LNG: A Seriously Underrated Low-Carbon Energy Technology

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LNG has been seriously underrated by climate policymakers. It is the only major energy technology that has the scale to slow the rate of growth of global greenhouse gas (GHG) emissions, facilitate the transition to a renewable energy future, and alleviate global energy security concerns.

The development of LNG trade is pivotal as a short to medium term pathway to a sustainable energy future. The entire LNG production, transportation and consumption cycle should not attract carbon penalties, in whatever form, or be subjected to emissions restrictions.

The accelerated development of LNG trade should be pursued as an international strategic policy priority to address climate change.

A Sustainable Energy Future

As the International Energy Agency (IEA) has repeatedly emphasised *"… our energy system remains at a crossroads and … current trends in energy supply and consumption are unsustainable, environmentally, economically, and socially".*[1]

According to the Intergovernmental Panel on Climate Change (IPCC), a transition to zero and low-carbon technologies is required.[2] Natural gas and nuclear power are by far the most important low-carbon technologies that are presently and widely available to achieve this goal but, for the next few decades, natural gas is likely to be the most feasible way of making the transition.

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[1] Nobuo Tanaka, Executive Director, IEA, from a speech delivered at the 50th anniversary of the Nuclear Energy Agency on 16 October 2008 and frequently repeated.

[2] *"Global dependence on fossil fuels has led to the release of over 1100 G CO_2 into the atmosphere since the mid-19th century. Currently, energy-related greenhouse gas emissions, mainly from fossil fuel combustion for heat supply, electricity generation and transport, account for around 70% of total emissions … the world is not on course to achieve a sustainable energy future. The global energy supply will continue to be dominated by fossil fuel for several decades. To reduce the resultant greenhouse gas emissions will require a transition to zero and low-carbon technologies",* IPCC Fourth Assessment Report, 2007.

Although the extraction, liquefaction and transportation stages of the LNG cycle generate some GHG emissions, the emissions saved in power generation in importing economies by displacing coal with natural gas can be up to nine times the emissions generated in the exporting country, depending on the fuel mix used at the importing end.

Apart from environmental considerations, growth in global energy demand, driven by rapidly growing economies such as China and India, makes an urgent increase in international LNG trade imperative. With the right government policy settings, LNG producers can respond by developing new export projects and accelerating the supply of substantial additional volumes of LNG to economies that are keen to preserve or increase the share of natural gas in their energy mix.

Where Does LNG Now Sit in the Scheme of Things?

Increasing the importation of LNG has already become one of the key strategies for managing energy security risk in oil-dependent, energy-importing economies.[3] LNG is also increasingly being considered as a strategic technology for overcoming infrastructural inadequacies and regional inequalities in resource distribution (for example, in Australia and Indonesia).

In the current era, LNG should be recognised by both exporting and importing economies as a strategic policy priority to address climate change. LNG's unique features that support this proposition are summarized below.

(a) LNG is a mechanism of transporting clean energy

LNG is a technology that makes natural gas more fungible - it enables surplus or stranded natural gas in one economy to be liquefied and then transported in liquid form to another economy with insufficient natural gas resources of its own.

As reported to APEC in 2004, natural gas is a source of safe, clean energy, offering the lowest GHG emissions of any fossil fuel.[4] However, the strategic environmental importance of LNG trade has either not been realized or has been seriously underrated by climate policymakers.

(b) LNG is a low-carbon energy technology of scale

LNG has traditionally been recognised as a long-distance transportation solution for exporting natural gas that would otherwise remain stranded. In the current era, LNG has a valid claim for recognition and promotion as the most practicable, easily accessible low-carbon energy technology of scale. LNG is the technological and commercial “missing link” in the battle against climate change.

LNG is not the same as LPG (which is a product of petroleum refining and has different uses). Liquefaction is not a chemical process; it is a refrigeration process with very simple thermodynamics that produces a safe, easily-transportable fuel.[5]

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[3] APEC Energy Ministers were amongst the first to recognise its importance when they endorsed "The APEC Natural Gas Initiative" at their third meeting in Okinawa, Japan in 1998.

