resilient, longer-term pathways for Western Canadian gas value chains in a decarbonizing world.

GROWTH OUTLOOK FOR LNG IN ASIA

- Long-term gas forecasts are highly uncertain given the wide range of possible pathways and rates of change in the energy mix related to climate policy. While the most recent outlook from the International Energy Agency (IEA) sees a peak for global gas demand by 2030, the same scenario shows that gas demand in Asia remains stronger than other regions. Moreover, other forecasts such as that of the Institute of Energy Economics Japan (IEEJ) see a much longer-term sustained growth outlook for LNG.
- These climate-related uncertainties have elevated fears about over-investment in LNG, in contrast with past cycles where gaps between supply and demand tended to signal and unlock new investment.
- The Asian market should be viewed as a series of regional markets with significantly differing prospects for gas demand growth linked to variations in overall energy demand growth, levels of competition from coal, nuclear power, renewables, and batteries, and policy focus from governments.
- Within this context, Japan and Korea stand out as markets aligned with Canada on climate and energy security policy, with high levels of existing gas infrastructure, and heavy investment in industrial decarbonization, blue ammonia and hydrogen, and carbon capture and storage that will provide longer-term partnership opportunities for Western Canadian gas exporters.
- At the same time, absolute gas demand growth in Japan and Korea will be modest or even decline in the decade ahead, particularly compared to faster growth markets in China, India, and ASEAN (Association of Southeast Asian Nations) countries.
- The faster growth markets in Asia will also be the most price-sensitive and least focused on the lower methane intensity and ESG benefits of Western Canadian LNG. Price sensitivity has intensified in the wake of the Russia-Ukraine war, which led to dramatic regional LNG price spikes, further bolstering coal and renewables versus gas in most emerging Asian markets.
- Canada's ability to win LNG market share in emerging Asian markets will likely be linked to government policy and G7-level support for coal phaseouts—countries such as Vietnam are including gas in their coal phaseout plans while

many other Asian markets are focused on renewables and carbon capture, usage, and storage (CCUS).
- The rapid growth and falling prices for renewable electricity will change the role for gas, with competition shifting from baseload to a battle with coal and long-duration battery storage for backing up renewables.
- Carbon pricing will play a role in the longer term—adding cost to coal and bolstering gas competitiveness in markets like Korea and Japan—as well as creating incentives for ammonia and hydrogen markets.

COMPETITIVE LANDSCAPE FOR LNG IN ASIA

- The most acute competition for Canadian LNG in Asia comes from Qatar and the U.S., which have the advantages of massive scale, deep existing customer relationships, and low costs.
- Yet both Qatar and the U.S. LNG plays face challenges in the years ahead—for Qatar, geopolitical risk linked to its proximity to Iran and growing regional tensions, while the U.S. LNG sector will face policy/regulatory uncertainty particularly around the question of expanding midstream infrastructure and managing potential political backlash against a perceived relationship between higher domestic gas prices and LNG exports.
- Russian gas will be a wild card—while prewar supply to Europe is unlikely to ever recover, more Russian LNG and pipeline gas will eventually find its way to Asia, most notably in the form of an expanded Power of Siberia pipeline to China and higher LNG volumes to price-sensitive markets in developing Asian economies.
- Canadian LNG will also compete to replace expiring LNG contracts from countries such as Brunei, Indonesia, and Malaysia, alongside new sources of demand.
- A significant portion of new LNG supply is being developed by super-majors and trading houses that are building portfolios of flexible contracts where short-term movements in supply in response to seasonal demand and market dislocations are replacing traditional longer-term, take or pay, single-destination offtake contracts.
- More flexible supply will ultimately benefit both buyers and sellers of LNG, particularly where prices remain stable and LNG supply is in moderate surplus to demand, reducing the likelihood of massive price spikes that weaken demand for gas and bolster competing sources like coal and renewables.

RESILIENT PATHWAYS FOR WESTERN CANADIAN GAS IN A DECARBONIZING WORLD

- Future demand for Canadian gas in Asia will be shaped by the speed and trajectory of climate policy, with multiple pathways for unabated, low-methane intensity LNG in the short to medium term and for blue hydrogen, ammonia, and other forms of abated gas in the longer term.
- Low methane-intensity gas benefits of Canadian LNG will take on more importance, but it is imperative to build end-to-end transparency in gas value chains in partnership with shippers and offtakers in Asia so that the lower life cycle emissions of Canadian LNG can be measured and verified. Without this level of aggressive methane mitigation and transparency, LNG will be vulnerable to accusations that its lifecycle emissions are no better than coal.
- Coal-to-gas switching is promising but expectations should be tempered by the dominant incumbent role of coal in most Asian electricity markets. Canadian LNG should target specific project level opportunities for fuel-switching, linked to government coal phaseout plans (as in Vietnam) or fuel oil (where switching economics for LNG are more favourable) or as an intermittency solution for wind/solar projects where gas will compete favourably with battery storage and hydrogen in many markets.
- Industrial decarbonization will be a key priority in Japan and Korea, including sectors such as steel, aluminum, chemicals, and cement. Substituting low methane intensity gas for industrial coal demand, for example through electric arc furnace production for steel, will be a bridge to longer-term substitution for clean hydrogen.
- Blue ammonia is a priority pathway for both Japan and Korea, specifically to blend in for use in coal-fired power plants to reduce the amount of coal combusted (and associated GHG emissions). While cost and transportation remain

key challenges, the ammonia blending pathway helps governments and utilities in Asia protect investments in existing coal infrastructure while lowering emissions.

- Internationally transferred mitigation outcomes (ITMOs) will be a difficult path for Canadian LNG to earn carbon credits due to Article 6 constraints on double-counting and additionality. Nonetheless, as Article 6 rules are still being implemented and finalized, there is opportunity for Canada and its LNG trading partners to test innovative scenarios and pathways for international carbon credit trading around fuel-switching.
- International cooperation is possible through climate clubs that create preferred markets for low methane intensity gas and longer-term abated natural gas value chains around blue ammonia and hydrogen. These value chains will complement emerging carbon border adjustment mechanisms and methane-intensity standards for gas and power imports, as recently implemented in the EU.

Studies of Note and Key Questions

A number of recent studies of note focus on the prospects for Canadian LNG. Many seek to make the case for or against the LNG sector from a public interest perspective. Others are written for the perspective of investors and/or industry considering the attractiveness of Canadian LNG versus other prospective opportunities. There are also deep dives into the climate implications of Canadian LNG.

Readers are encouraged to consult the following studies of note for additional background and information:

- https://energysecurefuture.ca/paper/canadas-lng-opportunity-a-value-proposition-worth-celebrating
- https://www.pembina.org/pub/lng-and-climate-change-the-global-context
- https://www.canadianenergycentre.ca/wp-content/uploads/2022/11/WM-CEC-Role-of-Canadian-LNG-in-Asia-Public-Report.pdf
- https://ppforum.ca/publications/a-leadership-blueprint-for-canadas-high-esg-gas/
- https://www.woodmac.com/press-releases/canadian-lng-has-potential-to-meet-growing-asian-demand/?utm_campaign=gas-lng-americas-2023&utm_medium=email&utm_source=-campaign-email&utm_content=q3-nurture
- https://thoughtleadership.rbc.com/canadas-conundrum-three-ways-to-address-the-worlds-gas-climate-crises/
- https://www.iisd.org/articles/deep-dive/canadian-lng-not-eu-energy-crisis-solution
- https://davidsuzuki.org/science-learning-centre-article/burning-bridge-debunking-lng-as-a-climate-solution/

Many of these reports tend to focus on one side or the other of this debate—economic and geopolitical opportunity or climate/environmental risk. We will do our best to consider both sides of the equation from an evidence-based perspective.

The broader approach in this study is complementary to these other reports but from a different starting place. Specifically, this study seeks to look at the prospects for Western Canadian LNG from the outside in. The goal is to assess the "pull" factors for Western Canadian LNG that either will or will not create the commercial viability and economic underpinning for the proposed projects, including in the longer-term transition to low and zero-carbon fuels.

We acknowledge fully that commercial viability must in turn be complemented by appropriate strategies for ensuring consent and shared benefits from impacted indigenous groups and alignment with Canadian federal and provincial climate policy. However, without a viable commercial pathway, questions of social and environmental licence for proposed projects are effectively moot. Similarly, discussions of economic and energy security benefits from Western Canadian LNG depend on actual projects with actual customers moving forward. While that may seem obvious to some, much of the debate around Western Canadian LNG at times bypasses the question of project viability.

Our focus is on the question of project viability for Western Canadian LNG at the macro level, and as such we will not seek to evaluate projects at the individual level. Each project will have its own competitive strengths and weaknesses ranging from location to technology to cost of capital to partnership structures.

TABLE 1. Proposed Western Canadian LNG Projects

Project	Timeline	Capacity
LNG Canada I	Under construction 2025	13 MPTA
LNG Canada II	Proposed 2028	13 MPTA
Woodfibre	Under construction 2027	2.1 MPTA
Cedar LNG	FID	3 MPTA
Ksi'Lsims LNG	Regulatory review	12 MPTA
Tilbury LNG Phase 2 Expansion	Regulatory review	Up to 0.65 MPTA

All of these projects will be influenced by the three central questions that will be explored in this study:

- Long-term outlook for Asian gas demand
- Competitive landscape and role of alternative LNG suppliers
- Resilience of Western Canadian LNG projects in the low-carbon transition.

The first critical question concerns the evolving overall role and growth trajectory for natural gas in the Asian energy balance over the long term, taking into account geopolitical, economic, and climate considerations as well as the roles of competing fuels and technologies. In this respect, understanding the outlook of Asian governments and LNG buyers—often closely intertwined—is vital.

The second critical question concerns who else is competing to supply gas markets in Asia and how that competition shapes the prospects for Western Canadian LNG. The competitive landscape includes both incumbents like Qatar, Australia, the U.S., and Russia, and new entrants like Mexico, Mozambique, and others. This competition is driven first and foremost by price for almost all Asian LNG buyers, with one or two potentially vital emerging exceptions in Japan and Korea. The focus on price is not to suggest that concerns about geopolitical risk, shipping distances, portfolio diversification, and environmental/climate impact do not matter, but rather that those factors are likely to be moot if customer expectations around price cannot be met.

The third critical question is understanding how resilient Western Canadian LNG projects are likely to be in a world of growing focus on climate change mitigation and significant decarbonization of the energy sector. Within this context, the business models for LNG that have been prevalent over the last decade or two are likely to evolve, with considerations around the overall methane intensity of LNG value chains and new, capital-intensive technologies such as carbon capture and storage, electrification of upstream production and liquefaction, and carbon credit/offset markets likely to become more significant. It is also evident that some gas developers will shift from LNG-based value chains to value chains based on producing and transporting blue hydrogen and ammonia. These GHG-friendly pathways must also be commercially viable within their own distinctive competitive landscapes, as Canada is not the only country pursuing these emerging opportunities.

The goal of this report is to shed insight on each of these questions in a balanced way that is realistic and gives (hopefully) equal weight to both the significant potential opportunities associated with Western Canadian LNG and the broad range of challenges and questions that must be accounted for if the projects are to achieve commercial viability and long-term resilience in a low carbon economy. With respect to challenges, the report will also seek to lay out potential solutions. Ultimately, markets and policymakers will decide whether there is a viable path forward.

SECTION A

The Asian Gas Market: Where Is Demand Headed?

LOOKING AT AN LNG SUPPLY GAP OR GLUT?

LNG developers are looking closely at the market balance and potential for a supply gap emerging by the end of this decade. A supply gap would traditionally signal a need for new supply, backstopped by customer commitments in the form of long-term offtake contracts. Yet the normal dynamics of developing and financing new projects are complicated by the energy transition and a wide range of decarbonization scenarios that call for a significantly reduced role for gas.

Among many examples is the most recent IEA World Energy Outlook (WEO) for 2023.[3] In its Announced Pledges Scenario, the IEA shows a huge increase in LNG supply through the end of this decade, anchored by the U.S. and Qatar, which is set to hit the market just as demand for natural gas and other fossil fuels peaks. In the Stated Policies (STEPS) scenario, natural gas demand peaks at around 4299 bcm and then stays roughly at that level until 2050. By contrast, in the Announced Policies (APS) and Net Zero Energy (NZE) scenarios, the peak in gas demand is followed by a dramatic collapse in demand displaced by renewables, clean hydrogen, and energy efficiency. These and similar scenarios create significant uncertainty for LNG project developers—both among investors worried about unfavourable project economics if demand falls and among many ESG-oriented investors and governments who believe that LNG development is inconsistent with the Paris Agreement-aligned decarbonization goals embedded in the IEA NZE scenario.

Yet within the IEA scenarios, the picture for gas demand in Asia and emerging Asia is much more bullish, at least in the STEPS scenarios particularly for China, India, and Southeast Asia, where gas demand grows from 587 bcm in 2022 to a projected 756 bcm in 2030. At the same time, global gas demand is held relatively flat in the STEPS scenario with incremental growth from 4159 bcm to 4299 bcm. This suggests that incumbent global LNG suppliers and new entrants will shift their focus from slower growth regions to target faster growth in Asia, amplifying the competitive challenge for Western Canada.

What do these numbers suggest for the supply gap and potential market signal for new suppliers? If one relies on the IEA data alone, all three of its WEO scenarios suggest that existing LNG supply in operation (650 bcm) plus supply under construction (250 bcm) will meet demand. In the NZE scenario, there is a large surplus and much of the proposed/ongoing new construction is stranded.

Beyond the IEA, however, many other industry and government forecasts show a more bullish picture for LNG demand which in turn suggests the current supply of LNG in operation and under construction will not be enough to keep the market in balance. The Institute of Energy Economics Japan (IEEJ) in its 2024 Outlook shows significant LNG demand growth in both its reference and

advanced technologies case, with a need for 8 to 18 million tonnes of new LNG supply annually to keep pace with demand.[4] The 2023 Shell LNG Outlook offers a similar perspective, showing a significant supply gap beginning in 2027, across several commercial consultant demand scenarios.[5]

The more bullish demand forecasts from IEEJ and Shell (and others) are highly at risk not just from climate policy, but also from strong prices that will keep coal in a competitive place and trigger faster investments in renewables. Demand growth is only as strong as the price at which the LNG is willing to be sold. This type of demand forecast is only reasonable at competitive prices—LNG growth will be strong at $9/MMBtu and below but still viable up to $11/MMBtu demanding on competing fuel prices and government policy. Above this level, demand does not grow as quickly and LNG rapidly loses ground to coal and renewables.

As intriguing as these questions are, it is beyond the scope of this paper to adjudicate conclusively the question of a supply gap. From the perspective of Western Canadian LNG developers, they ultimately need commercial partnerships and offtake at the project level, not the macro level. In turn, government regulators will take a view on the economic benefits and environmental effects of individual projects, not the LNG market as a whole. This reinforces the need for Western Canadian LNG producers to articulate a value proposition to individual offtakers based on price first and foremost, but also on energy security, flexible transportation, and environmental/social benefits. While this may seem obvious, it is meant to contrast from market conditions where there is a "golden age of gas" led by strong, sustained demand growth and broad gasification of industrial activity and power generation.

