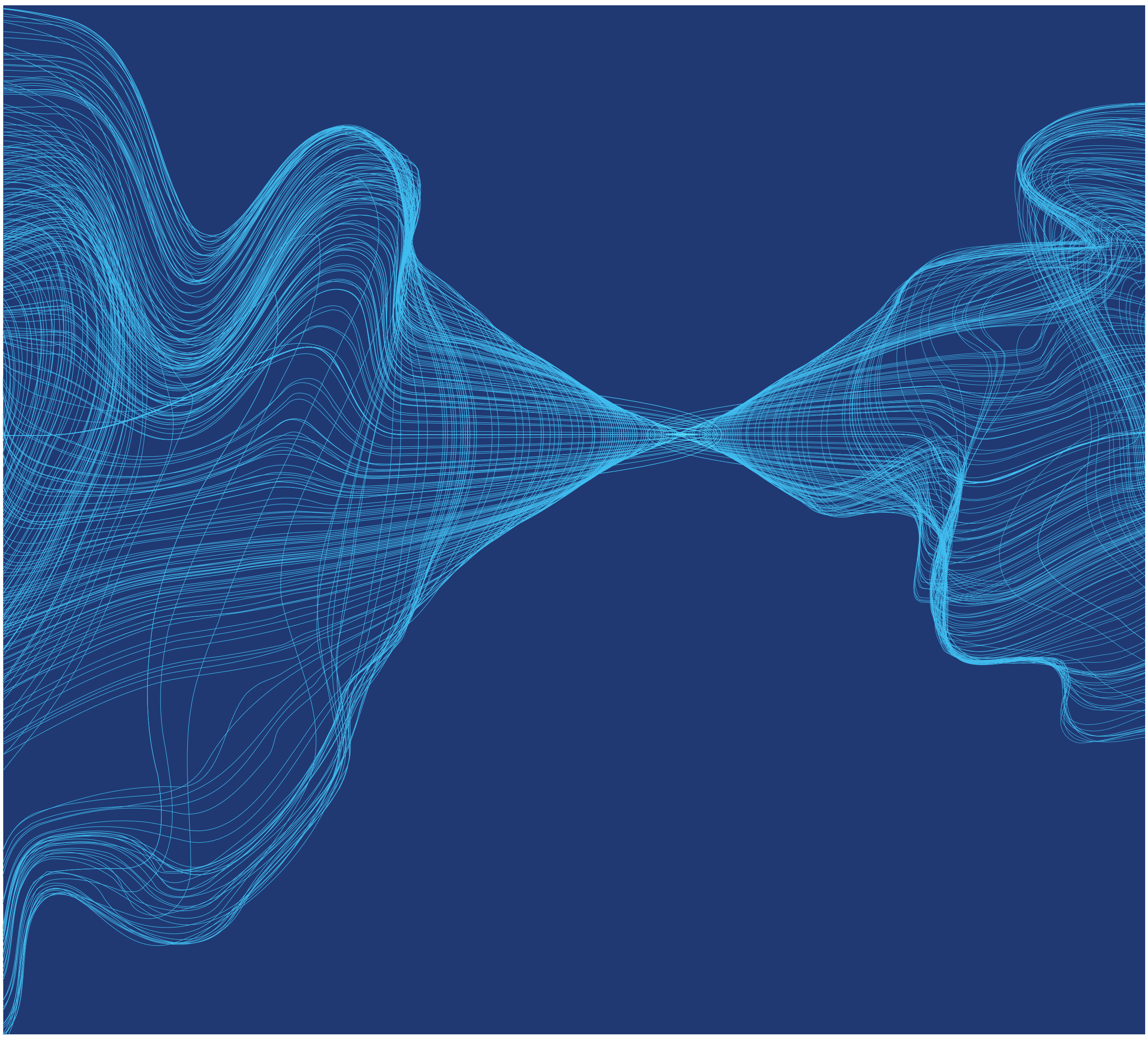
Pacific Economic Cooperation Council

Supplement to the State Of The Region 2011-2012

PROSPECTS FOR TRANSPACIFIC ENERGY TRADE



This paper was produced by Tilak K. Doshi and Nahim Bin Zahur of the Energy Studies Institute, National University of Singapore. It was commissioned as a background document for the State of the Region 2011-2012, under the leadership of SOTR coordinator Yuen Pau Woo. The views expressed in this paper are those of the authors and should not be construed as an endorsement by PECC or by the editorial committee of the State of the Region report.