[4] "*…natural gas offers the lowest GHG emissions of any fossil fuel and the acceleration of cross-border natural gas trade is a key strategy in making progress towards sustainability of the global economy and the global environment*", ResourcesLaw International, "Great Expectations: Cross-Border Natural Gas Trade in APEC Economies", Report to APEC Energy Working Group, Asia-Pacific Economic Cooperation Secretariat, Singapore, November 2004.

(c) LNG already exists and is affordable

LNG is a capital-intensive technology[6] but it remains the most cost-effective means of transporting large volumes of low-emissions fuel to energy-hungry economies, in accordance with UNFCCC principles.[7] LNG is a proven technology that already exists and is affordable– if it had just been invented, it would be hailed as a key technological breakthrough in the battle to keep commerce moving and economies growing while constraining GHG emissions.

(d) LNG is versatile

The role of natural gas in power generation extends from base load to peaking capacity as well as enabling the cogeneration of both heat and power.[8] Natural gas-fired power plants can be engineered to accept multiple fuels, giving supply flexibility in times of supply shortages. They provide commercial flexibility by giving end users a wide choice of potential suppliers, and the ability to arbitrage between short and long term supply choices, while avoiding the high emissions that taint other forms of thermal power generation. They rely on a fuel that can be supplied in the form of LNG from almost all regions of the world, unlike renewables which are tied to static, local fuel choices.

(e) LNG is the key enabler for the take-up of renewable energy

The advantages that natural gas-fired power plants offer over, for example, nuclear power plants are that they start up quickly and do not generate toxic waste. Natural gas for this and all of the above reasons is not just a transitional fuel – it has a pivotal long-term role as the balancing and back-up fuel in electricity generating systems that increasingly rely on intermittent forms of renewable energy, such as wind power and solar energy.[9]

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[5] When condensed by cooling into a liquid at minus 261ºC, LNG occupies only 1/600th the volume of its gaseous state. Shortly after it reaches its destination, LNG is reconverted into gas. LNG usually only "exists" in its liquefied state for about one month before being regasified.

[6] LNG plant construction costs have risen significantly in recent years. The capital cost of Chevron's 3-train Gorgon LNG plant which recently commenced construction in Australia is around US$37 billion.

[7] It is a principle of the UNFCCC that "… *policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost*", Article 3 of the UN Framework Convention on Climate Change.

[8] Greenpeace International and European Renewable Energy Council, "Energy Revolution: A Sustainable Global Energy Outlook", Brussels, Belgium, October 2008, pp 12, 30.

[9] *"Electricity systems must supply power in close balance to demand. The average load varies in predictable daily and seasonal patterns, but there is an unpredictable component due to random load variations and unforeseen events. To compensate for these variations, additional generation capacity is needed to provide regulation or set aside as reserves. Generators within an electrical system have varying operating characteristics: some are base-load plants; others, such as hydro or combustion turbines, are more agile in terms of response to fluctuations and start-up times. There is an economic value above the energy produced to a generator that can provide these ancillary services. Introducing wind generation can increase the regulation burden and need for reserves, due to its natural intermittency. The impact of the wind plant variability may range from negligible to significant depending on the level of penetration and intermittency of the wind resource", D Justus*," International Energy Technology Collaboration and Climate Change Mitigation, Case Study 5: Wind Power Integration into Electricity Systems", OECD/IEA, Paris, France, 2005.

Electricity grids, including the new "smart grids" currently being developed, must supply electricity to consumers on a continuous basis, most importantly at times of peak demand and at times of supply curtailment (such as whenever the wind is not blowing). Occasionally, peak demand coincides with supply curtailment, at which point the role of gas-fired power plants can be absolutely critical to system reliability and the maintenance of electricity supply. [10]

LNG is therefore the key enabler for increasing the utilisation of renewable energy in electricity generating systems. This has been widely accepted by energy policymakers but awaits recognition by their climate policy brethren.