Where the interests of LNG producers and consumers likely align is a pathway showing a market in modest surplus that keeps prices stable and allows for some supply disruption due to geopolitical or operational factors. The massive price swings between the COVID shock of 2020 and the Russia-Ukraine shock in 2022 serve neither

Beyond the IEA many other industry and government forecasts show a more bullish picture for LNG demand which in turn suggests the current supply of LNG in operation and under construction will not be enough to keep the market in balance.

producers nor consumers. On this basis, we believe that Asian governments, including slower growth/declining markets like Japan and Korea, will err on the side of encouraging new LNG supply growth at least at modest levels—even though these plans may be at odds with more bearish, decarbonization focused scenarios from the IEA and others. Consumers will not want to be caught short of supply and will likely hedge against delays in scaling key technologies such as long duration battery storage and clean hydrogen that might ultimately displace natural gas. This context helps explain Japan's resistance to G7 proposals to phase out support for new investments in natural gas.[6]

EVALUATING ASIAN GAS DEMAND

Asia is the demand engine that drives growth for natural resources and commodity markets, thanks to rising consumption, more energy use per capita as living standards rise, and a high degree of resource import dependence in several major markets. Natural gas is no exception, with growth expected to average 4.2% through 2040. This trajectory could vary widely depending on the amount of supply that comes on globally—an LNG market in balance or in a small surplus would support pricing that would encourage demand growth and help keep gas competitive versus coal (and in the future, in many markets, competitive with coal plus carbon price) and renewables. Yet no OPEC-type organization exists to coordinate prices, which instead will be set by individual decisions by dozens of companies and governments. Individual LNG developers must generate returns for their shareholders (whether private shareholders or governments that depend on dividends from national oil companies) and will be cautious about avoiding a glut of supply. Yet, given highly competitive dynamics with coal and renewable

electricity and a recent period of high price spikes that wiped out demand in emerging Asian growth markets, producers need to ensure markets are not undersupplied either.[7]

Policy will play a large role as well. Will Asian governments put their thumb on the scale to encourage more gas consumption, or will they continue to try to diversify away from imported gas—for energy security, affordability, or climate policy reasons, or in some cases all three? While gas-exporting countries see natural gas as part of the climate and energy security solution, for many Asian importers gas is a big part of the problem—unless it comes at the right price, low geopolitical risk, and increasingly with the right low level of methane intensity. Partnerships between Asian consuming states looking to displace coal and fuel with imported natural gas and exporting countries looking to monetize stranded gas assets have an unmistakable logic but are unlikely to happen through market forces alone given the low cost of coal, a relatively young coal-burning fleet, and the various incumbency advantages domestic coal enjoys in many Asian markets. Depending on these variables and many others, it is possible to construct a wide range of forecasts for Asian gas demand that range from extraordinarily robust in business-as-usual/high supply/slow energy transition cases to extraordinarily weak in low supply/rapid energy transition cases.

Our goal here is to understand which factors will shape the export opportunity for Western Canadian LNG in Asia, understand with whom Western Canada is competing, and most importantly determine pathways that will make economic opportunities for Western Canadian gas value chains resilient in the widest range of energy transition pathways. Overall, the Asian market is evolving in ways that will test traditional assumptions about how demand for gas and other forms of energy are likely to grow. Key trends to consider include the following:

- The Asian market consists of several sub-regions with differing characteristics that translate into varying outlooks for natural gas demand. Key among them is bearable price.
- Coal is still king in most markets and will not easily be displaced by natural gas—yet government coal phaseout commitments and even carbon pricing in select markets may indicate a promising path forward.
- Natural gas can backstop growing variable renewable energy supply in the power generation sector, but the economics of serving as a peaker fuel will be different than baseload.
- Expiring LNG contracts and shifting business models incorporating higher volumes of spot flexible supply will play a key role.
- Decarbonizing heavy industry will be an opportunity for natural gas in several Asian markets in the short-medium term, transitioning in the longer term to blue and green hydrogen/ammonia.

In addition to these broad trends, a deeper dive into Japan and Korea as potential partners for Western Canadian LNG is essential given the following factors:

- Geographic proximity
- Closer government and industry alignment over climate and energy security goals
- Existing presence in the Western Canadian gas sector.

ASIAN MARKET SUB-REGIONS—WHICH MARKETS MAKE THE MOST SENSE FOR CANADA?

A number of studies on Western Canadian LNG link the opportunity to overall gas demand growth potential in the broader Asian market. According to the International Group of Liquefied Natural Gas Importers (GIIGNL), Asia accounted for 65% of global gas demand in 2023.[8] It is helpful to go further and look at the nuances that produce significant differences in the opportunity set for Western Canadian LNG between Asian sub-regions.

While the Asian market can be divided in multiple ways, the taxonomy portrayed in Table 2 offers a good overview of key differences.

TABLE 2. Key Differences Among Asian LNG Markets
Source: GIIGNL Annual Report 2023, International Gas Union LNG Outlook 2023

Sub-Region	Key States (g CO2e/KWh)	2022 net LNG imports (MTPA)	LNG capacity under construction (MTPA)	Fit for Western Canadian LNG
NE Asia	Japan, Korea, Taiwan	139.31	5.1	Strong
China	China	63.32	126.9	Moderate
SE Asia	Vietnam, Thailand, Singapore, Philippines	11.97	12	Mixed
South Asia	India, Pakistan, Bangladesh	31.24	35.6	Weak
Asian exporters	Indonesia, Malaysia, Australia, PNG, Brunei	-133.25	0	N/A

Northeast Asia: Japan, Korea, Taiwan

The northeast Asian market represents a mixed picture for gas demand. The region features a high degree of installed LNG import capacity and baseload demand for power generation and industrial use. The region is also wealthier and less price-sensitive than emerging gas markets in Southeast and South Asia. Key swing variables on the demand side will likely include efforts to phase out coal-fired generation capacity (discussed in more detail below), the uncertain status of nuclear power (particularly in Japan), potential scaling of renewable energy given land and transmission constraints, aging populations, and potential offshoring of gas-intensive manufacturing industries.

While gas demand is unlikely to grow in northeast Asia and may sharply decline in faster low-carbon transition pathways, expiring LNG contracts and efforts to diversify away from Russia will create new opportunities. Of particular note will be "gas-on-gas competition," as the Japanese and Korean governments potentially look to the lowest methane-intensity LNG suppliers to support their own methane pledges and net zero/ESG targets. As discussed in the final section of this study, this shift represents a strategic opportunity for Western Canadian gas exports.

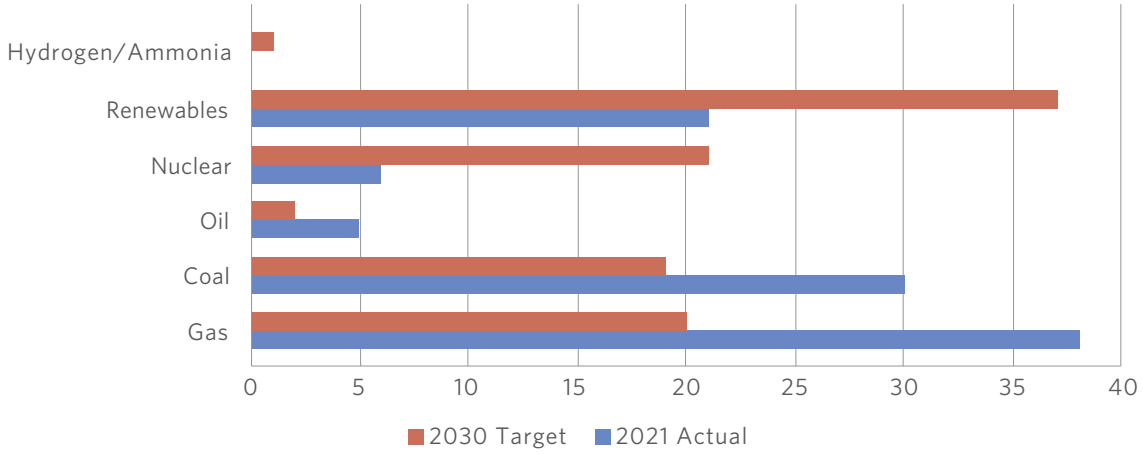
Japanese market outlook

Despite its 2050 net-zero pledge, Japan remains more vocally supportive of LNG as a "bridge fuel" than most other East Asian countries (and more than other G7 countries). In 2022, for example, Japan's Institute of Energy Economics stressed the "the need to avoid policies restricting or discouraging financing natural gas and LNG related projects."[9] This year, Japan helped push the G7 towards supportive language for gas as a transition fuel, particularly for short-term supply expansions to stabilize gas markets after 2022 market volatility.[10] How this short- and medium-term "bridge fuel" support for LNG squares with Japan's 2050 net-zero pledge and 2035 decarbonized electricity pledge, however, remains a question with a wide range of potential outcomes. Japan's declining population will also play a key role in shaping demand for all energy.

In the medium term, Japan will have to make important decisions on the quantity and supplier portfolio for its LNG contracts. Japan's long-term LNG contracts today are expected to fall by almost half after 2030.[11] This decline is driven by decreasing volumes from Russia and Qatar, among others. It also coincides with Japan's 2030 power mix targets, which call for significant drops in both coal-fired and gas-fired power generation: 30% to 19% for coal, and 38% to 20% for gas (Figure 1).[12] This proposed decline in the relative share of generation for both coal and gas points to limited enthusiasm for coal-to-gas switching as a long-term

Japan's long-term LNG contracts today are expected to fall by almost half after 2030

FIGURE 1. Japanese Annual Power Generation Mix by Fuel Percentage
Source: BNEF, METI



solution for power sector decarbonization in the minds of Japanese planners, particularly compared to other steps around co-firing or CCUS. However, it is also possible that the Japanese government will continue to lean on gas if renewable deployment and nuclear restarts are further stalled.

While politically unthinkable just a few years ago, the proposed restart of nuclear power has become an important plank of Japanese policy, with nuclear expected to provide up to 20% of total generation by 2030, up from just 6% in 2021. A nuclear expansion on that level would enable robust coal-to-nuclear *and* gas-to-nuclear switching. But with any further challenges to Japan's nuclear restart, those coal or gas declines would be much more difficult to accomplish. Indeed, if the coal-to-nuclear switching becomes less feasible, more government attention may turn to coal-to-gas switching instead, with more emphasis on aging coal plants switching to LNG and co-firing (similar to Korea). Japan's renewable rollout, expected to rise from just 20% of generation to almost 40% of generation by 2030, will likewise need to accelerate.

Regardless, minimizing the lifecycle GHG emissions of gas consumption will likely be an important criterion for Japanese gas planning post-2030 in all scenarios. Prioritization of low-emissions production is one likely result of that: this year, Japan received its first "low carbon ammonia" shipment from Saudi Arabia to be used in power generation.[13] Japan has also already publicly announced plans to explore blue hydrogen and ammonia trading with Western Canadian producers.[14] If nuclear and/or traditional renewables struggle to meet their 2030 targets, Japanese planners are unlikely to return to a business-as-usual approach to LNG imports. It is quite probable that, in the context of national emissions reductions goals, Japan would consider an EU-like focus on lifecycle emissions of gas imports as a key criterion.

Beyond 2030, all of Japan's LNG consumption will need to conform to its 2035 decarbonized power sector and 2050 net-zero goals. In its recent Green Transformation (GX) strategy adopted in early 2023, Japan outlines plans for a domestic emissions trading system (ETS) for high-emissions industries and the power sector to push these generators off unabated LNG or coal-firing.[15] It also highlights major corporate emitters (the "GX League") to help lead that transition, including on decarbonization of the supply chain. As in the power sector, this suggests downward risk for Japanese gas demand in the industrial sector, provided alternative fuels like hydrogen and ammonia are available at scale by 2030, a far from certain bet. Gas, particularly lower-methane intensity gas, could be an attractive bridge and alternative to coal in sectors like steel over the next decade or more.

Korean market outlook

Korea's medium- and long-term gas outlooks were both substantially reduced in the country's most recent Basic Plan for Energy Supply, released in early 2023. While the prior Basic Plan had called for more modest reductions in the shares of coal and LNG in Korea's generation mix by 2030, the most recent update takes a more aggressive approach to coal and LNG declines. By 2036, LNG's share in Korean power generation is targeted to drop from almost 30% in 2021 to less than 10%, while coal will fall from over 30% to under 15%.[16] As in Japan, these drops are enabled by Korea's pivot back to a growing role for nuclear power, alongside higher renewable output targets—goals that face similar uncertainties in terms of Korea's ability to achieve aggressive targets. Further, despite the anticipated reductions in LNG's share of overall consumption, nameplate LNG capacity may still rise as aging coal units are transitioned to LNG—an area of particular focus in Korean heavy decarbonization.

Even with growing policy enthusiasm for nuclear and renewable expansions in Korea, several factors could push LNG demand higher in Korea than in Japan in the medium and long term for Korea. First, Korea's coal phaseout target is more explicit than Japan's, with Korea placing more attention on retrofitting aging coal plants to LNG. This will likely push more corporate and policymaker attention onto low-carbon gas or zero-carbon turbines—i.e., gas-fired power plants combined with CCUS technology. Further, as in Japan, any shortfall in ambitious nuclear (or traditional renewable) buildout plans would put more medium-term pressure on LNG imports.[17] As a result, Korea may still see LNG demand expand until 2030 and even 2040.

China's near-term gas demand confronts energy security and cost concerns

Natural gas enjoyed a period of high policy enthusiasm in China between 2017 and 2020. In 2017, Chinese government planners began placing much higher emphasis on coal-to-gas switching, particularly in northern provinces for residential heating—a sector long dominated by coal. At the time, this movement was seen as part of China's broader attempts at addressing urban air quality issues. This implied that coal-to-gas switching could also quickly become a priority for the electricity and industrial sectors (the other primary consumers of coal in China's energy mix). In 2020, with the announcement of China's 30/60 goals (peak carbon emissions by 2030 and carbon neutrality by 2060),[18] coal-to-gas switching should have theoretically received further policy support as an effective decarbonization lever. This, however, did not occur.

Since 2020, multiple factors have combined to undermine policy enthusiasm for expanded gas reliance in China. In winter 2020/2021, domestic coal supply shortages, combined with rapid coal-to-gas switching in residential heating, caused the first in a series of gas price spikes since 2020, with LNG imports rising over $12/MMBtu.[19] While this price would be dwarfed in the next two years, this early blip was a sign to Chinese policymakers that global gas markets may be approaching a sustained period of high prices. $9 or $10/MMBtu is typically referenced as the price at which LNG starts to become competitive for coal-to-gas switching in China, meaning that as early as winter 2020, LNG was losing attractiveness on a price basis.

