

The progression of an LNG project

Canadian LNG Projects

*Canadian LNG Projects
and how our extensive
global LNG experience
can help you assess
and manage your LNG
projects*

Canadian LNG projects

Approved Canadian LNG export projects

(listed in order of NEB filing status)

Project	Planned capacity (mtpa)	Proposed start date	NEB approval
Kitimat LNG	10	2017	Approved
BC LNG Export Cooperative (Douglas Channel)	1.8	2015	Approved
LNG Canada	24	2019	Approved
Pacific Northwest LNG	12	2019	Approved
West Coast Canada LNG	30	2021–2023	Approved
Prince Rupert LNG	32	2020	Approved
Woodfibre LNG	2.1	2017–2021	Approved
Triton LNG	2.3	2017	Approved
Aurora LNG	12	2021–2023	Approved

To date, two further projects involve export of gas to the U.S. and nine further projects are pending with the NEB.

Source: National Energy Board

PwC Canada has extensive local and global experience to help joint venture partners to select, evaluate and progress with their investment choice.

LNG: An overview of growth

Liquefied natural gas has become an important part of the global energy supply chain. Currently representing just over 10% of natural gas volumes delivered, LNG is now exported by 18 countries and imported by 27. Many more are preparing or considering both exports and imports.

Canada is new to the LNG sector, one of the countries presently gearing up to export product to Asia, and perhaps beyond. Over the last few years, and more particularly in the past year, export licenses have been granted by the Canadian National Energy Board to several LNG developers.

This sudden surge in project development has been brought about by changes on global demand, market changes in North America and abundant natural gas resource availability in Western Canada. These factors have combined to boost an emerging industry that will compete for market share with other established producers or new entrants.

The majority of the LNG projects with export licenses are West Coast based, taking advantage of the relative proximity of British Columbia's shale gas basins, an integrated North American gas market and the relatively short distance to the Asian market.

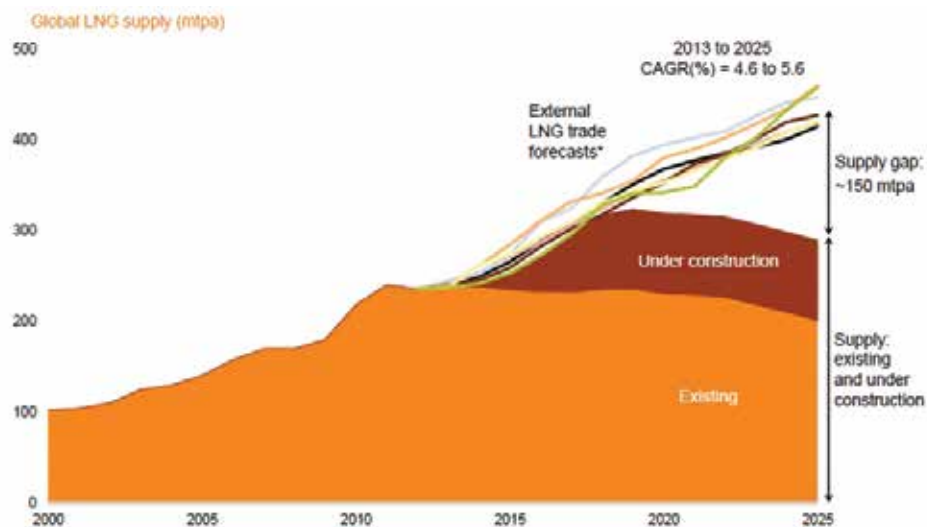
With a global supply gap forecast of approximately 150 million tonnes per annum (mtpa) by 2025, Canada's planned LNG project capacities total more than that amount. The conclusion would be that not all the Canadian developments will successfully move forward.

The major Canadian projects are mainly integrated, meaning the feedgas supply comes from within the consortium that develops the LNG project. This is in contrast to the US approach where the gas is sourced from the open market and a tolling fee is charged to liquefy it.

