CHEMICAL ECONOMICS - Is the value of the LNG export higher than the cost of fuel, chemical and fertilizer import?

At the time of writing there is a political consensus that Australia's 2030 emissions of carbon dioxide should be significantly lower than the emissions level of 2005. The present government's target is for a 26% reduction whilst that of the opposition is that the target should be over 30%.

Since 2030 is only 15 years away, it is worthwhile to consider the amount of carbon dioxide emission *increases* that are locked into the economy and consider the impact of this on the chemical and other process industries.

Whilst most commentaries focus on electricity generation and the emissions from coal powered generation, by 2030 most of the carbon dioxide emissions will be from electricity generation using natural gas. This will result from two major on-going developments in addition to those already in use. One is the increasing use of gas generators as a back-up for the planned expansion of renewable generators (wind and solar) and the other is for power generation to produce LNG for export.

One point to note is that both of these developments use gas in the open-cycle generation mode which is not very efficient. This is because the higher efficiency combined cycle mode cannot respond quickly to act as a back-up generator and the capital cost is too high for the LNG export business. Open cycle gas turbine systems have lower efficiency than modern coal fired plants and only marginally better than the newer Loy Yang generators in the La Trobe Valley.

Over the next 15 years, Australia could become the world's largest producer of LNG. Major operations are planned for the North-West of Australia considerably adding to the facilities already there. Facilities in Darwin are set to expand and three very large facilities will commence production using coal seam gas in Gladstone by 2016.

The production of LNG is a physical separation process which requires the large scale cryogenic cooling of large volumes of gas to -162^{o}C. This refrigeration requires the generation of large amount of power which is performed on-site using part of the gas stream. Whilst the refrigeration cycle is very efficient (over 90%), the complex as a whole operates at a thermal efficiency of typically 85%. This efficiency is higher than chemical processes (such as methanol production) which typically have efficiencies of 75% for the process and typically 65% for facility as a whole.

Despite this relative high efficiency, the enormous scale of the LNG facilities will generate and emit large volumes of carbon dioxide from the power generation required. For most LNG operations this emission is supplemented by emissions produced in producing the gas to the required and cleaning the gas prior to LNG production. This principally involves removing carbon dioxide from raw natural gas. In most cases this carbon dioxide is emitted to atmosphere. For the Gorgon project (which contains 15% (v) carbon dioxide in the raw gas) this carbon dioxide is captured and injected in deep strata below Barrow Island. For coal seam gas, further emissions arise from fugitive emissions of methane (22 time the greenhouse potential of carbon dioxide) and, because the gas is produced at low pressure, the compression of the gas to transfer the gas to the LNG facilities at Gladstone.

Current and upcoming LNG projects are given in the table. Using a value of 0.462t carbon dioxide per tonne LNG for the emission from the power generation to make LNG shows that these projects, when all completed in 2020, will emit in the region 35 million tonnes of carbon dioxide and by 2030 this emission could be 60 million tonnes.

The 2005 Australian carbon dioxide emission was about 535 million tonnes of carbon dioxide (MtCO2E). If this is to be reduced by 25% then the target total emissions will be about 400MtCO2e. If at 2030 LNG development goes as planned then this will result in emissions of at least 60MtCO2e or 15% of the total. In order to achieve the target, the non LNG part of the economy will have to cut CO2 emissions by 36% based or a national target of 25% reduction on 2005 levels. For a 30% target the reduction required would be over 40%.

The requirement for gas generators in the electricity generation sector will increase as the penetration of wind and solar generation increases for back-up power. Furthermore, there is a widespread view in the industry that the gas required for this duty is just not available so that many of the coal fired generators will still be required in 2030 to ensure an enduring electricity supply. It is highly unlikely that there will be significant cuts to emissions in the transport sector in the next 15 years, especially the fastest growing part of ir travel. The upshot is that a large portion of the emission reduction will have to come from other sectors including the chemical process industries.

This can be achieved in two ways. The first would require the closure of a significant portion of the chemical process industry, ending domestic production of fuels, polymers, fertilizer and other energy intensive industries. To-date there has been no economic analysis to show that the overall result will be beneficial.

The second method is to allow the purchase of carbon emission credits from overseas developing nations which have generated credits under the UN Clean Development Mechanism (CDM).

Whether or not international trading of CDMs and the like would be allowed in any new international protocol is a moot point. If the purchase of these credits are allowed then those industries that could afford them could still continue to operate. Ideally this should also apply to the LNG export industry but this industry has been very successful to-date in arguing that it should be largely exempt from carbon emission restrictions.

One aspect of carbon permit trading that has not been addressed is that since China (a developing centrally planned economy) generates a substantial number of CDM certificates, then companies owned by China could have a ready access to CDMs not available to their competitors in Australia. How the politics of this will pan out is anybody's guess.

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Table 1: Australian LNG Projects and estimated carbon emissions

				2020	2030
Project	Company	Site	Start	Mt/y	Mt/y
NWS	Woodside and JV Partners		1998	18.98	18.98
Pluto Train 1	Woodside Energy	Burrup Peninsula	2012	4.3	4.3
Darwin LNG	ConocoPhillips/INPEX	Darwin/Bayu Udan	2006	3.2	3.2
Gorgon LNG	Chevron/Shell/ExxonMobil	Barrow Island, WA	2016	15	30
Ichthys gasfield	INPEX Holdings	Browse Basin/Darwin	2016	8	8
Wheatstone LNG	Chevron/Apache/KUFPEC/Tokyo Electric	Carnarvon Basin/Dampier	2016	8.6	25
QCLNG	BG Group	Gladstone Qld	2014	8.5	12
Gladstone LNG	Santos/Petronas/Total/Kogas	Gladstone Qld	2016	3.9	10
Australia Pacific LNG	Origin/ConocoPhillips/Sinopec	Gladstone Qld	2016	4.5	18
TOTAL LNG				74.98	129.48
CO2 EMISSIONS	tonne CO2/tonne LNG	0.462		34.61	59.77