In fall 2021, China was hit by an even more acute electricity crisis. While this crisis was primarily caused by domestic coal supply issues, it focused Chinese policymaker attention on the short-term issue of energy security. Indeed, government rhetoric even pivoted to prioritize 'energy security' issues on a higher level than the decarbonization progress achieved in 2021 and 2022. The most notable result of these short-term energy security fears has been to increase the permitting of domestic coal projects and domestic renewable projects. Domestic coal and renewables are seen as less vulnerable to the whims of international commodity markets. In 2022 (the year after the most severe electricity crisis), China permitted over 100 GW of coal plants and installed over 100 GW of renewables—both monumental figures on a global level.[20] Notedly absent in this

response was any indication of a higher priority for gas projects, which are not seen as providing short-term energy security value in the same way as domestic coal or renewables.

In 2022, gas market turmoil from the Russian invasion of Ukraine created further policy uncertainty for gas in China. With spot LNG prices reaching record levels of above $30/MMBtu and many cargoes being redirected to meet European gas demand, LNG imports became even more uneconomic for Chinese policymakers.[21] Indeed, if 2022 gas market disruptions did anything to Chinese policymakers, it was likely to push them closer to embracing Russian gas imports that can no longer go to Europe. Russian imports—either pipeline or LNG—are likely to come at significant cost discounts to other sources.[22]

Even with a dominant role for coal and renewables, the long-term growth for Chinese gas demand is evident in recent estimates by influential Chinese think tanks and academic institutions. Most of these government-affiliated reports expect Chinese gas demand to rise ~60% to almost 600 bcm by 2030, not peaking until 2040 at a level between 600-700 bcm.[23] These scenarios would all entail an expansion of LNG contract procurement. One less bullish view on Chinese gas demand comes from the IEA, which expects Chinese gas demand to peak in 2030 at just 440 bcm. Even this view, however, represents over 20% growth from 2022 demand, and leaves open the question of the speed of post-2030 demand declines. It is worth adding that no matter which demand scenario pans out, Beijing has given the green light to state-owned entities to sign LNG contracts that could potentially go beyond expected domestic demand. The government wants Chinese companies to be in a position to trade actively and, consequently, all major importers are beefing up global trading desks to match the sizable length being accrued by IOCs to do the same. This shift is significant for Western Canadian LNG developers both because it makes demand signals harder to read but also (on a more positive note) because it adds liquidity and flexibility to the LNG market, which should benefit both buyers and sellers over time by reducing volatility.

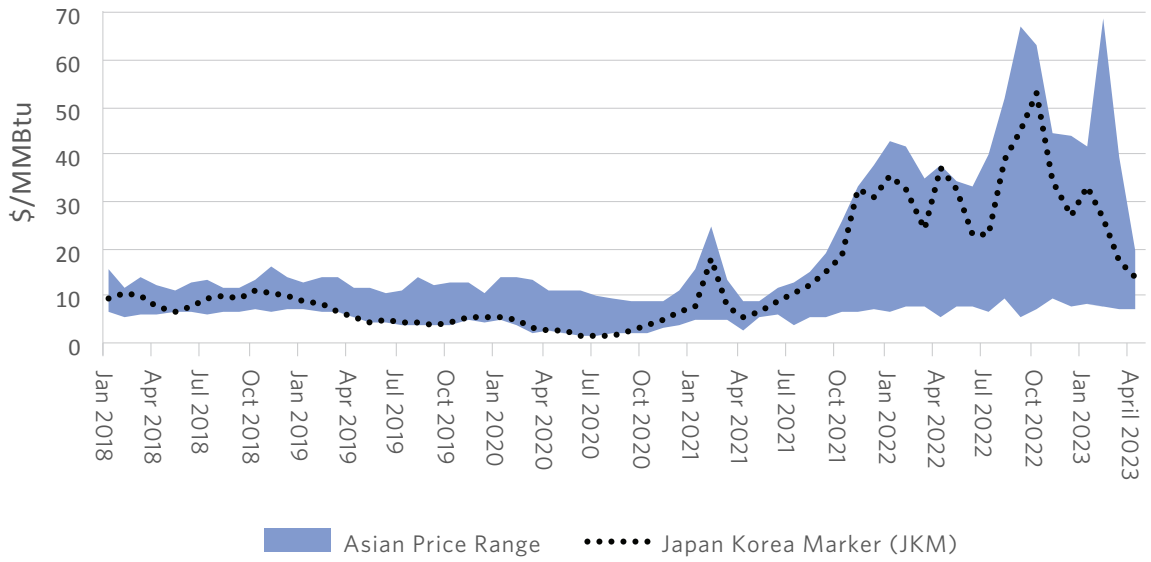
Even with a dominant role for coal and renewables, the long-term growth for Chinese gas demand is evident in recent estimates by influential Chinese think tanks and academic institutions.

For Chinese institutions, these projections align with China's headline climate target of peaking emissions in 2030 and reaching net-zero emissions in 2060. But the real uncertainty for gas demand comes after the 2030 peaking. Namely, how quickly will gas demand growth move into rapid demand reductions? And how will Chinese policymakers view GHG emissions from gas as China moves into the more difficult stages of post-2030 emissions reduction policy? While these are critical questions for long-term LNG balances globally, overall Chinese gas demand growth is likely to be a leading factor in driving demand for new supply. For Western Canadian LNG producers, the key question is what factors China will prioritize in its gas procurement strategy, which we discuss in the next section of this paper. Moreover, if China achieves the higher range growth forecasts, it is likely to contribute to a supply gap that will go beyond the ability of the lowest-cost producers in Qatar and the US to meet.

ASEAN and South Asia: price sensitivity will influence utilization of emerging new LNG capacity

For the ASEAN importing region, installed LNG import capacity is set to double as new terminals in Vietnam and the Philippines come online. Gas demand in these regions will be powered by dynamic population growth and booming inbound investment bolstered by a flight of Western investment from China. Energy consumption growth will be among the world's fastest, but that does not ensure a position for natural gas unless prices are competitive with coal and renewables.[24] Recent price spikes and volatility have created market dislocations, particularly around the

FIGURE 2. LNG Price Volatility Discourages Consumption in Emerging Asian Markets
Source: S&P Global Commodity Insights



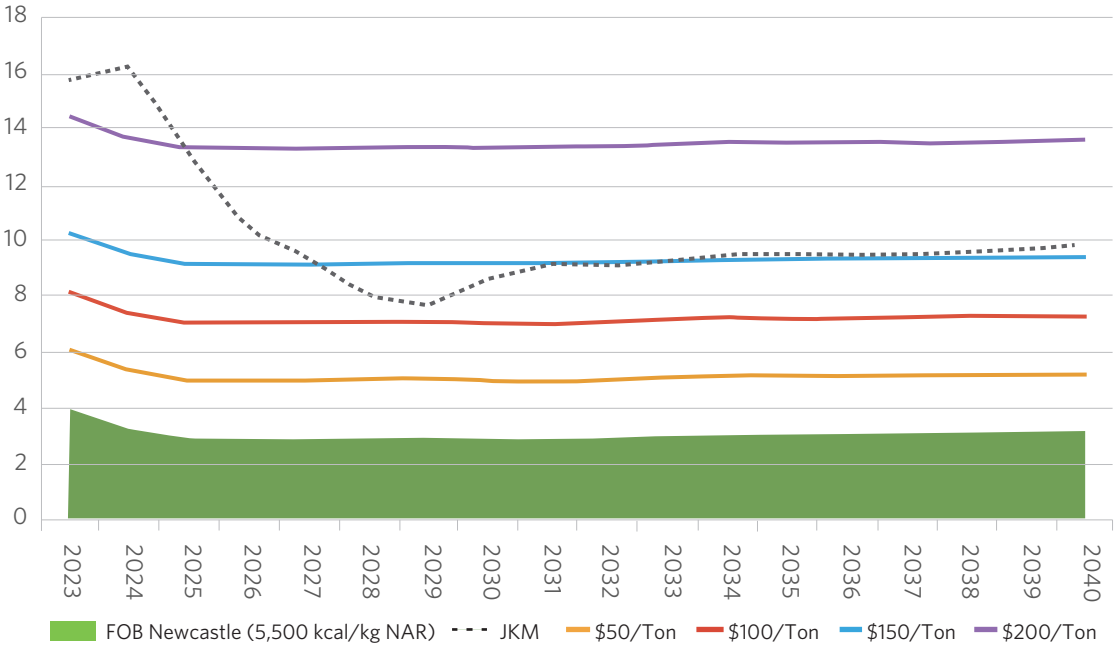
question of who should bear the cost of higher prices, among consumers, distributors, suppliers, and government.[25] A further complexity is that the ASEAN buyers generally need to build import capacity to meet projected peak seasonal demand rather than baseload use, as none of these countries operate or plan to invest in gas storage.

Coal retirements will be a priority backstopped potentially by Just Energy Transition Partnership support from the U.S. and other G7 governments, with $15.5 billion pledged to Vietnam and other coal-dependent countries likely to follow.[26] Vietnam is a particularly intriguing case study, as the government is promoting natural gas powered generation[27] alongside large-scale renewables investment as central to its coal phaseout plans.[28] By contrast, Indonesian plans for a coal phaseout seem to exclude gas at this stage and instead are leaning into renewables and transmission network expansion.[29] Like Japan, it is possible that delays will occur in the proposed massive scale-up of renewable energy in the ASEAN states, particularly given challenges around permitting, managing the role of state-owned utilities, and attracting sufficient levels of foreign investment. However, unlike in Japan, which has a high level of installed gas import and gas-fired power generation capacity, delays to renewable buildout in the ASEAN countries will likely favour coal.

The dynamic for South Asia will be similarly price-sensitive, although countries like India and Pakistan start with a larger base of installed LNG import and distribution capacity. Gas will be a premium fuel that is unlikely to gain share in the power sector in particular absent low prices combined with an additional carbon tax type incentive, the latter of which seems unlikely. Countries like Pakistan and Bangladesh were among the most severely affected by the 2021–22 price spikes in natural gas and coal, with both countries seeing LNG cargoes diverted away to Europe.[30] The crisis helped re-establish coal as a baseload fuel for reliability and energy security purposes, with a lesser impact on scarce foreign exchange reserves than LNG imports.[31]

India stands out in the eyes of LNG developers due to its vast population and surging energy demand, combined with a higher level of installed LNG capacity than many of the emerging Asian markets. The Modi government has committed to a target expansion of natural gas to 15% of the overall fuel mix by 2030.[32] Indian LNG demand has shown recent signs of rebounding after a slump during the high price period of 2021-22.[33] Yet India

FIGURE 3. Carbon Pricing Bolsters LNG Competitiveness Versus Coal in the Asian Power Sector
Source: S&P Global Commodity Insights



also appears to be opting for a China-like coal plus renewables strategy, leveraging its domestic capacity in both areas. Gas for fertilizer and industrial use in India is a promising but price-sensitive market. There is also potential opportunity for compressed natural gas in fleet and heavy transportation. But the power sector, in particular, is the area where LNG is going to be challenged in India due to affordability and surging coal/renewables competition.

This brief overview of gas demand outlook in the emerging Asian regions is not intended to suggest there is neither opportunity for LNG generally nor for Western Canadian LNG in particular. Rather, the core argument is that these markets are more likely to prioritize price and energy security over coal phaseouts or a potential preference for ESG-aligned, lower methane intensity gas sourced from markets like Western Canada. Within this context, the best opportunities for Canadian gas are likely aligned with countries like Vietnam that are embracing LNG as part of their coal phaseout plans. There is probably additional scope for integrated gas-renewable projects in power generation or industrials, wherein Canadian LNG is embedded alongside a renewable energy project as an intermittency solution or in an industrial decarbonization project as a bridge to hydrogen or ammonia. Such projects could be backstopped by the Export Development Corporation and other federal credit agencies as a central element of Canada's international climate strategy. Affordability and external financing through the G7 and Just Energy Transition Partnership (JETP) type programs will be critical. There are further opportunities to cooperate with Japan and Korea not just on coal phaseouts in their own markets but also in third party markets across the emerging Asian markets, where Japanese and Korean government and industry presence is well-established.

CARBON MARKETS AS A RESCUE FOR GAS?

Coal to gas switching in China and other Asian markets would be greatly accelerated by the addition of a carbon price. A carbon price of $100–200 per tonne would put the use of coal and gas on more equal footing in Asian power generation. Absent a carbon price, higher priced

LNG will both struggle to compete with coal and simultaneously help drive renewable power development instead. Higher carbon prices in the EU have bolstered both gas-fired generation and renewables versus coal, although the combination of Russian risk-related disruptions and lack of investment in domestic gas reserves and infrastructure have made gas prices higher than they might otherwise have been. Nonetheless, tighter EU emissions targets combined with surging coal demand drove EU emission allowance prices making gas more attractive for electric utilities. Carbon pricing schemes are few and far between across Asia but will likely expand in the years ahead, creating a demand signal that Western Canadian LNG exporters should evaluate closely.

For China, the trajectory of its domestic emissions trading system (ETS) will be an important signpost for long-term gas demand. Theoretically, an ambitious Chinese ETS could provide momentum for coal-to-gas switching in the same way that high ETS prices have in the EU. China's ETS currently only covers the power sector, despite long-planned efforts to expand it to other heavy industries. Even for just the power sector, Chinese planners have faced serious challenges in ensuring compliance. Fees for noncompliance remain low, and data quality issues persist. Further, Chinese ETS prices have historically been below $10/tonne—less than 10% of EU ETS prices. This means that in the power sector, the ETS does little to incentivize coal-to-gas switching (in addition to the power sector constraints discussed above). A decision to increase the ETS price would likely support demand for natural gas, at least at the margin- potentially higher utilization for existing gas peaker plants versus coal.

Non-power generation usage for steam coal in China currently accounts for about one-third of overall coal demand, according to the IEA.[34] Chinese industrial demand may provide more room for coal-to-gas switching than what is likely in the electric power sector. Industrial demand accounts for ~40% of Chinese gas demand, primarily in light industry including ceramics, glass, and cement. Some of these light industries have already undergone government-led coal-to-gas switching since 2017. But even as early as summer 2021, high LNG prices were reportedly weighing on these industries' profitability, and likely dampening some enthusiasm for future coal-to-gas campaigns.

While there is still further room for coal-to-gas switching in these light industries, the larger potential opportunity for external LNG to drive industrial coal-to-gas switching would be in heavier and more traditional industrial sectors like steel. In these sectors, however, Chinese policymakers have been reticent so far to embrace gas as a decarbonization tool. Indeed, the discussion around sectors has been more focused on policy steps including carbon capture, utilization, and storage (CCUS), hydrogen-based fuel switching, and even offsets as part of China's domestic carbon market system. To make gas a priority for decarbonization in these sectors, international gas prices would likely need to be much lower than they are today.

Carbon pricing could play a key role in shaping fuel-switching dynamics in the Chinese industrial sector, both coal-to-gas in the medium-term and ammonia/hydrogen value chains in the longer term. If China does effectively and quickly expand its ETS to other sectors, it will first prioritize heavy industrial sectors like iron, steel, aluminum, and cement.[35] This expansion will face a slow rollout similar to the power sector ETS expansion. The expansion of China's ETS to these industrial sectors is largely targeted at minimizing the future effect of the EU's Carbon Border Adjustment Mechanism (CBAM) on Chinese exports, rather than at pushing domestic fuel switching. However, as discussed later in this paper, compliance with CBAM may drive opportunities for Western Canadian gas value chains in GHG-intensive manufacturing sectors, particularly in displacing the use of coal.