For joint venture partners, evaluating and selecting the right project then becomes a matter of some importance. Certain unique elements, like consultation and participation

with First Nations and familiarity with the various gas formations make the Canadian LNG industry somewhat different from other jurisdictions.

PwC Canada has assisted several joint venture partners with an appreciation and understanding of these unique characteristics of the Canadian LNG sector and advised those partners how to execute the business plan and avoid potential issues in the future.



Sources: Supply: BG Group interpretation of Wood Mackenzie data (Q4 2013); as of Q4 2013 Yamal LNG not included in under-construction
 *Trade: various research house views; (2014): Wood Mackenzie, PFC Energy, IHS CERA, Poten & Partners, FACTS Global Energy, (2013): PIRA, Gas Strategies

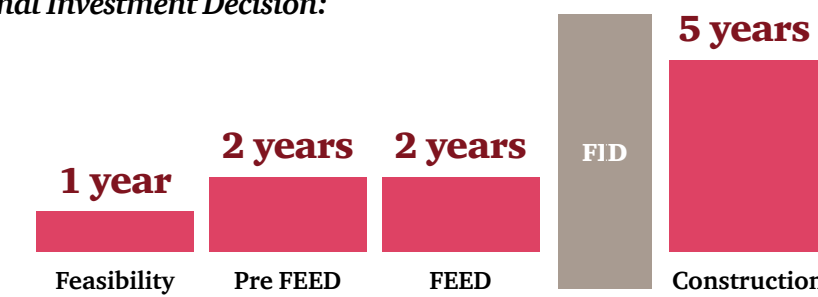
Broadly, for Canadian LNG projects these events and activities fall into two distinct project phases: pre-Final Investment Decision (FID); and post-FID. Whereas an owner has to follow the sequence in its entirety, a joint venture partner can opt in at several points.

PwC is able to assist with both the pre- and post-FID activities and help you consider the risks and rewards that accompany a major LNG project. Unlike many other capital projects in the oil and gas industry, these projects must spend a considerable amount of time, effort and money before the final investment decision is made.

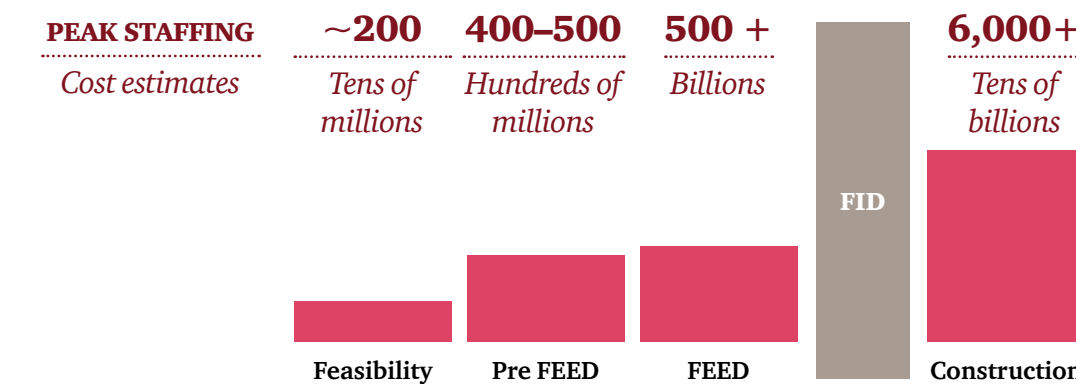
The timeline, level of effort and cost

The complexity of major LNG projects is reflected in their time scales to completion. It is not unusual for an elapsed time of 10 years between inception and first gas delivery, especially when greenfield projects are contemplated, where no previous infrastructure exists to shorten the construction period.

The elapsed time is roughly equally split between pre- and post-Final Investment Decision:



From experience with actual projects, the level of effort and spending can also be approximately quantified as follows:



As a rule of thumb 1 trillion cubic foot (tcf) of proven gas reserves is required for every 1 million tonnes per annum (mtpa) liquefied for a 20 year period.