How LNG is Traded

The LNG industry is commercially quite complex. This is a legacy of the large scale of most projects and their high capital cost; the need to secure supply contracts to underwrite financing of, and investment in, supply; the need for extensive infrastructure, including ports; the need to dovetail the development of new export projects with the development of new power stations or domestic gas supply grids; and the fact that trade in LNG is almost entirely confined to trade across borders.

Most LNG is still sold under long-term contracts, typically 15 – 25 years, with fixed volumes and prices that are adjusted for shifts in the international prices of oil or competing fuels. Both sellers and buyers continue to require long-term contracts for security of revenues and security of supply respectively. [11] An LNG spot market and arbitrage market is developing to provide some flexibility for market participants in managing seasonal and other fluctuations in demand, but its growth is slow. It is in the interests of both exporters and importers to accelerate the pace of growth of short term trading in LNG, and thereby hasten its commoditisation.

With recent further discoveries of conventional and unconventional gas, especially coal seam gas (CSG) and shale gas, there is now a lot more LNG "looking for a home" than ever before. This is a good thing for global emissions reduction and for global energy security. However, the development of additional LNG production capacity continues to depend on favourable policy settings as well as on buyers that can commit themselves to long term take-or-pay contracts.

The Effects of Imposition of a Carbon Penalty on LNG Exporters

The main goal of climate policy is of course to reduce global GHG emissions. However, it is clear that economies are moving at greatly different speeds and some economies are scarcely moving at all. In this regard, cap-and-trade schemes that are limited to domestic jurisdictions carry the risk of diminishing LNG exports and distorting international LNG trade.

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[10] "*Gas can also serve as the perfect complement to increasing levels of renewable energy in our electricity supply. Gas power generation is highly flexible in its ability to ramp-up and down, vastly superior to coal-fired power stations that tend to be very sluggish and inflexible in their output. In fact, gas already plays a critical role in maintaining the security of current electricity supplies by rapidly altering its output to cope with sudden changes in demand and the sudden breakdowns of large coal-fired power stations.",* Australian Clean Energy Council, "Clean Energy Fact Sheets: All About Gas," Melbourne, Australia, 2008.

[11] Many, if not most, buyers of LNG are energy utilities that need to make 40 year, multi-billion dollar decisions to invest in gas-fired power stations, instead of coal or nuclear.

By accelerating exports of LNG, gas-rich economies can contribute directly and immediately to the global climate change solution. In effect, LNG is a mechanism for accelerating global emission reductions.

For climate policy purposes, the LNG export industry cannot be categorized in the same way as other trade-exposed, energy-intensive industries. The liquefaction process is a mechanism for gas transportation that adds to supply costs – it does not add any economic value to the gas. However, LNG trade provides enormous environmental benefits by facilitating the cross-border flow of clean energy. These are benefits that are not recognised or quantified commercially, but are crucial to the management of the global greenhouse "commons".

For the foreseeable future, the imposition of a carbon penalty on LNG production in any exporting economy would be bad policy – bad for the exporting economy, and bad for the world. It would provide a barrier to investment in new LNG supply, be injurious to international LNG trade and would constitute an unnecessary and counter-productive hurdle in the effort to reduce global GHG emissions.

LNG exporters are particularly vulnerable to carbon cost exposure because they are locked in to long term contract prices. Also it can take them the best part of a decade from the time new projects are submitted into the approval process for a project to reach the commissioning stage, and many more years to reach payback.

As has been understood for some time, importers of LNG remain "free riders" so far as emission reduction benefits are concerned.[12] This does not give rise to any real problem **as long as the inequities associated with carbon penalties are not imposed on LNG exporters.**

The imposition of a carbon penalty on LNG exporters will only add to the competitive disadvantage that LNG faces from less-costly coal. Without the rapid development of additional LNG projects, increasing international demand for energy will continue to be met by coal - with no net environmental gain, and with global emissions increasing faster than they otherwise would.