Korea has the most developed ETS system of the target markets discussed here and represents a more positive outlook for natural gas. Korea's ETS system has been in service since 2015, covering over 70% of Korean emissions at an average price of ~$18/tonne in 2022 (far from EU prices but better than Chinese prices).[36] Korea's development

of its ETS has followed a similar planning pathway as the EU, with Korea's ETS currently in Phase III (2021-2025) before Phase IV takes effect in 2026. This institutional knowledge means Korea is much better equipped to tighten ETS standards on power generators and heavy industry, particularly from 2026 (the phase III rules were set before Korea's net-zero pledge in 2020). Korea's post-2026 changes may include more decisive rules on reducing free allowances and reducing the overall cap for emissions—the same issues that EU policymakers have been working on in recent years. These changes make Korea the most likely candidate to reach an ETS price environment that enables more coal-to-gas switching or carbon capture and storage (CCS) deployment in the short/medium-term for LNG importers.

Japan, on the other hand, will likely only achieve an ETS structure of similar effect post-2030 at the earliest. Japan's domestic ETS system began the first preliminary stages of operation in 2023 as a voluntary program among its GX League, with companies *only responsible for buying credits when they underperform on self-imposed emissions reductions targets*. This means a much smaller market until at least the start of the second GX League phase in 2026, with a fuller compliance market only taking shape in 2030. These timelines and institutional policy knowledge on ETS significantly lag behind Korea and China (and especially the EU). Further, much attention in Japan remains concentrated on offsets/credits from projects in other countries, priced further below the ranges necessary to impact coal-to-gas switching or CCS uptake.[37]

RENEWABLES VS. GAS

The central policy decision of this era will be whether Asian governments support higher gas imports or a domestic renewables buildout—or perhaps how governments balance the two in their broader energy strategy. One of the biggest sources of political pushback in Canada against LNG exports to Asia is the concern that increased gas exports will displace renewable energy, particularly wind and solar in the electricity sector. The argument suggests that falling renewables costs will displace fossil fuels and underpin a decarbonization of the electricity sector, while enabling additional decarbonization through electric vehicles, heat pumps (in northern Asia), and green hydrogen for industrial and heavy transportation.

In several countries, particularly in emerging Asia, this pathway to net zero emissions will be challenged by massive capital requirements for new electricity infrastructure, land availability for agricultural production vs. utility scale renewable projects, inadequate transmission and distribution infrastructure, and just transition concerns for legacy coal workers.[38] All countries will need to manage the challenge of integrating variable renewable energy on to the grid, a process that will drive decarbonization but also weaken returns for already financially shaky power companies and even create reliability concerns if not managed correctly.[39]

At the same time, it would be foolish to dismiss the impact that renewable energy will likely have on future gas demand in Asia. High prices for both coal and gas in 2021-22, combined with falling renewables costs, provide support for scenarios developed by groups such as the Rocky Mountain Institute (RMI) and International Renewable Energy Agency (IRENA) arguing that decarbonization of the power sector without LNG will be cheaper and faster for many developing economy countries.[40] RMI argues, for example, that a "no LNG/green only" scenario for Vietnam power generation investment through 2050 would be 20% lower net present cost than a LNG-intensive pathway.[41] Yet the RMI study also includes a reference of LNG price of $25/MMBtu—consistent with price spikes of 2022 but not necessarily where markets are headed over the next decade as new U.S. and Qatari supply comes online. Further, other studies argue that the pace of energy demand growth requires both renewable energy and LNG—absent LNG, renewable energy might remain linked to coal as the incumbent peaking electricity supply source.[42]

Asian governments are also leaning into a "coal plus renewables" strategy in which massive amounts of renewables are added to grid capacity, with

concerns over intermittency managed by using coal-fired plants as firming, or peak capacity, when renewable resources are not available. In regions like the U.S. where natural gas prices remain well below global benchmarks, gas is a highly complementary and economic backstop for variable renewable power. In Asia, coal is playing the same role. An exception may be markets like Japan and Korea that will favour gas, given large existing levels of LNG and gas power generation infrastructure. Both gas and blue ammonia may be favoured in wealthier Asian markets over coal peaking for climate strategy purposes, but even there, the gas price must be well below the 2021–22 levels.

Managing grid intermittency in most of Asia will remain a three-way game among coal, gas, and utility-scale battery storage, which has a small but growing role for long duration. The latter is constrained by supply chain and critical mineral availability but will likely gradually gain market share in China in particular, which is expected to be the largest global market for battery storage; ahead of the U.S. and EU, with 20 GW of annual installed capacity growth expected by 2025.

To "win" the intermittency challenge, LNG will need to be affordable, with verifiably low methane intensity relative to coal, and more flexible and cheap compared to batteries. Gas plus renewables projects offer interesting partnership opportunities between Canadian and Asian energy firms, where gas value chains for export could be built with supporting renewable power generation at both ends. Canadian LNG developers are looking to integrate more renewable power to address Scope I emissions, while Asian utilities are increasing renewable generation and simultaneously looking for low-cost solutions to manage intermittency.

Overall, it is not accurate to suggest Western Canadian LNG or any other source of gas will displace renewables, as the overall trend is in the opposite direction in the Asian electricity sector—renewables are displacing gas but not coal, at least not to the same extent. It is fair to argue that Asian governments and state-owned utilities investments in LNG could crowd out capital needed for renewables and electrification. However, the competition between gas and renewables is ultimately for different spaces in the electricity market—utilities are likely to use more renewables and less gas over time but the two sources will work together in many circumstances. Particularly in a scenario where critical minerals and supply chain constraints limit the deployment of battery storage, gas will offer significant advantages over coal as a lower carbon intermittency solution. The IEA Net Zero scenario accounts for both gas and batteries as critical intermittency solutions, particularly in developing economies. As the share of renewables in Asia grows, the competition for gas will shift to battery storage. Here gas may compete more favourably with battery storage than it does with either renewables or coal directly—gas can compete with batteries at higher pricing point due to both capital and operational costs facing a massive battery scale up. The flexibility of gas end use and LNG deliverability bolsters its competitive position with battery storage and is central to the overall growth argument for LNG in Asia.

Gas plus renewables projects offer interesting partnership opportunities between Canadian and Asian energy firms, where gas value chains for export could be built with supporting renewable power generation at both ends.

LNG prices ultimately need to be low enough to create a substitution market for coal capacity, which is how older U.S. coal capacity has been able to retire so quickly, even without a carbon price. In Asia, it's more difficult, although not impossible, because the average age of the fleet is so much newer. Alongside price, policy can play a key role with government financing renewable infrastructure, supply chains, grid modernizations, etc. So-called "abated" gas (gas plus CCUS) may play a key role in markets such as Korea, both for conventional combined-cycle gas turbines as well as for the production of blue ammonia for blending into coal-fired power plants. Both are discussed further below.

SECTION B

Assessing the Competitive Landscape for Western Canadian LNG in Asia

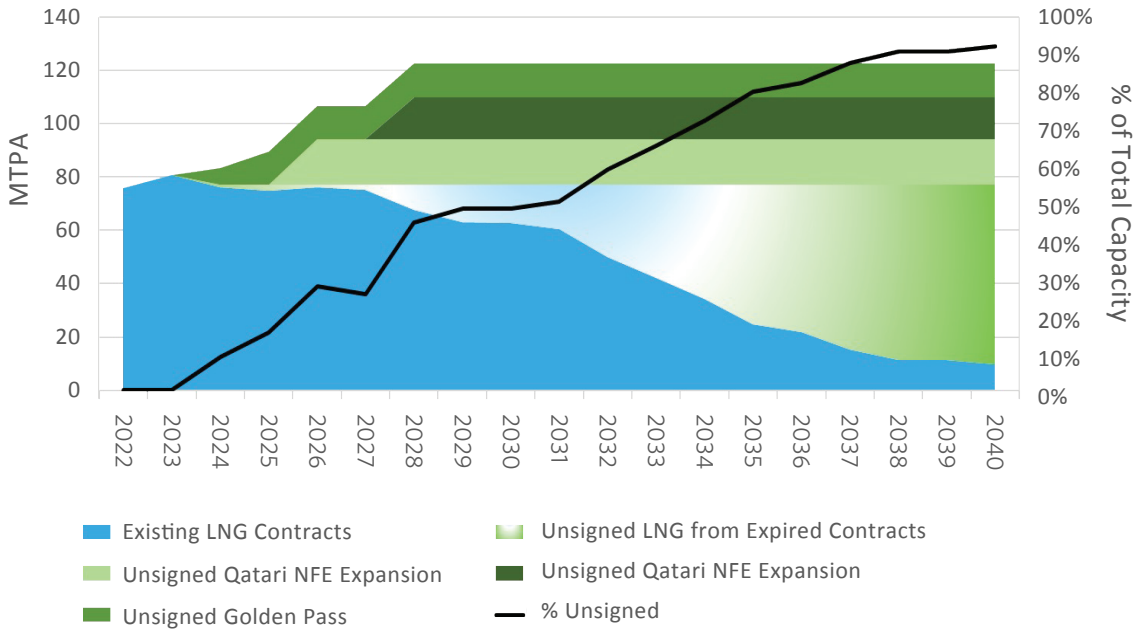
The Russian invasion of Ukraine has significantly increased and accelerated the supply outlook for the LNG market and arguably has spurred renewed market interest in Western Canadian LNG as well. The second major question in this study concerns the competitive landscape for Western Canadian LNG in Asia. In the previous section, we outlined some of the key drivers and uncertainties about how gas will compete with other fuels and energy technologies in Asia, across the various countries and subregions, each with its distinctive outlook. There is also, of course, competition among gas/LNG suppliers for market share, and Western Canada faces stiff competition, particularly from Qatar and the U.S. Yet there is a clear opportunity for Western Canada toward the end of the decade as supply from Qatar and the U.S. peaks. In the longer term, there is further opportunity to leverage Canadian gas value chains into feedstocks for ammonia and hydrogen production, emerging low-carbon markets that will have their own competitive landscapes.

THE MAIN COMPETITION: QATAR AND THE U.S.

Western Canadian LNG developers face the most direct competition in our view from the U.S. and Qatar, as well as a significant supply wild card relating to Russian gas. The U.S. and Qatar offer favourable pricing anchored by a massive scale that dwarfs the still nascent Canadian LNG sector. In the case of Qatar, the country's decision to expand from 77MTPA capacity to 126MTPA by 2026 has dominated recent post-COVID LNG procurement from China to Germany to India.[43] The U.S. has experienced a decade of LNG export growth and has further upside driven by additional EU demand seeking to replace supply from Russia. Its strength is market flexibility, robust infrastructure and connectivity, and (so far) mostly bipartisan political support for LNG exports.[44] U.S. supply is expected to grow from 13 bcf/day to 19 bcf/day by 2027 with additional potential up to 25 bcf/day in some scenarios.[45]

Key risks to U.S. supply include growing political sensitivity to a linkage between rising exports and higher domestic prices.[46] These concerns were elevated during the 2022 price spike but eased when domestic prices fell in 2023 even with LNG export levels remaining at peak levels.[47] Other prospective problems could include reliability and congestion problems in the Panama Canal due to more frequent droughts affecting the transit of LNG tankers from the U.S. Gulf Coast to Asia.[48] The heavy concentration of US LNG capacity along the Gulf Coast at a time of intensifying hurricane activity and storm surge due to climate change is creating additional vulnerabilities for LNG supply related to flooding and power outages.[49] There are also questions about whether U.S. LNG supply can continue to grow from an upstream perspective, should associated gas production from shale oil drilling fall[50] or new

FIGURE 4. Qatari North Field and Golden Pass Capacity Expansion Plans Through 2040
Source: GIGNL (International Group of Liquefied Natural Gas Importers; Columbia Center on Global Energy Policy



supplies in the northeast Marcellus region remain constrained by midstream regulatory delays.[51]

From the perspective of Asian buyers, the strong pull of the EU both for flexible supply during the 2022 gas crisis and the emerging new long-term offtake agreements being signed between a variety of U.S. suppliers and EU counterparties[52] means that there is not as much U.S. LNG available as was expected before the war—at least not at the prices Asian buyers hoped for.[53] The flexible nature of U.S. LNG contracts mean that U.S. volumes will swing towards Asia during peak winter demand periods and back to European storage for the rest of the year. The increased pull of U.S. LNG to the Atlantic Basin and the EU may create an opportunity for Western Canadian LNG developers targeting Asia, particularly when offering long-term, baseload type contracts.

The loss of Russian pipeline gas (discussed below) has certainly enhanced the outlook for LNG exports from the U.S., but also from Mexico. U.S. and Mexican projects moving ahead from 2023 will replace more than 50% of the lost Russian volumes. Mexican LNG exports will launch from the Pacific and are squarely focused on providing baseload supply to Asia and avoiding the emerging risk of using the Panama Canal. This strategy is similar to Western Canada but includes advantages around the repurposing of brownfield LNG regasification sites and the short transportation distance from Eagle Ford/Permian Basin gas supplies.[54] The biggest flaw for Mexican LNG exports is that they rely on U.S. gas production and therefore are vulnerable to commercial and political forces on both the left and right in Mexico and the U.S.[55]

For Qatar, its status as a global swing producer and price-setter is unlikely to change in the near to medium term, but geopolitics will remain a key risk and headwind for its long-term position in the market. Qatari supply is vulnerable to regional tensions around Iran, currently as of this writing in the ascendancy due to the Hamas-Israel war and potential spillover to a variety of Iranian-backed regional proxies from Yemen to Lebanon to Iraq.[56] These risks could manifest in a variety of ways,

The increased pull of U.S. LNG to the Atlantic Basin and the EU may create an opportunity for Western Canadian LNG developers targeting Asia, particularly when offering long-term, baseload type contracts.

from sanctions to physical attacks against Qatar's North Field (which shares a maritime border with Iran) to blockades/military activity in the Straits of Hormuz. While these tensions are not likely to derail the Qatari expansion to 126MMTPA nor displace buyer appetite for the lowest cost supply, a further escalation in regional tensions will bolster the appeal of North American LNG as a geopolitical hedge.[57] This is no doubt even more true for LNG buyers bruised by the Russia-Ukraine disruption. While the LNG market muddled through the first 12 months of the Russia-Ukraine crisis, no one is suggesting the market has enough spare capacity for a simultaneous disruption to Russian and Qatari supplies.[58]

Despite the above risks, the supply gap will be largely filled by incremental supplies from Qatar and the U.S. in the first order. The LNG supply gap consists not only of demand growth but also declining baseline "LNG supply in operation." Much of this supply is based in Asia (Indonesia, Malaysia, Brunei) as well as in Trinidad, Algeria, and Nigeria. Declining intraregional supply and emerging Asian demand for LNG will be matched by long haul volumes from the Mideast, North America, and East Africa.[59] Western Canada is well positioned to support this demand, particularly as Qatari and U.S. supplies peak toward the end of the decade. Other suppliers like Mozambique will add significant volumes to the market, but greenfield high volume LNG projects are dwindling to a smaller number of countries than expected a few years ago. Russia is having success with internalizing the processes to build out additional LNG capacity focused on Baltic Sea exports. Its goal is to build enough capacity to redirect 25% of its lost pipeline exports to Europe, with Spain as the most likely destination.