Breaking down what's involved in an LNG project

Evaluating a potential LNG project is a difficult undertaking. Historically, completed LNG projects have been complex, reliable, operationally sound, profitable, but always very challenging to move from inception to operation. No two are the same, as the commercial and technical aspects vary from project to project and from country to country.

However, it is possible to break down the sequence of events that must occur during the progression of the project and the major inputs that contribute to the final decisions and results. This systematic approach is required to ensure confidence in the project, as each segment of the LNG value chain is planned, assessed and sanctioned.

The progression of an LNG project

Pre-FID

The lines of inquiry that might accompany each pre-FID activity could include the following types of questions and topics:

Feasibility: is the initial idea sound and can a value chain be built?	Memorandum of Understanding: establishing the basic parameters for partners to proceed	Commerciality: what structure will it take to make money and defer risk?	Markets: what are seen as the possible markets and sales prices?	Pre Front End Engineering Design (FEED): progression of technical work to the next level of detail	Permits: what are the legal, regulatory and permitting requirements?	Location: where exactly can we site the marine and onshore facilities for the project?	Reserves: can the capacities be backed up by proven gas reserves?	Sales and Purchase Agreements (SPAs): initial agreements with LNG off takers to guarantee sales	FEED: engineering work to cost project for accurate decision making and tendering	Finance: meeting lenders criteria for financing
“What are the unavoidable local issues that must be addressed?”	“Has the right project structure and correct range of partners been chosen?”	“Has the allocation of risk between the participating parties been satisfactorily achieved?”	“What are the future global LNG supply and demand characteristics?”	“How site specific are our costs?”	“Are there likely to be any significant changes in the regulatory or permitting processes?”	“What local issues must be taken into consideration in the choice of a suitable site for plant location?”	“Has the availability of drilling rigs to prove up gas reserves been examined?”	“What are the risks involved in the pricing formulae used in the SPAs to be signed?”	“Are we confident that the FEED work will provide enough detailed information for an FID?”	“Do we have an investment grade project?”
“How can we achieve the lowest cost in the shortest schedule?”	“How will the agreements operate to create the value chain?”	“Do we understand the tax and regulatory regime in place?”	“How will markets evolve in the future?”	“Stick built liquefaction plant or a modular design approach?”	“What exactly are the permitting requirements for LNG in British Columbia?”	“How will the site chosen affect the local community going forward?”	“Will the shale gas fields deliver the production volumes required over the time period to be contracted?”	“Do the SPAs ensure that the project could proceed?”	“Have all the risks been surfaced and addressed?”	“What will be our overall cost of financing?”

Post-FID

Similar topics for the post-FID activities might include these types of questions and topics for consideration:

Pipeline build: not always an easy task in Canada	EPC contracts: execute contracts awarded pre-FID based on FEED input	Drilling: providing the production required for feedgas	Construction: greenfield situation for Canadian LNG projects	Utilities: mostly greenfield builds and installations on the West Coast	Marine terminal: size, timing of construction of coastal facilities	Liquefaction plant: major capital expenditure and labor sourcing	Commissioning: standard post-build procedures	Operations: long term operational capability, in some cases with train additions	Shipping: securing LNG carriers and rates, or taking delivery of custom built boats	Regasification: end user facilities either expansion of existing, or new plants
“When should First Nations be first engaged and consulted over pipeline routes?”	“Will the timing of the long lead items delay the project?”	“How will the shortened Western Canadian drilling season affect feed gas production and upstream development?”	“What exactly will the construction and labor situation be in Western Canada in these remote areas?”	“How much power can the local grid supply, or do we have to generate our own?”	“Should this be built early so that complete process units can be shipped in?”	“What are the economics of adding future trains?”	“What are our risks at this stage and can they be mitigated?”	“Will the project run successfully to ensure generation of revenues to service debt and provide returns?”	“What does the forward market for LNG carriers look like?”	“Are we working with the optimal tariffs for regasification?”
“Should we own the pipeline, or not?”	“Was the FEED work sufficient to tender the EPC contracts?”	“What is the local level of acceptance of fracking techniques and procedures?”	“How can we ensure that our schedule will be met and that we have all the right controls in place and working correctly?”	“What are the local regulations and standards regarding utilities operation?”	“Will a breakwater or dredging be required for the chosen site?”	“Do we have a final assessment of the environmental and social impacts?”	“Has the commissioning been carried out satisfactorily to ensure efficient and effective future operation?”	“What is the best way to include local communities in the operation of the plant?”	“What level of control over shipping is most suitable – charter, ownership or avoid participation in transportation?”	“Should the buyer or the seller take responsibility for delivery?”