The imposition of a carbon penalty on LNG production in a single exporting economy can also cause "carbon leakage" – that is, it can result in LNG supply relocating to another exporting economy that does not impose a carbon cost. [13]

When LNG supply relocation occurs, it distorts trade and investment patterns. Decisions to relocate LNG production facilities cannot be empirically proven because of their counterfactual

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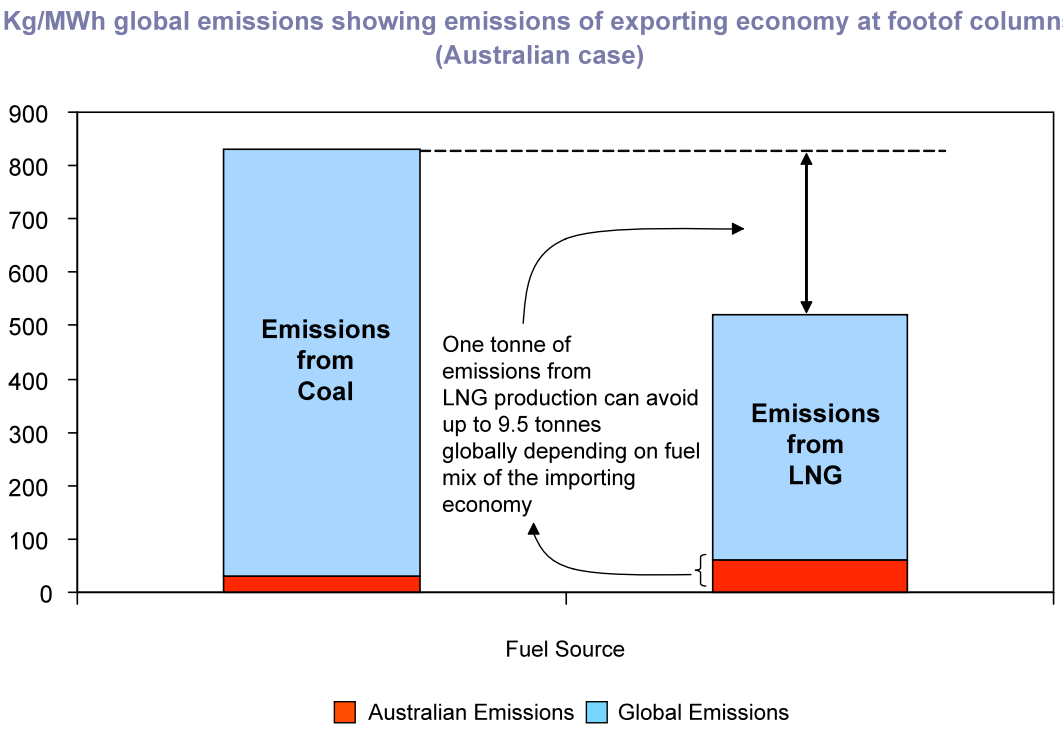
[12] *"Although there is still uncertainty about how carbon intensities will eventually be reduced and valued, producers of natural gas should endeavour to extract full value for its clean burning attributes. This is not presently occurring where LNG producers are "cleaning up" LNG prior to export and suffering the "carbon penalty" domestically. It will become necessary for energy buyers to recognise the value of the "fossil fuel of choice" and to share any future windfall gains from GHG emission reductions with the resource owner"*, ResourcesLaw International report to APEC Energy Working Group, 2004, note 4 above.

[13] As the Australian Minister for Climate Change acknowledged before designing legislation to establish a cap-and-trade scheme in Australia, *"…. The introduction of a carbon price ahead of effective international action can lead to perverse incentives for such industries to relocate or source production offshore. There is no point in imposing a carbon price domestically which result in emissions and production transferring internationally for no environmental gain",* Senator Penny Wong, Speech to the Australian Industry Group, Melbourne, 6 February 2008.

nature (i.e., the inability to prove what would have happened in the absence of the cost). In any case, capital-intensive existing LNG facilities are very unlikely to close down. What actually happens in a competitive market is that LNG buyers, when faced with a choice of reliable supply from more than one supplier, always choose the least-cost alternative; LNG importers do not accept 'pass-through' of an exporting economy's taxes or carbon penalties.