An important feature of the Qatari and U.S. project expansions is that much of the supply is being built regardless of its direct connection to contracts with end users. Qatar has so far sold less than 30% of its 50 MTPA expansion and must also face the prospect of trying to resign up its existing buyers as well as find a market for its 11 MTPA of equity from its Golden Pass asset in the U.S.

All of this U.S.-Qatari LNG will eventually need to be sold by super-majors and trading houses to end users. Right now, it sits in limbo as buyers assess market conditions. Asian buyers are looking for price relief while EU buyers look for shorter, flexible contracts to allow room for lower carbon fuels to emerge as part of their climate transition pathways. In essence, the market is paying for the LNG to be produced before it has a fix on how much the market is willing to pay to consume it. These dynamics are likely to clear up over the next few years, which will provide a stronger directional signal on the strength of demand, the size of a potential supply gap, and the call for additional LNG supply from Western Canada elsewhere.

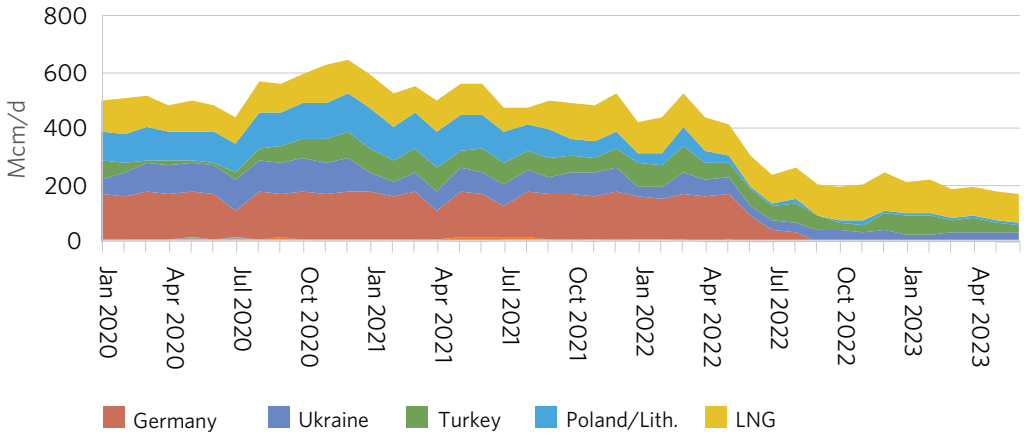
THE WILD CARD: RUSSIA PIPELINE GAS AND LNG

Since 2022, LNG markets have undergone significant structural changes, driven principally by geopolitics. The most consequential driver of this has been Russia's invasion of Ukraine in February 2022, which resulted in unprecedented LNG market volatility and renewed energy security fears in LNG-importing countries.

The loss of 150–200 bcm/year of Russian pipeline gas has created a unique opportunity to develop alternative gas supplies for the global gas market. While the risk of this Russian gas eventually returning to market is real, the development of new sources in the interim period will potentially displace this Russian volume permanently. The risk of Russian gas returning to the market will be minimized by the EU's limit on what it will be willing to take. The EU will limit imports to a small percentage of the total, essentially trapping the gas in Russia. Shifting this gas to Asia will be a long and costly process. However, in the context of longer-term energy security outlooks, China along with potential LNG buyers in south and southeast Asia will look to acquire "advantaged" Russian pipeline gas and LNG.

In terms of market flows, the biggest short-term structural shift in LNG markets resulting from the war has been the rise of European LNG

FIGURE 5. Russian LNG Exports Surge as Pipeline Exports Fall
Source: McWilliams, B., G. Sgaravatti, G. Zachmann (2021) 'European natural gas imports', Bruegel Datasets, first published 29 October, available at https://www.bruegel.org/dataset/european-natural-gas-demand-tracker



NOTE: Finland, Latvia and Estonia each import such small quantities of gas that they are not included in this figure.

consumption, largely filled by displaced Asian cargoes. For Europe, Russia's invasion of Ukraine meant declining access to piped Russian gas imports, which supplied close to 40% of European gas demand before the war but are moving quickly towards a state of permanent decline. Losing access to Russian piped gas forced the EU into a public push for short-term LNG procurement, with LNG rising to meet almost 35% of EU gas demand in 2022. Europe's rabid LNG demand led to large price premiums over Asian LNG buyers, establishing Europe as the highest price-point market for LNG, despite its continued hesitancy to embrace long-term reliance on LNG for climate reasons.

This revival in EU LNG demand pushed China (and Asia in general) into a 'balancing' role in gas markets. Indeed, several East Asian countries allowed LNG cargoes to be redirected to the EU in 2022/2023 to take advantage of record prices. Until 2022, the EU had historically played more of this balancing role in global LNG markets. But after Russia/Ukraine, this role appears to be moving to Asia in the short term—particularly China. China is responsible for a growing share of global LNG contracting and has large domestic demand variability, making its future role in LNG markets more consequential. Chinese buyers are buying LNG contracts to be put in a position to consume domestically or trade internationally. The aggressive push by super-majors to create large LNG portfolios is prompting Chinese buyers to do the same thing. Once again, as many deals are being signed to secure supply as are being signed to target some expectation of demand growth.

In China, Japan, and Korea, perhaps the most important takeaway from 2022/2023 market volatility was on the real risks that geopolitical tensions pose for energy security. For Japan, Russian LNG provided 9% of total supply in 2021, versus 6% of supply in Korea and 5% in China—significant volumes but not comparable to EU dependence.[60] Nonetheless, the disruption for all three countries was felt in form of higher prices and longer-term uncertainty about supply in the context of sanctions and geopolitical risk. For China, energy security anxieties in 2022/2023 led to an expansion of domestic coal and domestic renewables (at the expense of imported gas).

Japan, without China's ability to ramp up domestic coal and renewables, was forced to double down on its existing gas contracts, even when these caught political pushback. Japan's continued engagement on the Russian Sakhalin LNG project in 2022—even as it supported other countries' efforts to sanction Russian fuel exports—was a key example of this.[61] For Japanese policymakers, though, even this scenario caused discomfort due to its geopolitical consequences: going forward, suppliers with more overall political alignment

will reduce the energy security anxieties associated with those imports. As a G7/G20 partner, Canada is well positioned as an energy supplier to Japan and Korea in particular. Unlike China, neither Korea nor Japan are likely to double down on coal nor are they looking for new opportunities to acquire Russian gas at a discount, as China may do through an expansion of the Power of Siberia pipeline.[62] Growing energy security fears have also been an important factor behind Japan and Korea's movement back towards domestic nuclear generation in the last 18 months.[63]

For other developing economies in Asia, market volatility in 2022/2023 left a different lesson: that historical projections of low-cost LNG may not apply in the future. For some smaller-scale LNG importers in South and Southeast Asia, significantly expanding LNG infrastructure was already tenuous from a cost perspective before recent LNG price spikes. After the price increases seen in 2022, those countries are more likely to rely on a combination of existing domestic fuels and/or a straight jump to lower-cost renewables. That path is more broadly similar to the Chinese decarbonization path than to the Japanese/Korean decarbonization path.

The year 2022 also saw the EU, U.S., and Japan offer more vocal support for short-term LNG expansions, despite pledges as recently as 2021 not to do so. EU gas buyers even backtracked on earlier objections to the methane-intensity of U.S. LNG exports, which had previously imperiled U.S.-EU LNG deals. Energy security became more important than emissions intensity. LNG was instead increasingly branded as a short-term solution to guarantee this security, but not an excuse to derail existing plans for reducing gas's share in overall decarbonization pathways (especially unabated gas). For Canada, these G7 dynamics are critical both in identifying alignment over emerging LNG supply with key allies and in developing longer-term opportunities for hydrogen and ammonia. Canada's positioning as a low-methane intensity LNG supplier will be particularly important in assuaging EU concerns about the future of gas.

U.S. and Qatari ability to supply the EU with short-term LNG (at very high prices) underscored the leverage that large LNG providers enjoyed in 2022. This fact was also evident in the diplomatic clout enjoyed by Qatar in 2022, which was afforded the title of "major non-NATO ally" by the U.S. in 2022 and expanded strategic relationships with Europe.

CHINA'S SUPPLY STRATEGY AND 2021–23 CONTRACTING SPREE

While Chinese government rhetoric on gas reliance since 2020 has been tepid, it has been more active than most international peers in securing new long-term supply deals. In 2021, 2022, and 2023, China has signed more new long-term gas supply agreements than any other country. More than a symbolic pivot back to gas, however, this pattern likely represents China's desire to lock more of its gas demand into long-term contracts rather than being reliant on spot market exposure. It also fears the large position being taken by Western IOCs in creating large LNG supply portfolios that have the potential to influence spot prices. China's experience in 2022 of redirecting cargoes to Europe to satisfy high-price demand also shows that China is willing to occupy a more strategic role in LNG markets for reasons beyond energy security.

China's ultimate appetite for LNG imports is more likely to be determined by the pace of its domestic gas production growth, its pipeline import outlook, and external LNG market conditions outside of its control. On all three counts, Chinese buyers are likely to prefer domestic, piped, or geopolitically aligned LNG providers.

The potential strategic benefits offered by Western Canadian LNG suppliers are likely to be less persuasive to Chinese buyers than the benefits offered by other large LNG suppliers. This is so for two main reasons. Firstly, the emphasis (and legal requirements) of Canadian LNG on low-emissions production, stakeholder involvement, and potential ITMO appeal are unlikely to be significant value-adds for Chinese producers. China has shown little appetite for making low-GHG

production a criterion in its LNG contracts (or any other commodity contracts). This is particularly the case if that environmental benefit requires a price premium. Further, the strict emissions rules regulating the production of low-carbon gas in British Columbia, for example, may even be seen as a strategic liability by Chinese producers: another risk that could threaten the long-term delivery of agreed-upon terms.

Secondly, China has been aggressive in expanding contracts with suppliers that it sees as aligned with China geopolitically. This can be seen most clearly in China's replacement of Japan in multiple contracts with Qatar, as well as with the continued expansion of pipeline and LNG relationships with Russia. From the Chinese perspective, suppliers like Qatar and Russia are less exposed to geopolitically induced trade tensions than other partners like Canada or Australia, even with LNG being largely spared from commodity tension in the past. Deals with Qatar and Russia also come with more explicit government-to-government presence in contracts, something Canadian suppliers may struggle to guarantee in the same way.

Interestingly, despite bilateral tensions, China has been liberal in expanding contractual relationships with U.S. LNG suppliers in the last two years. This expansion, however, is likely more closely tied to LNG's role in the US-China bilateral trade deficit and its role in managing the near-term trajectory of U.S.-China relations more broadly.

The potential strategic benefits offered by Western Canadian LNG suppliers are likely to be less persuasive to Chinese buyers than the benefits offered by other large LNG suppliers.

The aftermath of Russia/Ukraine and the increasingly political nature of LNG trade has led some analysts to speculate about a bifurcation of global LNG trade. On one hand, there are buyers and suppliers largely aligned with the G7, climate urgency, and (at least in 2022) Russian sanctions. Canada, Japan, and Korea all fit in that group. On the other hand, there are buyers and suppliers opposed to sanctions and without the same degree of climate urgency. These are primarily developing economies and China. How any such bifurcation continues in the future will be a key variable for global LNG markets and in shaping the competitive opportunity for Western Canadian suppliers.

SECTION C

Resilient Pathways for Canadian Gas Exports in a Decarbonizing World

Through the course of interviews, research, and our two expert workshops, we see four possible pathways through which Western Canadian natural gas can contribute to decarbonization goals in the Asian economy. These four pathways would be bolstered by two Ottawa-led enabling policy mechanisms. The goal is to align Western Canadian gas value chains with a future similar to the IEA Net Zero scenario, which, as illustrated in Figure 6, shows a sharp decline in unabated gas and significant growth in gas plus CCUS, renewable natural gas, and hydrogen. We are by no means predicting the timing or likelihood of this scenario, but rather encouraging the gas sector to consider how its resources can retain value by developing new pathways and a new business model for net zero type scenarios, as indeed most industry members are already doing. We also look at where unabated gas can make an impact as a transition fuel, particularly in coal/fuel oil switching and industrial decarbonization.

THE FOUR PRIMARY PATHWAYS

The four primary pathwasys include the following:

Coal-to-gas fuel switching

The dominant position of coal across Asian energy markets is a core challenge for global climate goals, and, as discussed above, a competitive barrier for developing new export markets for Western Canadian LNG. Major emitters like China and India have announced dates for "peak coal" but continue to add new coal-fired generation capacity for energy security and affordability reasons and

FIGURE 6. IEA Net Zero Scenario: Total Energy Supply (exajoules)
Source: International Energy Agency Net-Zero Scenario 2021

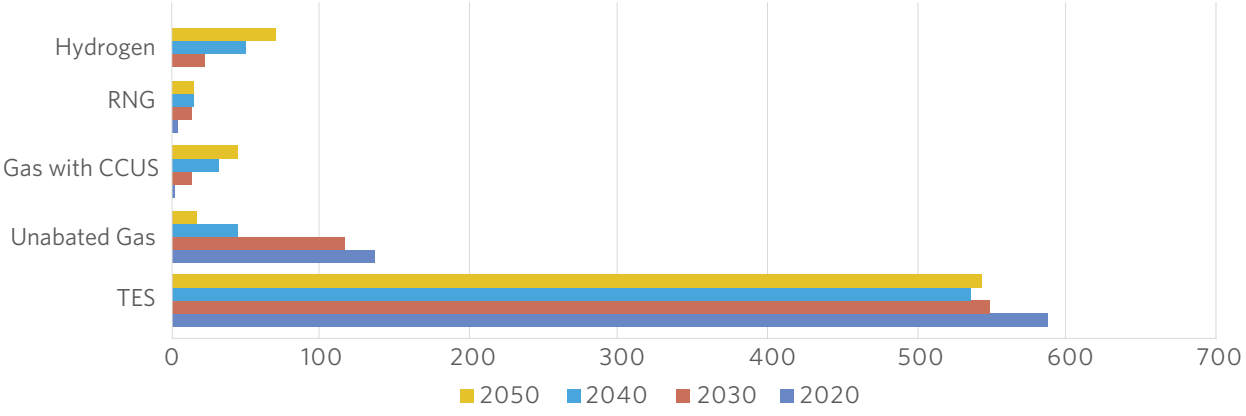


TABLE 3. Coal and Gas Capacity in East Asian Countries
Source: Global Energy Monitor, author research

Country	Grid intensity (g CO2e/KWh)	Existing coal capacity (GW)	Average coal capacity factors	Existing gas capacity (GW)	Average gas power capacity factor	2021 LNG imports (bcm)
China	531	1,092	48%	108	28% (2023)	109.5
Japan	483	53	73%	78	58% (2016)	101.3
Korea	436	39	80%	42	41% (2020)	64.1
Vietnam	309	25	61.5%	8	8% (2021)	n/a

are expected to continue to do so for at least the next decade. Coal also has a dominant position in emerging Southeast Asian and South Asian markets, where new capacity has been added in recent years.