EXECUTIVE SUMMARY

Even though oil and gas is the most traded product in the Asia-Pacific region, there is virtually no energy trade across the Pacific. The major energy importing countries of Northeast Asia source their oil and gas largely from the Middle East, Southeast Asia and Australia, while the United States imports energy from the Americas, West Africa, and the Middle East. Indeed, transpacific trade in energy products (oil, gas, and coal) accounts for only 1.4 percent of global trade in those products. The segmentation of energy markets between Asia and the Americas is seen in the sharp price differential for natural gas between the two regions, and – more recently – in a price differential for crude oil as well.

A number of developments in recent years have raised the possibility of transpacific trade in oil and gas, and the emergence of a more integrated and competitive market in energy products in the Asia-Pacific region. These include:

A) The discovery of massive unconventional (shale) gas deposits in the United States and Canada which are creating a gas glut in North America;

B) Increased demand in Asian countries for less carbon-intensive energy sources, in particular a shift away from coal to natural gas;

C) Concerns about nuclear power following the Fukushima Daiichi disaster and the resulting search for clean alternatives to nuclear energy;

D) The changing energy balance in Southeast Asia, particularly Indonesia and Malaysia, which are expected to become importers of LNG due to rapid increases in domestic demand; and

E) Rapidly growing investment by Asian national oil and gas companies in North American energy assets, especially in the Canadian oil sands, which has the third largest proven reserves of crude oil in the world.

SECTION 01

STATUS OF ASIA-PACIFIC ENERGY USE AND ENERGY TRADE

ENERGY USE IN ASIA-PACIFIC ECONOMIES

Figure 1: *Energy mix of selected economies in 2010* **Source:** *BP Statistical Review of World Energy 2011*

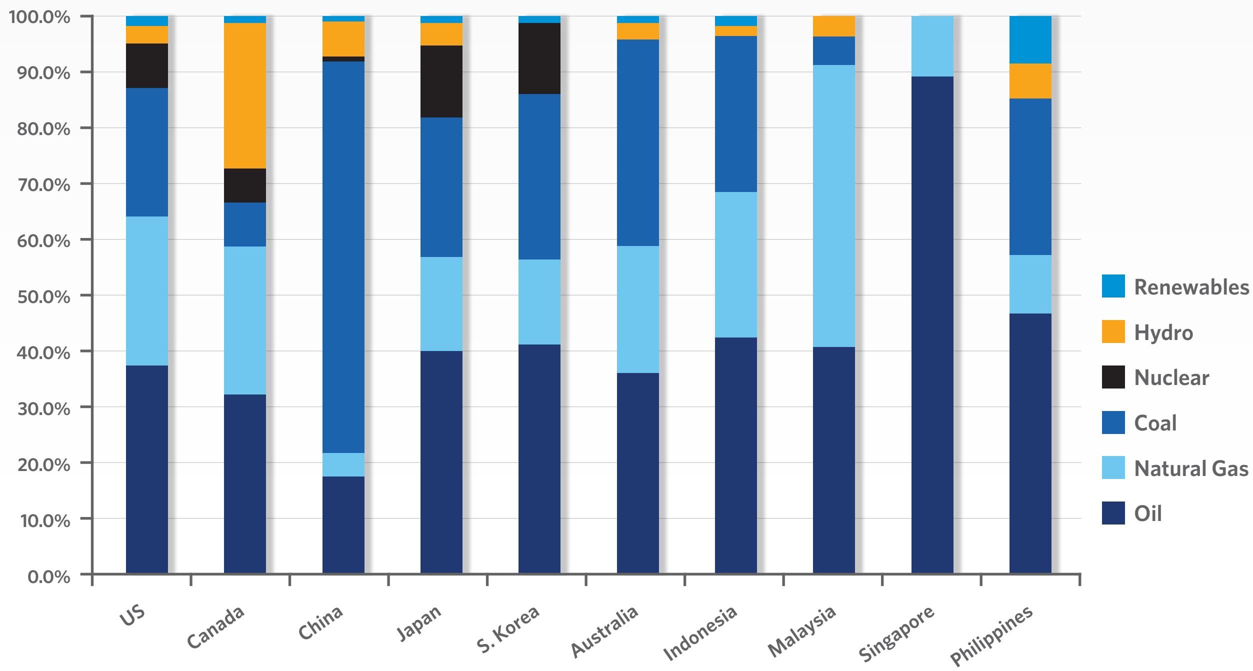
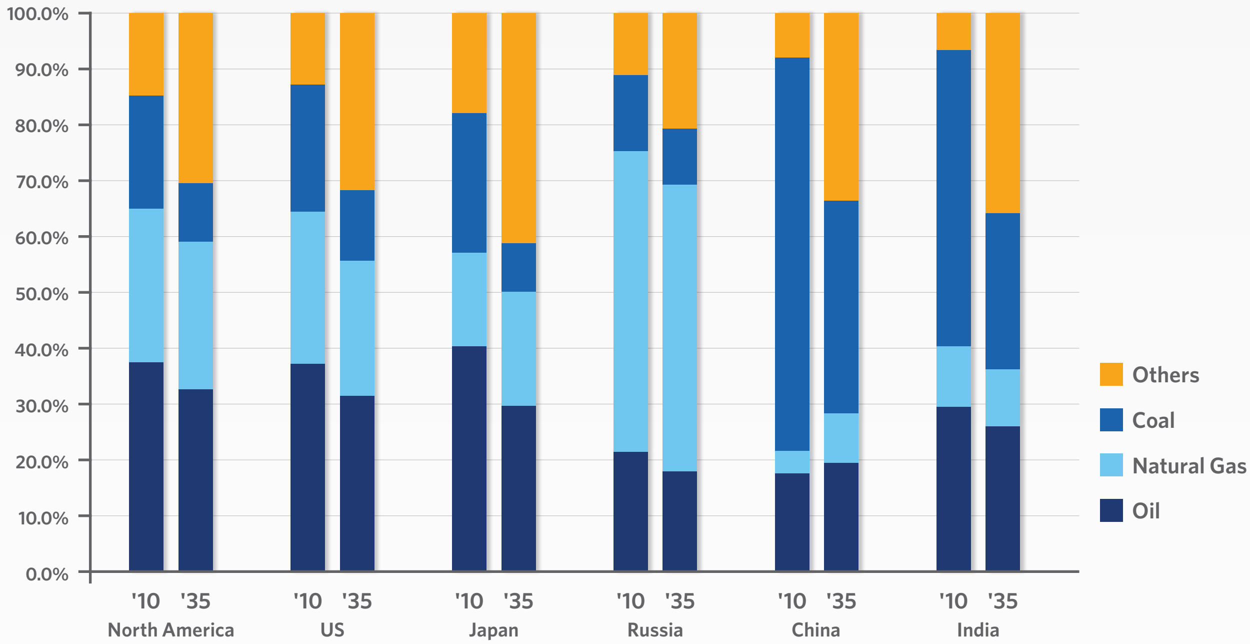