How we can help with pre-FID and post-FID activities

PwC’s experience in the LNG industry can be of assistance to developers or joint venture partners wanting to evaluate Canadian LNG projects. We have provided the following services to projects proponents on a global basis:

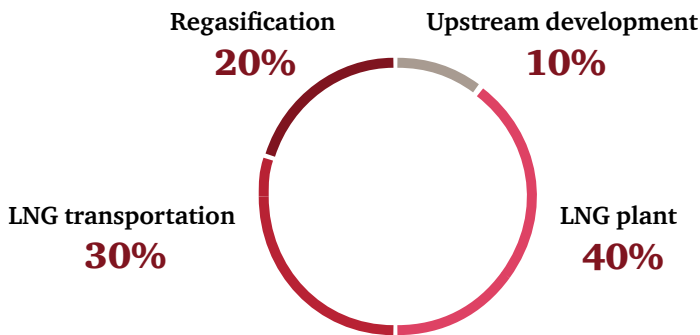
Commercial structuring and financing The commercial structuring and financing of LNG import terminals and competitive tender for LNG supply. This involved: market analysis and evaluation of demand for gas; constructing a financial model of the proposed project(s); economic assessment of the value chain; risk mitigation requirements for project finance purposes; presentation of projects to prospective lending banks/financial institutions; and financial structuring.	Due diligence and agreement negotiations The financial and tax due diligence in connection with an investment to fund the proposed development and construction of an LNG liquefaction terminal within an entity operating existing LNG regasification assets. Our work included evaluating forecast cash flows and working capital requirements; assessing the mechanics of the financial model, including the complex domestic and international tax attributes; renegotiation of existing and preparation of new related party agreements for operating and maintenance services, management services and involvement with investment agreements.	Tax structuring The tax structuring analysis of an existing LNG regasification seeking new equity and debt financing to fund the development and construction of new LNG liquefaction trains; provided the accounting and tax restructuring, financial and tax due diligence in connection with an investment in the proposed development.	Carve-out Analysis on behalf of new investors into an existing LNG business being carved out of a corporate parent into a new entity which intends to build a new LNG liquefaction facility. Our work included analysis of the carve-out, labor matters, financial and tax due diligence structuring and valuation of the assets to be contributed by the corporate parent.	Investment advisory Support on the development of LNG strategy in the context of expected market development and trading options. We compared and contrasted the economics of alternative development schemes including the sizing of LNG regasification terminals and a range of options for future capacity expansions; and undertook a market analysis of US and European LNG capacity, their expected future development and commodity price forecasts.	Project assessment External project advisory services in relation to the client’s world-wide LNG construction program, including assessments on projects in China, the United Kingdom, Peru, Australia, Chile, and Angola that were in excess of \$6B. Our work included a comprehensive review and implementation of project control tools related to cost, time, and change control; risk identification; schedule analysis and advice on opportunities for performance improvement.	LNG model due diligence PwC was engaged by a large publicly listed energy company to perform model due diligence on the financial model and supporting assumptions developed for the purpose of obtaining financing for the development of its liquefaction facility. The model included detailed cash flow and operational forecasts for each of the natural gas liquefaction trains associated with the project, in addition to overlays for the proposed financing structure and supporting credit metrics.
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PwC can also provide the following services for pre-FID and post-FID activities