The relatively young age of this coal fleet makes retirement economically challenging for local utilities and governments that still have significant upfront capital investments that are supposed to be recovered over decades and would be at risk in an early decommissioning. S&P reports that in Southeast Asia, the fleet of coal-fired and gas-fired operating power plants averages less than ten years of age, with a normal technical life of 25 to 40 years alongside other 40GW of fossil generation under production.[64] Table 3 above shows both the dominant role for coal-fired generation in four key Asian markets—and the under-utilization of existing gas power plants in face of high fuel prices.

Even Japan and Korea have added coal capacity over the past decade, thus lowering the average age of their operating coal fleet, with older combustion plants retiring and new ultra-critical coal plants coming online. The coal comeback in Japan and Korea has been driven by high LNG prices and nuclear uncertainties. The coal rebound in Japan in particular adds complexity to Japan's "green transformation" (GX) strategy as well as to G7 discussions around coal and gas phaseouts and government financing.[65] The same is true at the G20 level where China, India, Indonesia, and Korea are reluctant to fully abandon coal even as they ramp up investment in alternatives. For each country, the calculus of continuing energy demand growth, local economic and market conditions for renewables, legacy coal investments and political interests (both companies and workers), and concerns about affordability challenge the timelines for coal phaseouts, even as the eventual shift in that direction becomes more certain.

Given its status as the world's largest GHG emitter and its coal-heavy electric power sector, fuel-switching in China is a key target for the LNG sector in terms of potential new markets. Yet China will likely be a more challenging market for coal-to-gas switching than other East Asian importers for a number of reasons. Firstly, Chinese gas demand today is dominated by the industrial sector at over 40% of gas demand, followed by power generation at under 20%. The relatively marginal role for gas in power generation reflects the reality that decarbonization in China's electricity sector will be driven by newly installed renewables, hydro, and nuclear.

While China leads the world in renewable deployment, it faces major challenges in managing the politics of phasing out its existing coal fleet. China has committed that it will start to phase down coal plants from 2025. But China's coal fleet is larger than that of the rest of the world combined, has a high penetration of younger plants, and suffers from lower utilization rates than other East Asian neighbours. This combination of factors means that, at least in the electricity sector, policymakers will likely search for some way to preserve the long-term financial health of coal plants, which will leave little room for coal-to-gas switching.[66] One example of this may be that coal plants run at lower capacities or in 'peaking' roles more traditionally fulfilled by gas plants in other countries.

Alongside the intense focus on coal-to-gas fuel

TABLE 4. National Coal Phaseout Targets by Asian Country

Source: World Review of Energy Statistics 2023, Climate Action Tracker, media reports

Sub-Region	Key States (g CO2e/KWh)	2022 net LNG imports (MTPA)	LNG capacity under construction (MTPA)	Fit for Western Canadian LNG
China	55.4	2060	2026-2030	None
India	55.1	2070	None	None
Indonesia	44.8	2060	2030 (peak power sector emissions)	2040 (power generation)
Japan	27.5	2050	None	None
Korea	22.5	2050	2030	2050
Vietnam	44.6	2050	2030	2050 (power generation)

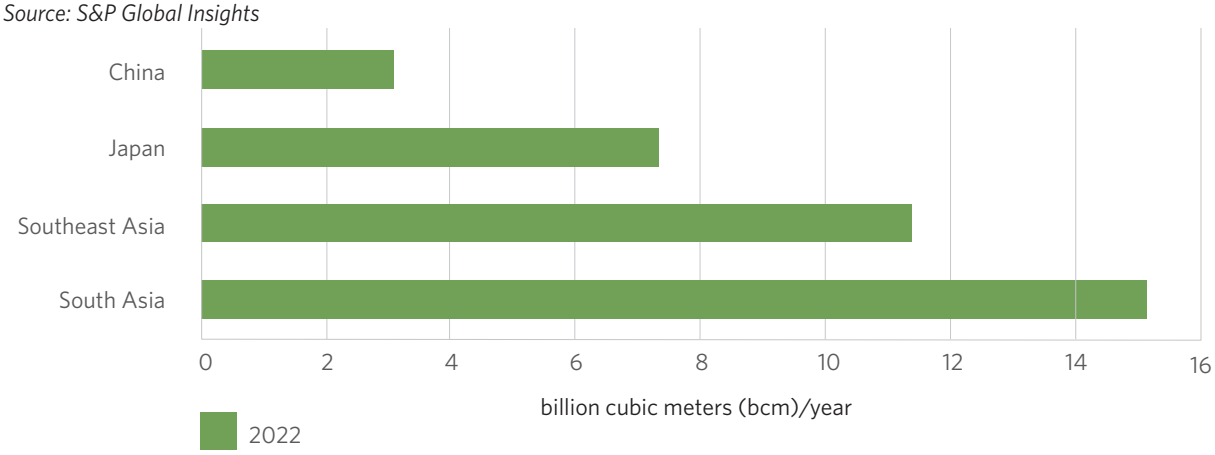
switching as a catalyst for Asian LNG demand, it is also important to consider the potential for gas to displace oil-fired power generation as well. Promising markets for oil/gas switching include India, Southeast Asia, Japan, and China. Collectively, replacing oil-fired power plants with gas in these markets could create 35 bcm/year of incremental demand. The economics of substituting for oil or diesel are far more favourable than coal, even though the overall opportunity is significantly smaller.

The GHG benefits of coal-to-gas fuel switching have gained little traction in the climate policy debate, at least with respect to the LNG sector. This has been frustrating for proponents of the LNG sector in both the U.S. and Canada. Instead of a broad, cross-Asia approach to fuel-switching, Canadian policy might be more effective in a targeted way based on several factors:

- Canadian LNG will face a more difficult path in markets dominated by cheap coal and cheap renewables, including the largest markets by population in India and China. Canadian LNG is more likely to drive substitution in markets with both existing gas infrastructure[67] and governments with similar ambitions on climate change as well as shared geopolitical interests in energy security and supplier diversification. The strongest candidates for this criterion are fellow G20 members Japan and Korea.
- Canada has played a strong leadership role in Global Coal Phaseout dialogue through the COP and other international climate policy arenas.[68] Given the powerful incumbency role of coal, there is a recognition that novel forms of climate finance will be needed to dislodge coal and get many of the large emitting Asian economies on track to meaningful GHG reductions.[69]

FIGURE 7. Potential Oil-to-Gas Fuel-switching in Key Asian Markets

Source: S&P Global Insights



Gas has not featured as a major factor in these discussions, but could easily do so in the future.

- To bring gas into Global Coal Phaseout dialogue, Ottawa alongside the Biden administration and the EU would likely need to be convinced that coal-to-gas switching includes life cycle emissions analysis and measuring/verification of methane intensity to ensure that coal is not displaced by an equally dirty fuel.
- Asian governments would need to be confident that higher quality, lower methane intensity gas would not be priced at a significant premium to the market. This strategy will make the most sense in markets with existing LNG and gas distribution infrastructure, including India.
- Emerging gas importers like Vietnam are including gas alongside renewable energy in their coal phaseout program.[70] While this is not applicable to all emerging Asian markets, Canada should partner with countries that are looking to gas to replace coal, backstop renewables, and offset declining hydroelectric resources.
- Finally, the Canadian government focus on verifiable fuel-switching creates a barrier, as it means that projects linked to portfolio/trading-based partners will have a more difficult time given that they will sell to different customers at different points. If this standard remains in place, there will be a premium on projects that have fixed offtake to a single buyer, particularly where there is integration between upstream and downstream. An alternative model around transparent LNG value chains is discussed below.

Development of fully transparent "end to end" methane reporting across LNG value chains to support gas-on-gas substitution

Canada, British Columbia, and Alberta have been in the forefront of efforts to establish rigorous methane emissions reporting, both at the governmental level and through industry-led efforts. Such efforts are increasingly extending from upstream only to full value chain inclusive of processing, liquefaction, transportation, distribution, and consumption.[71] However, the ability to monetize or create value from lower methane-intensity remains limited, as buyers have been slow to validate markets built around certified, verifiable lower methane intensity gas. Such markets are likely to grow further with government support. Government support in the form of clear policy and regulatory standards around reporting requirements that are available to the public, investors, and to market participants will help create a premium as demand for certifiably low methane intensity/zero fugitive emissions LNG will grow. Strong policy and reporting requirements will also be necessary in the context of carbon border adjustment mechanisms and potential climate clubs, as discussed further below in this study.

The ability to monetize or create value from lower methane-intensity remains limited, as buyers have been slow to validate markets built around certified, verifiable lower methane intensity gas.

One major reason for this growing focus on methane emissions is that satellites and other technologies are now enabling more external scrutiny on industry claims about methane intensity. Recent studies have found actual methane leakage rates at U.S. natural gas facilities several times higher than industry/EPA estimates, major gas leaks have been detected in countries with minimal methane emissions monitoring, and some recent studies have even begun suggesting that gas could have a higher warming impact than coal when methane leaks are fully counted.[72] This increasing scrutiny holds true across the LNG value chain, from upstream/midstream infrastructure to shipping and regasification.[73]

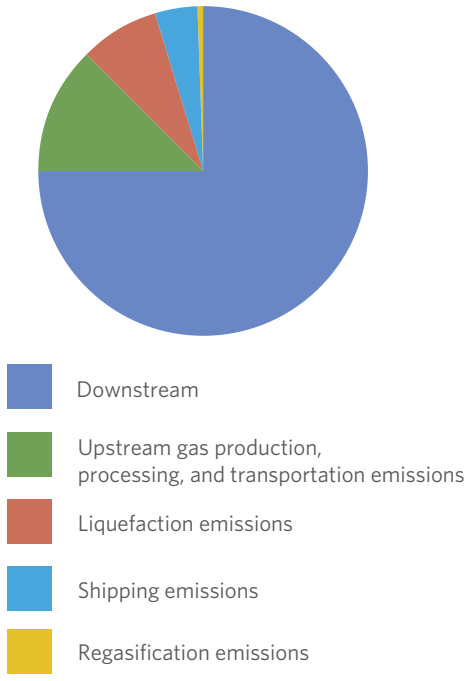
This trend is pushing a larger and more disparate range of stakeholders into independent methane emissions monitoring. In terms of governmental action, the most high-profile example of this is the International Methane Emissions Observatory (IMEO), established in 2021 through the UN using principles based on the Oil and Gas Methane Partnership (OGMP). The same year also saw the unveiling of the "Global Methane Pledge," now with over 150 countries committing to reduce global methane emissions over 30% by 2030. Canada and Japan committed to being "Champions" for the Global Methane Pledge at

Climate Week in September 2023, with more action on the Global Methane Pledge likely to be a priority area at COP 28.[74]

Outside of government, more NGOs and environmental groups are getting involved with methane monitoring, with methane emissions better suited to external audit than carbon emissions (the Environmental Defense Fund's independent methane monitoring satellite, set to launch next year, is one example of this).[75] Fully dynamic, real-time systemic monitoring of methane emissions remains limited, but satellite and laser-based standards are moving in this direction. And gas producers themselves will be increasingly pushed towards more granular methane accounting methodologies in terms of site-level reporting and shorter time intervals in reporting, rather than using traditional emissions-factor calculations. In this context, the Western Canadian LNG sector has an opportunity to adopt industry best practices from the outset of production and provide a legitimate test case for how low-methane LNG can be verified and transparent.

The potential contrast between Western Canadian LNG and other gas producers in this regard is stark, especially in upstream emissions. Canada's methane intensity in gas production is already lower than most global peers; and within Canada, upstream natural gas from the Montney has the best chance of verifiable low-methane production, thanks to geological conditions and provincial-level policy guidance. In the short and medium term, more international attention will come to the negative methane intensity stories from other global suppliers. This will create opportune openings for Western Canadian LNG providers to market their climate credentials.

FIGURE 8. Carbon Intensity of the LNG Supply Chain (by %)
Source: GTI Energy



Particularly for gas exporters like Russia, Nigeria, and Turkmenistan, methane exposure will be a growing strategic liability—but only for consumers that prioritize methane intensity. As discussed earlier, this criterion will likely be more applicable to Japanese and Korean buyers than Chinese or Southeast Asian buyers. This trend may lead to a further bifurcation of global LNG agreements along the lines of what has already occurred since Russia/Ukraine in early 2022. Importantly, Japanese and Korean buyers will want to reduce the methane intensity of their LNG portfolio at the same time that more questions emerge over existing industry methane claims. This will likely add more policy impetus (and financial bandwidth) for these markets to prioritize low-methane LNG procurement.

Shipping will also become an increasingly relevant part of Western Canadian LNG's methane footprint. While shipping typically accounts for less than 5% of emissions in the LNG value chain, it will attract attention as part of the broader conversation around shipping decarbonization. Actions from the International Maritime Organization (IMO) will be a relevant driver of Western Canadian LNG's total GHG footprint. The IMO has been one of the more effective multilateral institutions in setting sectoral-specific decarbonization trends in recent years, and this July finalized its most recent decarbonization guidance: aiming to reduce global shipping emissions by 20–30% from 2008 levels by 2030, and 70–80% by 2040.

As part of this plan, a number of IMO actions will affect the role of shipping in LNG's methane

footprint (and LNG's role as a potential maritime fuel).[76] Firstly, the IMO will increase data collection both through internal and external mechanisms. Methane 'slip' in LNG tankers will likely be a key area of concern for data collection, including through IMEO and NGO satellites. Last year, a coalition of shipping companies launched a new program called the Methane Abatement in Marine Innovation Initiative, focused on quantifying true levels of methane slip in LNG-fueled shipping to combat similar claims.[77] While LNG-fueled ships are gaining popularity among some shippers for immediate incremental emissions savings (~25% lower emissions than standard marine fuels), uncertainty around the true scale of methane 'slip' and the technological pathways to address it is the reason that the IMO is hesitant to endorse LNG as a long-term solution in decarbonized shipping. Andjust like debates about LNG in industrial decarbonization—there are also growing calls for LNG-fueled ships to be compatible with ammonia or renewable LNG switching in the future.

Secondly, the IMO standards for shipping-related emissions will be calculated based on the "well-to-wake" emissions of various fuels. This was a stipulation which LNG industry associations had explicitly called for the IMO to adopt.[78] Well-to-wake metrics will make gas-based fuels like blue hydrogen or blue ammonia more viable as a decarbonization pathway for shipping (it would also make low-methane intensity LNG a more viable shipping fuel). Low-methane LNG playing a role in marine decarbonization would be an important positive story for LNG's role in the energy transition, and one well suited to B.C. LNG. There is also room for synergy between the technologies and fuels needed for marine decarbonization and the gas-buying East Asian markets that have some of the largest shipping fleets in the world.