In Australia, it has been reported that, for every tonne of greenhouse gas emitted in the production of Australian LNG, up to 9.5 tonnes of greenhouse gas emissions are displaced in customer economies (if LNG is used to displace higher-emission fuels such as coal or HSFO in electricity generation).[14] This is depicted in Figure 1.

Figure 1: Displacement of Coal by LNG



If Australian LNG export capacity were to grow in line with industry forecasts to levels of 50 to 60 million tonnes per annum over the next 10 – 15 years[15], the net result would be that global carbon emissions could be reduced by hundreds of millions of tonnes per annum.[16] This level of incremental emissions reduction could be achieved without any significantly harmful effect on the global trade in seaborne export coal.

[14] CSIRO, "Lifecycle Emissions and Energy Analysis", 1996 and Worley Parsons, "Greenhouse Gas Emissions Study of Australian LNG", Woodside Energy Ltd, 2008.

[15] APPEA, "Platform for Prosperity", Australian Upstream Oil and Gas Industry Strategy, April 2007.

[16] Worley Parsons, note 14 above.

Cap-and-Trade Schemes May Cause Environmental Harm

Global energy demand continues to grow. Because many governments are driven by short term imbalances between supply and demand for electricity (rather than by rational, long term energy policy) and by short term capital cost considerations (rather than full life cycle costs) and, because coal remains a relatively cheap and available fuel, its share of the fuel mix in power generation will continue to rise. As a consequence, the world's climate, to whatever extent that global warming is caused by the accumulated stock of greenhouse gases in the atmosphere, must continue to deteriorate

The question that therefore must be asked about all economy-wide cap-and-trade schemes is whether, by imposing penalties on all sources of emissions, they unwittingly do much more environmental harm than good by reducing the comparative burden on, and masking the real costs of, more emissions-intensive energy sources, such as coal. It is assumed that proponents of these schemes mean well, but they do not seem to realize the full implications of what they will fail to achieve.

In this author's opinion, cap-and-trade schemes that focus on preferentially gaining reductions from the dominant sources of global emissions, not all sources, will be the least economically disruptive and the most environmentally effective.

One thing is nonetheless absolutely clear: domestic cap-and-trade schemes will impede the ultimate objective of reducing global emissions unless any penalty they impose on LNG exporters is fully offset. Imposing economic penalties on relatively clean fuels only benefits the suppliers of relatively dirty fuels.

Conclusions

The further expansion of international LNG trade will be an important step along the pathway to a clean energy future and a sustainable global energy system.

APGAS therefore recommends to policymakers that:

- LNG should be recognised by both exporting and importing economies as a strategic policy priority to address global climate change.

- The accelerated development of LNG trade should be urgently pursued as an international strategic policy priority and climate policies should proactively facilitate this. The entire LNG production, transportation and consumption cycle should not attract carbon penalties, in whatever form, or be subjected to emissions restrictions.

With the development of additional LNG production capacity, LNG exporting economies will, in effect, increase the export of emission reductions to importing economies, making a substantial, long-term contribution to addressing global climate change, as well as enhancing regional and global energy security.

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APGAS was established in 2005 to foster best practice in cross-border natural gas trade in the Asia-Pacific region and to contribute to public education and community capacity building. Its role was endorsed by APEC Energy Ministers at their meeting in Korea in 2006.

ResourcesLaw International is an Australian-based consultancy which provides specialist advisory services to governments and corporations on law and policy as it affects energy projects, project financing and risk management.

ResourcesLaw International has been a consultant to the APEC Energy Working Group on Cross-Border Power, Micro-Economic Reform of the Electricity Industry, Cross-Border Natural Gas Trade and Energy Security.

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