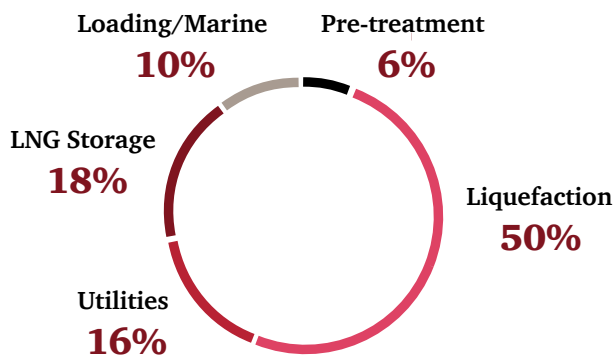
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Domestic tax compliance and consulting services We can help better manage tax risk through timely filings, reduce your internal resources spend on compliance, reduce your exposure to penalties, be abreast of the most relevant information and control your compliance costs.	International tax and structuring Our international tax structuring professionals can help you to structure your international business in a tax efficient manner, both locally and globally. We can help you construct effective cross-border strategies and manage your global structural tax rate.	Transfer pricing Our transfer pricing practice draws from a global pool of 1,100 professionals in more than 150 countries to efficiently meet the cross-border tax challenges of globalization. We can help you establish and document the appropriate Canadian transfer pricing policies and evaluation of tolling structures.	Indirect tax and GST Our indirect tax professionals can assist in determining what taxes are imposed by a jurisdiction, whether the activities of a company are enough to subject it to the tax, and how to either structure the company’s activities to eliminate the tax or assist in complying with the filing requirements.	Human resources services (HRS) and legal immigration and expat personal tax issues We can help ensure your international assignment policies are tax-compliant, meet the needs of the business and are cost-effective. We can also help you with your mobility delivery structure, develop competitive payroll, compensation and benefits packages, manage the risks associated with deployment and help ensure you’re selecting the right staff for an international assignment.	Accounting advisory services We specialize in complex accounting matters to help you develop a corporate response to technical accounting developments including the transition to IFRS accounting policies. We can help you evaluate and develop accounting policies for both conventional and unconventional oil and gas operations.	Market assessment We can help you understand the business environment and strategic investment opportunities, bring you a comprehensive overview of the issues, challenges and thought leadership specific to the Canadian energy industry and connect you to networks and the right advisors such as lawyers and engineers.
Choosing the right deal Our deals team will help you make the right acquisition that fits your business strategy. We’ll then assist with determining the target and deal structure, and setting up a solid agreement. Whether it’s entering Canada in a complete control capacity, pursuing non-operating transactions, joint ventures or a partnership, it requires a strategic approach.	Valuations and purchase price allocation With the largest in-house actuarial practice of any Canadian professional services firm, we’ll be able to offer strong support in determining the value of your business enterprises, interests, assets or liabilities. We can also help develop economic models and estimate the fair value of your assets, such as oil and gas reserves, resources and undeveloped land.	IT infrastructure We can help you to select an accounting information software platform, develop vendor evaluations, establish fit for purpose information systems operations, prepare estimates on licensing and operational costs of software systems, establish effective information security practices to mitigate cybercrime risks, integrate with your existing corporate systems and set up an information architecture that enables efficient access to critical information needed for decision making.	Financial and operational accounting We’ll help you set up a master file to manage both acquisitions and ongoing transactions, integrate capital expenditure accounting with tax reporting, and prepare and analyze your budget.	Integration We can help you identify the critical integration points with your existing business, create detailed action plans to deliver value from the deal, execute detailed integration plans, and enhance cost reductions through supply chain analysis.	Capital project management Achieving schedule, cost and safety goals on major projects has never been more important in terms of the market impact of failing to meet major project milestones. As the scale and size of projects continue to increase, so do the failure rates. Our capital projects specialists apply leading practices and frameworks that can help you address challenges throughout your capital project and realize the outcomes you set out to achieve.	Supply chain management Companies need to manage third-party costs by transforming the supply chain strategy, structure, process, people and technology, including categorizing external spending across the company. This will achieve balance between third party and in-house capability and drive value by better aligning the business requirements with supplier capability and focusing on performance. Effective category management also drives sustainable value and can create a higher level of compliance and visibility to enable contracts and commitments to be managed more effectively.