Liquefaction is the other component of the LNG value chain that will come under growing scrutiny in coming years. Thus far, liquefaction facilities for LNG export have received less attention than upstream/midstream gas infrastructure, and even shipping emissions.

From a foreign market perspective, Western Canadian LNG's low-methane intensity claims pair well with the consuming markets already best suited, particularly Korea and Japan.

But they account for a larger share of lifecycle LNG emissions than shipping and regasification. Because the nature of liquefaction emissions is even more dependent on facility-specific considerations, facility-level emissions reporting will likely become more standard in the future. Western Canadian LNG facilities will be well suited to claim low emissions from liquefaction given the low carbon intensity of B.C.'s power grid (assuming sufficient hydro/renewable resources are available).[79] For LNG liquefaction facilities dependent on more fossil-heavy grids, it will be more challenging to achieve rapid reductions in liquefaction-related emissions, meaning liquefaction can be another area where Western Canadian producers separate from global competitors in GHG intensity.

This low-methane pathway is attractive for Western Canadian LNG in terms of both domestic and foreign market perspectives. From a domestic policy perspective, more rigorous methane mitigation and methane accounting will help B.C. LNG projects comply with provincial and federal guidelines and preserve its domestic operating licence. Helping set best practices in these claims may also help Western Canadian LNG appeal to more sources of project financing, regardless of the end-use.

From a foreign market perspective, Western Canadian LNG's low-methane intensity claims pair well with the consuming markets already best suited, particularly Korea and Japan. Those countries also have shared interests in related priorities like shipping decarbonization and foreign production of fuels like ammonia and hydrogen, which will help lower the methane-intensity bill of LNG suppliers and buyers.

This discussion is largely separate from the topic of regasification and end-use combustion (the scope III emissions of LNG sales). From a Western

Canadian LNG perspective, East Asian buyers like Korea and Japan will likely make faster progress in reducing those scope III emissions than China or SE Asian buyers. Regardless, if Western Canadian LNG is able to establish more transparency and validity in its own methane intensity claims, it will expand the specific-use cases where the combustion of its gas exports has a verifiable climate benefit.

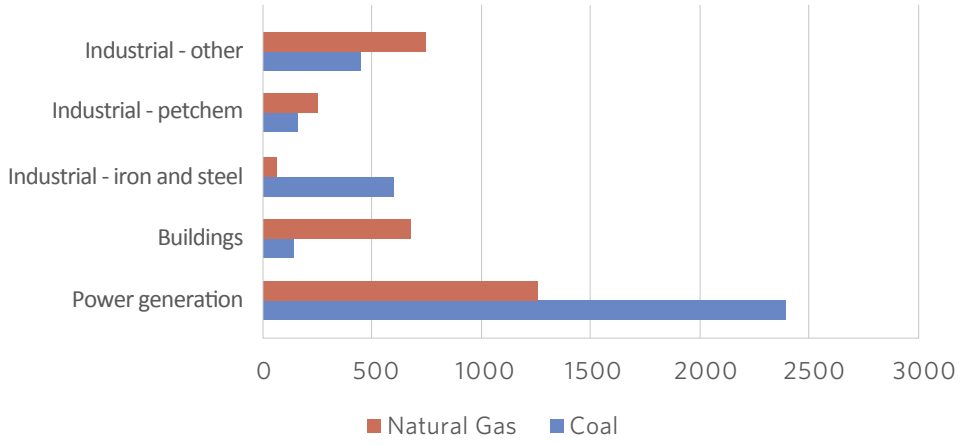
The following strategies would help support the development of end-to-end transparent LNG value chains for Western Canada:

- The Canadian federal/provincial governments and gas industry should continue to lead and embrace the latest technology including satellite readings in order to get the most accurate data on fugitive emissions.[80] These efforts, which are well underway, will be critical in addressing concerns about under-reporting of fugitive methane emissions.[81]
- Despite existing high data integrity and standards,[82] government and industry should be open to third party verification of methane intensity data. This field is extremely competitive and multiple options are available both to identify methane intensity as well as register and certify it for sale. Third party verification will be essential to access ESG-aligned financing and to meet regulatory requirements from importing markets including the EU.[83]
- Armed with best-in-class technology and third party verification of its industry methane data, Canada should partner with shipping companies and downstream LNG customers to build full end-to-end transparent methane reporting value chains. Given that 75% of the life cycle emissions associated with LNG are in the shipping and combustion stages, this is vital to establishing meaningful and measurable GHG benefits.
- Countries and companies aligned with the Global Methane Pledge goals should be natural partners for Canadian LNG, with the goal of replacing higher methane-intensity LNG with lower methane-intensity LNG. Canada should support the Global Decarbonization Alliance goals at COP 28, including "near zero" methane emissions across oil/gas value chains by 2030.
- Collectively, these actions should help accelerate the emergence of further demand for lower methane-intensity gas. One pathway is driven by regulatory compliance as consumer governments implement the Global Methane Pledge and look to minimize life cycle emissions associated with gas imports and consumption.[84] A second and related pathway is a possible price premium for the gas value chains that have both end to end transparency and credible, independent third party verification.[85] As discussed below, cost of capital and trade policy considerations would provide additional support.

Industrial decarbonization including direct engagement with downstream gas consumers in Asia

While the benefits of coal-to-gas switching are often focused on power generation, as argued throughout this study there are significant barriers to coal-to-gas switching in most Asian markets. The industrial sector may offer a more favourable outlook due to

FIGURE 9. Global Coal and Gas Demand by Sector (MTOE) *Source: IEA*



constraints on renewable electricity for the industrial sector and potential long development times to developing clean hydrogen supply chains that could eventually displace both coal and natural gas.

- Canada should partner with Asian steel producers to encourage the use of electric arc furnace (EAF) technology linked to direct reduced iron (DRI) production powered by natural gas, as an alternative to coking coal. Canada has already invested in similar technology for domestic steel producers, through projects that allow them to convert blast furnace production with coking coal to gas-powered DRI and electric arc furnace production.[86] Canada's ability to scale production of high grade DRI-ready iron pellets is another strategic advantage.[87] Eventually, as the supply of hydrogen grows, natural gas in DRI processing could be phased out. According to a report by Imperial College, "Plants that use methane-derived gas and renewable electricity for DRI emit 61% less CO_2 than coke-based ones. Better still, plants that use only hydrogen for DRI could reduce emissions by 97% to 50 kilograms or less per tonne of steel."[88]
- Canada should explore opportunities for fuel-switching in the global aluminum sector, as coal accounts for 55% of energy consumed in the global aluminum sector versus only 15% for natural gas.[89] The prospect of emerging Carbon Border Adjustment Mechanisms in the EU and elsewhere will create increased demand for lower GHG-intensity aluminum and other industrial products.
- Canada should support efforts by the International Maritime Organization to accelerate the decarbonization of the shipping industry through fuel-switching from bunkers. LNG is by far the leading pathway to lowering GHG emissions in shipping in the short-medium term, with 829 of 1,376 ships on order including LNG-powered engines.[90] LNG-ready vessels are also easier than fuel oil powered ships to convert to eventual ammonia fuel given the presence of gas systems that support both LNG and ammonia.
- Canada should support the development of international carbon pricing markets, particularly in Korea, China, and Japan that will (over time) encourage the displacement of coal with natural gas and renewables in the industrial sector.
- Partnering on the development of integrated gas value chains with Asian partners will help Canadian gas producers address their downstream Scope III emissions.[91] Canadian support for efficient use of gas in industrial end-uses, as well as the development of abated natural gas-derived products like blue ammonia will support lower life cycle emissions for Canadian gas producers.

Development of blue ammonia markets

A key theme in this analysis is the importance of a long-term view on gas value chains. The idea of natural gas as a transition fuel is not new, but increasingly the debate is not just gas-to-renewables but also "unabated gas to abated gas." Abated gas includes gas plus CCUS as well as conversions to blue hydrogen and blue ammonia. While blue hydrogen conversion has considerable value as a future value for the domestic Canadian economy, difficulty shipping hydrogen means ammonia is a promising pathway for bringing Canadian abated gas to Asian markets.[92]

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Co-firing of ammonia and hydrogen in emissions-intensive sectors is a point of major emphasis in recent Japanese policy documents—the ability of gas-derived ammonia or hydrogen to compete with green ammonia and hydrogen produced from electrolysis and renewable energy will be a key signpost for gas demand. The 2023 GX strategy calls for successful cases of ammonia/hydrogen co-firing by 2024 and the development of a co-firing supply chain from 2025. Jera has stated that it plans to reach 100% ammonia fueling at its thermal plants by 2050 (a sign of where thermal generators in Japan are headed long-term), while most other large Japanese

TABLE 5. Potential GHG Reduction from Ammonia Blending in Coal-Fired Power Plants
Source: author analysis of Korean government data

Current GHG emissions (MT) from electric power sector	283.91
Current GHG emissions from coal-fired generation (MT)	222
Prospective GHG emissions from coal-fired generation at 20% ammonia blending	177.6
Prospective GHG emissions from coal-fired generation at 50% ammonia blending	111

power companies have short-term plans in the 2020s to pursue co-firing projects. Japan has also grown more active in promoting co-firing in the decarbonization strategies of other Asian countries. Activist opposition to over-reliance on co-firing—particularly in the power sector as opposed to heavy industry—may create challenges for long-term implementation of co-firing goals, or force Japanese firms into more transparency on the lifecycle emissions and cost of co-firing investments.[93]

Korea is currently aiming for 20% ammonia blending in 24 of its 43 coal-fired power plants by 2030.[94] Ammonia blending would have climate benefits if (a) the ammonia feedstock is carbon-neutral and (b) if it is reducing the volume of coal burned in coal-fired power plants. By 2050, ammonia and hydrogen-fired gas turbines should supply between 14% and 21% of total generation in Korea—more explicit guidance for ammonia development than in Japan. Importantly, Korean planners have stressed the importance of participation by Korean industrial firms in the development of ammonia/hydrogen-based generation.[95] This includes the involvement of Korean firms when ammonia/hydrogen is purchased from overseas producers (B.C, LNG, for example). Like Japan, Korea's efforts at quickly increasing ammonia co-firing may draw environmental scrutiny and push Korean buyers into more transparency on the lifecycle implications of ammonia/hydrogen purchases.

- Canada should partner with Japan and Korea on build blue ammonia value chains to support coal-blending for power generation, which is a foundational element of Paris Agreement Nationally Determined Contributions in both countries.
- Canada should evaluate the potential of ammonia blending in other coal-intensive Asian economies. Along with CCUS, ammonia blending offers a pathway for Asian countries to avoid stranding existing coal power plants. While renewables displacement is preferable from a climate perspective, realistically many Asian governments will continue to use coal for backing up renewables given the high cost of natural gas.
- While coal blending in power generation represents a promising opportunity, Canada should also explore developing LNG and ammonia infrastructure for refueling maritime markets.
- Canada should also evaluate opportunities for blue ammonia transportation to the Pacific Coast from Alberta. Pipeline opportunities are likely to draw greater public support than ammonia-by-rail. Pipeline projects, in turn, will likely benefit from indigenous partnerships and use of existing rights of way wherever possible.
- Ammonia production on the Pacific Coast in an existing industrial area such as Kitimat, Prince Rupert, or the Lower Mainland should also be evaluated, as it may be easier to ship gas to tidewater than ammonia. Siting such projects and managing CO_2 capture may be more difficult in BC than in Alberta, but it is possible that captured CO_2 could be shipped back to Alberta or used for industrial purposes.
- If the above markets can be successfully developed, Canada should evaluate adjusting Clean Hydrogen Investment Tax Credits to be more in line with comparable support in the US Inflation Reduction Act, whether directly or in combination with contracts-for-difference agreements that lock in carbon pricing benefits.[96]
- Canada should continue to support R&D for multiple pathways to low carbon hydrogen/ammonia, including pyrolysis technology, to complement steam methane reforming and electrolysis technologies.[97]

The above pathways offer potential resilient pathways for Canadian gas value chains in a decarbonizing world. Each is fraught with uncertainties around cost, market, competition from other low-carbon technologies (particularly

electrification), and policy uncertainty. Yet Canada like other gas exporting states will likely continue to explore these models to protect the economic value of the resources and associated economic activity, with a strong supporting role from the gas-producing Western provinces. Two areas of policy would backstop efforts to develop strategies for low-carbon gas value chains—international cooperation on carbon markets and the development of sustainable finance taxonomies and policies:

Development of a "climate club" model to backstop investments in lower methane-intensity LNG, transparent value chains, and fuel-switching

The prospect of internationally transferred mitigation outcomes (ITMOs) linked to coal-to-gas switching and associated GHG reductions has been an alluring prospect for the Western Canadian LNG industry.[98] It remains uncertain whether the federal government will back such an initiative and, even if it does, whether potential counter-parties will be interested in transferring credits back to Canada given their own carbon budgets and climate commitments.[99] The creation of fractional carbon credits between ITMO partners is one idea that could be pursued.

While the ITMO path should be explored further, there are alternative pathways, including so-called "climate clubs." The concept of a climate club offers an intriguing pathway for Canada. According to a recent CSIS study, the elements of a climate club include the identification of a number of high emissions-intensity industries as the focal point of the club, the need for members to establish comparable (if not identical) GHG pricing mechanisms, and the ability of members to trade freely in target industries with each other while charging a tariff on states outside the club that do not have comparable GHG pricing mechanisms.[100]

To be clear, these pathways are less direct than an ITMO, in which a tonne of carbon displaced in the export market by Canadian LNG translates to a one-tonne carbon credit being booked against Canada's climate register and targets. Still, the formation of climate clubs inclusive of lower methane-intensity LNG would support the spirit of international collaboration on decarbonization, while increasing ambition for GHG reductions in the hardest to abate industrial sectors and deterring free-riding by countries with less stringent GHG regulations.[101]

The value in a climate club would not come directly from a carbon credit. It would come from market access and a narrower competitive landscape that excludes higher emitting but potentially lower cost players.

ITMOs are challenging for LNG markets because they require, according to the UN guidelines of Article 6, both additionality and no double-counting. It is possible that LNG projects in developing markets could demonstrate additionality—i.e., that they would not be built without the ability to generate carbon credits—but in most cases the scale and capital-intensity of LNG value chains requires that each project have a credible commercial underpinning. Double-counting means that an emissions reduction cannot be counted twice for carbon credit purposes.102 So if Western Canadian LNG displaces coal-fired generation in Japan, that would generate an emissions reduction credit but it could only be booked once—in either Japan or Canada. An ITMO would allow for the transfer of a credit between countries, but in this example Japan would likely need the credit to hit its own emissions reduction goals.

By contrast, the value in a climate club would not come directly from a carbon credit. It would come from market access and a narrower competitive landscape that excludes higher emitting but potentially lower cost players. Governments could also provide transition support for implementing technology standards aligned with the climate club, as is proposed in steel, aluminum, and plastics. It is also possible that governments could count exports of low emissions products as offsets within a domestic market.