There are multiple components to the LNG value chain and typically the spend proportions would be as indicated:



Examining the LNG Plant percentage, this might be broken down as follows for a greenfield project:

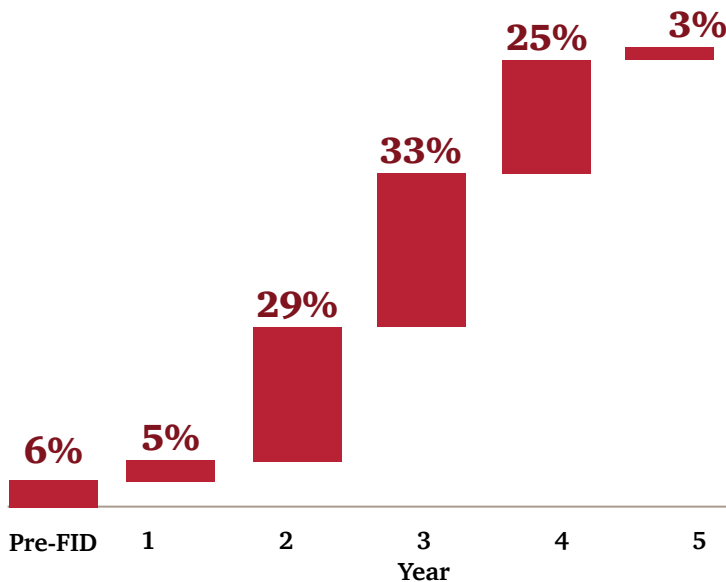


When the Canadian LNG projects are compared to this matrix, we would suggest that the upstream percentage will be higher. This will occur because of the need to feed the plants with shale gas from remote fields where little pipeline infrastructure is in place and also to allow for the high depletion rate of shale gas wells and subsequent higher drilling budgets. On the other hand LNG shipping costs will be lower as Asian markets are relatively close to the West Coast.

Liquefaction then is only 20% of total project costs. A rule of thumb for Opex is 3% of Capex per annum.

A leading energy consultancy company has indicated that 6% of the Capex is spent pre-FID. So for a \$30 billion project, \$1.8 billion will be spent before a final decision to proceed is made. This is followed by the first year of construction, mainly procurement effort and hence only 5% of the project cost.

Indicative Capex for integrated LNG project



Source: PFC Energy

Our LNG experience

PwC has LNG experience in many countries around the globe

Canada Performed due diligence on the financial model and supporting assumptions developed by the company for the purpose of obtaining over \$4 billion in financing for the development of a liquefaction project. The model included detailed cash flow and operational forecasts for each of the natural gas liquefaction trains associated with the project, in addition to overlays for the proposed financing structure and supporting credit metrics.

Canada Assisted a large multinational in its acquisition of a 10% interest in gas assets and participation in a planned LNG facility in BC. Our involvement included financial modeling, valuation market comparisons, financial and tax transaction assistance and diligence, tax structuring, assistance with leading practice in terms of accounting procedures for joint venture agreements, IFRS accounting advice for proposed transaction, and transaction and agreement advice.

Canada Developed a financial model to assist the client in assessing a contemplated acquisition of an interest in Canadian shale gas assets and the proposed LNG export terminal.

Canada LNG modelling, accounting and tax services for various proposed pre-FID investors.

North America Advisor on LNG from Russia to US and Canada. It involved a feasibility study and project structuring to enable finance-raising. The areas covered included: LNG liquefaction, shipping, regasification and gas marketing.

Colombia Served as a lead advisor to a consortium of utilities developing the first liquefied natural gas regasification terminal in Colombia. Provided advice throughout the tender and procurement process, including: proposed enhancements to the terms of reference; performed a comparative risk analysis of proposed facility configurations focusing on risks to meeting commercial operation date and to maintaining operational reliability/availability; conducted bidder interviews; identifying risks related to each technical proposal; and supported contract negotiations.

Peru Provided observations and recommendations for the development of project management tools and procedures where current gaps exist and made recommendations for changes or improvements to processes and/or controls where appropriate at the liquefaction plant and marine facilities.

Chile For the owners, validated time and cost projections and conducted an analysis of the outturn cost forecast and likely profit or loss position at an LNG regasification and send-out system, including marine jetty with complete ship unloading facilities and storage tanks.

Wales Advice on the gas transportation infrastructure implications of locating LNG terminals in Wales and the identification of gas transportation infrastructure investment requirements and calculation of tariff implications of additional investment.

Wales Assessment of risk at an LNG regasification plant, jetty and shiploading facilities as it related to engineering, procurement, construction and commissioning of the terminal system works, encompassing civil, mechanical, piping, structural, buildings, and electrical and instrumentation work.

UK Commercial structuring advice to an LNG regasification project development company, assisting them to evaluate the advantages and disadvantages of selecting a downstream participant for the project, while considering the overall process for selection, and analysing the various options for structuring the company's participation in the project.

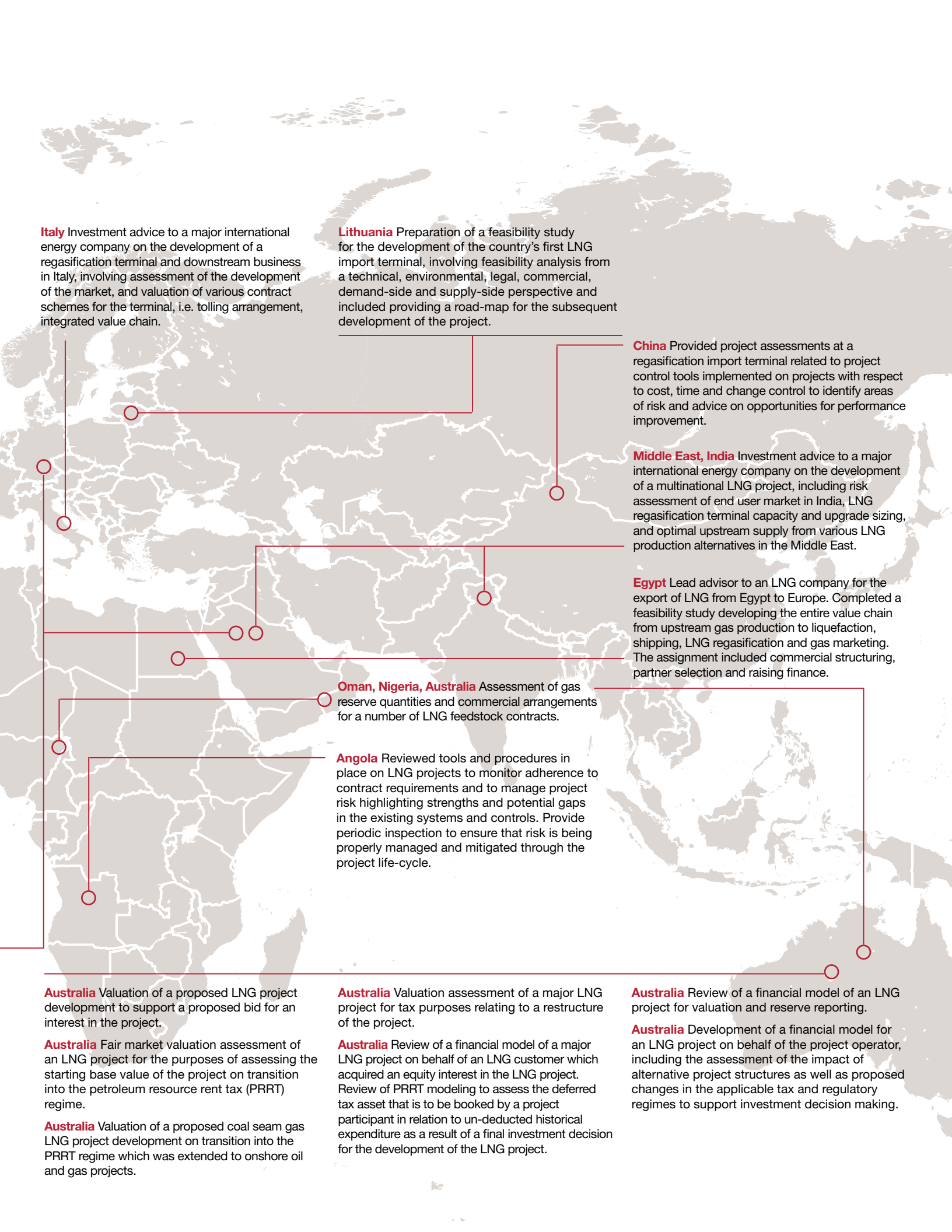
UK Provided advice on project structuring for an LNG facility, including review of joint venture agreement and evaluation of commercial drivers for each party to the agreement.