The following steps would help Canada establish a climate club for low carbon intensity LNG:

- Canada should explore the potential for gas-to-hydrogen pathways in the industrial decarbonization pathways for the U.S. and the EU, as both are pursuing border adjustment tariffs through the Global Agreement on Sustainable Steel and Aluminum (GASSA) and the EU Carbon Border Adjustment Mechanism (CBAM).[103]
- Canada should work to provide its gas, hydrogen, ammonia, DRI-grade iron, and innovative aluminum smelting technologies to support decarbonization of heavy industry in Asian markets facing prospective trade barriers from the US and EU border adjustment tariffs.
- Canada should work to support and expand EU-led performance standards for low-methane intensity gas. The EU is currently proposing a threshold of 0.2% for methane intensity for imported LNG, a standard that Canadian LNG is well-positioned to achieve.[104] While Canadian LNG exports may not reach the EU directly, other key importers like Japan, Korea, and Singapore are likely to adopt standards similar to that of the EU.
- Canada should also ensure that its standards for the upstream gas and LNG sectors are aligned with trading partners in a climate club type model, in order to ensure that there is less likelihood of carbon leakage—i.e., capital flight to LNG or blue hydrogen/ammonia projects in markets with looser standards around methane intensity and no carbon pricing.

Clarification of ESG/sustainable finance taxonomies to include natural gas and abated natural gas in cases where there are measurable and verifiable GHG benefits

Cost of capital is a major component of LNG project development and ultimately helps shape the competitive landscape in the LNG market through pricing. Developers must sell LNG at a price that ensures recovery of capital plus a reasonable return. Sovereign-backed Qatari LNG and lower capital cost brownfield U.S. LNG projects have enjoyed an advantage on this basis. To address capital costs, Western Canadian LNG projects should target the highest possible ESG standards, both to access the widest possible range of capital providers and to potentially develop sustainable finance sources that offer a moderately lower cost of capital.

- Canada should clarify "blue" taxonomy for sustainable finance—potentially following the EU example to include natural gas (particularly low-methane intensity LNG). This could be time-limited as the EU system entails or could be more open-ended if linked to the longer transition times and potentially more significant role for gas in Asian markets.
- ESG/sustainable finance frameworks should consider including indigenous-backed low carbon energy projects, as they bring social value in the form of economic reconciliation along with environmental benefits. This could significantly help with cost of capital and access to capital. Federal loan guarantees for debt issuances from indigenous-backed low-carbon energy projects can help in these areas as well. There are likely further opportunities to explore nature-based solutions and offset projects on indigenous land that could provide additional flexibility and capital to support low-carbon energy projects—including potential net zero or low methane intensity LNG.

ENDNOTES

1 https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/natural-gas/111522-feature-surging-us-lng-exports-to-europe-heighten-focus-on-us-inflationary-pressures
2 https://www.cnbc.com/2023/09/08/gas-european-prices-jump-as-strikes-start-at-australia-lng-facilities.html
3 https://iea.blob.core.windows.net/assets/2b0ded44-6a47-495b-96d9-2fac0ac735a8/WorldEnergyOutlook2023.pdf
4 https://eneken.ieej.or.jp/data/11389.pdf
5 https://www.shell.com/energy-and-innovation/natural-gas/liquefied-natural-gas-lng/lng-outlook-2023
6 Japan is pushing G7 to step up gas investments - source | Reuters
7 Asia's lower LNG demand in 2022 highlights challenges for industry growth | IEEFA
8 https://giignl.org/wp-content/uploads/2023/07/GIIGNL-2023-Annual-Report-July20.pdf
9 https://eneken.ieej.or.jp/en/chairmans-message/chairmans-message_202211.html
10 https://www.reuters.com/business/energy/g7-brings-gas-investments-back-temporary-solution-dismay-climate-activists-2023-05-20/
11 https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/energy-transition/021723-japans-green-transformation-policy-to-alter-lng-contract-strategies
12 https://assets.bbhub.io/professional/sites/24/BNEF-Japans-Costly-Ammonia-Coal-Co-Firing-Strategy_FINAL.pdf
13 https://www.reuters.com/business/sustainable-business/japan-receives-first-low-carbon-ammonia-cargo-saudi-arabia-2023-04-21/
14 https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/energy-transition/053123-pembina-marubeni-to-establish-blue-ammonia-supply-chain-linking-alberta-to-japan
15 https://grjapan.com/sites/default/files/content/articles/files/gr_japan_overview_of_gx_plans_january_2023.pdf
16 https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/lng/011223-south-korea-to-cut-lng-in-power-mix-to-93-in-2036-sharply-raises-role-of-nuclear-energy
17 https://www.energyintel.com/00000185-94e0-d02f-ad9d-9ff0b3490000
18 https://www.energypolicy.columbia.edu/publications/getting-30-60-how-china-s-biggest-coal-power-cement-and-steel-corporations-are-responding-national/
19 https://www.power-technology.com/features/china-energy-crisis/?cf-view
20 https://www.reuters.com/world/asia-pacific/chinas-new-coal-plant-approvals-surge-2022-highest-since-2015-research-2023-02-27/
21 https://www.reuters.com/markets/europe/lng-cargoes-diverted-toward-europe-asia-gas-prices-soar-2021-12-21/
22 https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/lng/091323-chinas-cnpc-drives-hard-bargain-for-impending-power-of-siberia-2-gas-deal-with-russia
23 https://chineseclimatepolicy.oxfordenergy.org/book-content/domestic-policies/natural-gas/#:~:text=China's%20National%20Energy%20Administration's%20(NEA,13%25%20of%20the%20energy%20mix.
24 Asia's lower LNG demand in 2022 highlights challenges for industry growth | IEEFA
25 Examining-Cracks-in-Emerging-Asias-LNG-to-Power-Value-Chain_December-2021.pdf (ieefa.org)
26 https://apnews.com/article/denmark-norway-vietnam-climate-and-environment-5998288f683cf70dcaccdb1d0b08ec84
27 Long-awaited Vietnam energy plan aims to boost renewables, but fossil fuels still in the mix | AP News
28 Analysis: Heatwave lays bare Vietnam's structural electricity woes | Reuters
29 https://zerocarbon-analytics.org/archives/economics/report-indonesia-just-energy-transition-partnership
30 Why Russia's war is causing blackouts in Asia - POLITICO
31 Exclusive: Pakistan plans to quadruple domestic coal-fired power, move away from gas | Reuters
32 https://www.ft.com/content/b759618d-5803-4527-95a2-546469ed9f8a
33 https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/coal/050423-india-to-see-huge-jump-in-lng-demand-if-prices-stabilize-petronet-ceo
34 https://www.iea.org/data-and-statistics/charts/coal-consumption-by-sector-in-china-2008-2024
35 https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/energy-transition/050923-chinas-compliance-emission-trading-system-to-accelerate-coverage-of-cbam-eligible-sectors
36 https://www.ieta.org/resources/Conferences_Events/2022/IETA%20LIVE%20logos%20and%20slides/[KIS]%20Korean%20ETS%20Market%20Review_070922_final.pdf
37 https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/energy-transition/081123-interview-japan-lacks-political-will-to-advance-carbon-pricing-mechanisms-south-pole
38 https://www.iea.org/reports/asean-renewables-investment-opportunities-and-challenges
39 https://www.spglobal.com/commodityinsights/en/ci/research-analysis/are-southeast-asian-power-systems-ready-for-the-rise.html#:~:text=Although%20the%20level%20of%20solar,challenge%20to%20accommodate%20more%20renewables.
40 https://www.irena.org/News/articles/2022/Jul/Competitiveness-of-Renewables-Continued-Amid-Fossil-Fuel-Crisis
41 Power Sector Growth without Liquefied Natural Gas - RMI
42 https://www.csis.org/analysis/clean-energy-and-decarbonization-southeast-asia-overview-obstacles-and-opportunities
43 https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/lng/083023-infographic-qatar-expands-gas-imports-globalisation-china-india-southkorea-pakistan
44 US LNG Exports: Supply, Siting and Bottlenecks | Baker Institute
45 Opportunities and Risks in Expanding US Gas and LNG Capacity - Center on Global Energy Policy at Columbia University SIPA | CGEP
46 https://www.woodmac.com/news/opinion/US-policy-uncertainty-for-LNG-projects/?utm_campaign=gas-lng-americas-2023&utm_medium=email&utm_source=nurture-email&utm_content=q3-nurture
47 FEATURE: Surging US LNG exports to Europe heighten focus on US inflationary pressures | S&P Global Commodity Insights (spglobal.com)
48 https://www.cnbc.com/2023/08/09/panama-canal-shipping-pileup-due-to-drought-reaches-154-vessels.html
49 https://www.eenews.net/articles/u-s-lng-surge-may-have-a-flood-problem/

50 https://insight.factset.com/if-associated-gas-production-slips-on-low-oil-prices-does-lng-follow
51 https://finance.yahoo.com/news/us-gas-exports-primed-soar-040000971.html
52 Opportunities and Risks in Expanding US Gas and LNG Capacity - Center on Global Energy Policy at Columbia University SIPA | CGEP
53 U.S. LNG: Remapping Energy Security (csis.org)
54 https://www.bloomberg.com/news/articles/2022-08-12/mexico-plans-to-become-lng-export-hub-using-american-drilled-natural-gas#xj4y7vzkg
55 https://www.energypolicy.columbia.edu/publications/lucrative-reward-or-mounting-risk-mexicos-growing-reliance-on-us-gas/
56 https://www.telegraph.co.uk/news/2023/10/18/natural-gas-hamas-hq-qatar-israel-prices-lng-supplies/
57 https://www.naturalgasintel.com/u-s-lng-seen-as-safe-bet-amid-war-in-israel-qatars-balancing-act/
58 https://foreignpolicy.com/2023/10/11/israel-hamas-war-energy-natural-gas-oil-prices/
59 For more information on East African LNG supply, see Africa and the global LNG crunch: Balancing energy security, development, and decarbonization - Atlantic Council
60 Asian-Energy-Markets-Following-the-Russian-Invasion-of-Ukraine.pdf (oxfordenergy.org)
61 https://www.reuters.com/business/energy/jera-signs-deal-with-new-operator-russias-sakhalin-2-keep-lng-contract-2022-08-26/
62 China's CNPC drives hard bargain for impending Power of Siberia 2 gas deal with Russia | S&P Global Commodity Insights (spglobal.com)
63 See https://www.japantimes.co.jp/news/2023/03/06/national/nuclear-power-revival/ and https://www.cnn.com/2022/07/06/asia/south-korea-nuclear-plants-renewable-energy-intl-hnk/index.html
64 Post–coal-to-gas switch, what is the next fuel option for Southeast Asia? | S&P Global (spglobal.com)
65 https://www.cnbc.com/2023/04/16/no-date-for-coal-phase-out-as-g-7-environment-ministers-wrap-meeting-in-japan.html
66 China's new coal power spree continues as more provinces jump on the bandwagon – Centre for Research on Energy and Clean Air
67 The Role of Gas (windows.net)
68 https://www.theguardian.com/environment/2021/nov/03/more-than-40-countries-agree-to-phase-out-coal-fired-power
69 https://www.straitstimes.com/world/indonesia-to-urge-g-20-to-label-coal-power-plant-retirement-funding-as-green
70 Long-awaited Vietnam energy plan aims to boost renewables, but fossil fuels still in the mix | AP News
71 https://veritas.gti.energy/protocols
72 https://www.npr.org/2023/07/14/1187648553/natural-gas-can-rival-coals-climate-warming-potential-when-leaks-are-counted
73 https://theicct.org/publication/the-climate-implications-of-using-lng-as-a-marine-fuel/
74 https://www.ccacoalition.org/news/new-global-methane-pledge-champions-call-accelerated-action-methane-keep-15degc-within-reach
75 https://www.methanesat.org/satellite/
76 https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/annex/MEPC%2080/Annex%2015.pdf
77 https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/energy-transition/092322-lng-still-a-viable-solution-for-maritime-decarbonization-despite-hurdles
78 https://sea-lng.org/2023/06/sea-lng-coalition-calls-on-imo-to-regulate-all-ghg-emissions-on-a-full-lifecycle-basis/
79 https://watershedsentinel.ca/articles/where-will-bc-get-the-electricity-for-future-lng/
80 Reducing methane emissions from B.C.'s oil and gas sector | Pembina Institute
81 https://www.nature.com/articles/s41598-021-87610-3
82 Canada raises bar for methane leadership with new regulatory framework – Clean Air Task Force (catf.us)
83 https://www.csis.org/analysis/transatlantic-efforts-cut-methane-emissions#h2-eu-import-requirements-and-the-push-for-lower-emissions-gas
84 https://www.iea.org/reports/global-methane-tracker-2022/the-global-methane-pledge
85 https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/market-will-develop-for-gas-with-very-low-methane-intensity-8211-project-canary-ceo-77161602
86 ArcelorMittal Dofasco getting $400M from Ottawa to cut greenhouse gas emissions | CBC News and
87 TheStrengthOfGreenSteelCaseStudy-PPF-April2023-EN2.pdf (ppforum.ca)
88 https://www.imperial.ac.uk/news/235134/greening-cement-steel-ways-these-industries/
89 https://www.weforum.org/reports/the-net-zero-industry-tracker/in-full/aluminium-industry/
90 4 takeaways surface from DNV's Maritime Forecast to 2050 report | GreenBiz
91 https://www.weforum.org/agenda/2022/09/scope-emissions-climate-greenhouse-business/
92 An emerging alternative is using methane pyrolysis technology to convert natural gas to hydrogen and usable solid carbon (carbon black, graphite) without creating emissions (reference Monolith, Innova H2, Hazer). This can be done at the point of utilization eliminating the challenges associated with transporting hydrogen and ammonia.
93 https://www.e3g.org/news/explained-why-ammonia-co-firing-in-coal-power-generation-is-a-flawed-approach/
94 https://www.ammoniaenergy.org/articles/south-korea-sets-targets-for-hydrogen-ammonia-power-eneration/#:~:text=Commercialization%20of%20ammonia%20co%2Dfired,dramatically%20reduce%20greenhouse%20gas%20emissions%E2%80%A6
95 https://www.argusmedia.com/en/news/2432689-s-korea-on-track-to-open-hydrogen-power-bidding-market
96 https://www.budget.canada.ca/2023/report-rapport/chap3-en.html and https://www.yahoo.com/lifestyle/canadas-green-subsidies-a-bankable-gap-weaker-than-us-report-175514077.html
97 https://www.ammoniaenergy.org/articles/methane-to-ammonia-via-pyrolysis/
98 LeadershipBlueprintForCanadasHighESGGas-PPF-Aug2022-EN2.pdf (ppforum.ca)
99 No, Canada cannot get credit for its low-carbon exports - Canadian Climate Institute
100 EU and U.S. Cooperation on Climate Clubs and Related Trade Measures (csis.org)
101 https://ycsg.yale.edu/sites/default/files/files/nordhaus-climate-clubs.pdf
102 https://www.iisd.org/articles/paris-agreement-article-6-rules
103 EU and U.S. Cooperation on Climate Clubs and Related Trade Measures (csis.org)
104 Transatlantic Efforts to Cut Methane Emissions (csis.org)

First Nations Climate Initiative