UK Lead advisor to an oil-products storage company, evaluating a greenfield LNG import facility in the UK.

US Provided continuous external project assessment services to a major EPC vendor in relation to its global LNG construction program.

Algeria, US, UK Investment advice to a major international energy company on the development of a multinational LNG project, including evaluation of alternative development schemes, LNG regasification terminal sizing and location, arbitrage evaluation, and analysis of US and Europe market capacity and prices.

Middle East, Europe, US Investment advice to a major international energy company on the development of a multinational LNG project. The assignment included evaluation of alternative development schemes, LNG regasification terminal sizing, contract advice for further capacity expansions, analysis of US and Europe market capacity and prices, and valuation of portfolio options for LNG swaps.



Italy Investment advice to a major international energy company on the development of a regasification terminal and downstream business in Italy, involving assessment of the development of the market, and valuation of various contract schemes for the terminal, i.e. tolling arrangement, integrated value chain.

Lithuania Preparation of a feasibility study for the development of the country's first LNG import terminal, involving feasibility analysis from a technical, environmental, legal, commercial, demand-side and supply-side perspective and included providing a road-map for the subsequent development of the project.

China Provided project assessments at a regasification import terminal related to project control tools implemented on projects with respect to cost, time and change control to identify areas of risk and advice on opportunities for performance improvement.

Middle East, India Investment advice to a major international energy company on the development of a multinational LNG project, including risk assessment of end user market in India, LNG regasification terminal capacity and upgrade sizing, and optimal upstream supply from various LNG production alternatives in the Middle East.

Egypt Lead advisor to an LNG company for the export of LNG from Egypt to Europe. Completed a feasibility study developing the entire value chain from upstream gas production to liquefaction, shipping, LNG regasification and gas marketing. The assignment included commercial structuring, partner selection and raising finance.

Oman, Nigeria, Australia Assessment of gas reserve quantities and commercial arrangements for a number of LNG feedstock contracts.

Angola Reviewed tools and procedures in place on LNG projects to monitor adherence to contract requirements and to manage project risk highlighting strengths and potential gaps in the existing systems and controls. Provide periodic inspection to ensure that risk is being properly managed and mitigated through the project life-cycle.

Australia Valuation of a proposed LNG project development to support a proposed bid for an interest in the project.

Australia Fair market valuation assessment of an LNG project for the purposes of assessing the starting base value of the project on transition into the petroleum resource rent tax (PRRT) regime.

Australia Valuation of a proposed coal seam gas LNG project development on transition into the PRRT regime which was extended to onshore oil and gas projects.

Australia Valuation assessment of a major LNG project for tax purposes relating to a restructure of the project.

Australia Review of a financial model of a major LNG project on behalf of an LNG customer which acquired an equity interest in the LNG project. Review of PRRT modeling to assess the deferred tax asset that is to be booked by a project participant in relation to un-deducted historical expenditure as a result of a final investment decision for the development of the LNG project.

Australia Review of a financial model of an LNG project for valuation and reserve reporting.

Australia Development of a financial model for an LNG project on behalf of the project operator, including the assessment of the impact of alternative project structures as well as proposed changes in the applicable tax and regulatory regimes to support investment decision making.

Our experts

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