Figure 1 illustrates the mix of energy use in some of the major economies in the Asia-Pacific region. The use of fossil fuels is predominant in the Asia-Pacific region, with hydro-electricity, renewables and nuclear energy typically accounting for less than 20% of overall energy use. Oil is the fuel of choice in most Asia-Pacific economies (the key exception is China which relies heavily on coal), accounting for 30-40% or more of energy needs in most economies. Coal constitutes more than 20% of overall energy use in the majority of Asia-Pacific economies, while natural gas typically accounts for 10-20% of the energy mix (China is again the exception, with only 4% of its energy needs met by natural gas).

Figure 2: *Energy mix of selected economies in 2010 and 2035* **Source:** *BP Statistical Review of World Energy 2011*



The basic patterns of energy use in the Asia-Pacific region are unlikely to change materially in the foreseeable future. **Figure 2** illustrates how the energy mix in Asia-Pacific economies (including Russia) can be expected to change between now and 2035, under IEA's New Policies Scenario. In this scenario, the use of non-fossil fuel sources of energy (nuclear, hydro-electricity and renewables) increases appreciably in each of the major economies. Nevertheless, fossil fuels continue to dominate the energy mix, accounting for 60-80% of the energy mix in most economies. The share of coal, in particular, as well as oil decreases in almost all countries- particularly dramatic is the reduction in the share of coal in China's energy mix from around 70% in 2010 to 38% in 2035. By contrast, natural gas shares remain relatively stable, reflecting its status as a cleaner fuel relative to oil and coal.

The significance of energy trade to the Asia-Pacific economies is underscored by the fact that much of the fossil fuel needs of Asia are met by imports[1]. In particular, 94.3% of the region's oil needs are met by imports. Natural gas imports are fairly significant, accounting for 37.2% of total natural gas use, while coal imports are comparatively less significant, only accounting for 14.9% of total coal use. Aggregating across all 3 fuels, 41.2% of fossil fuel needs of the Asian economies are met from imports.[2]

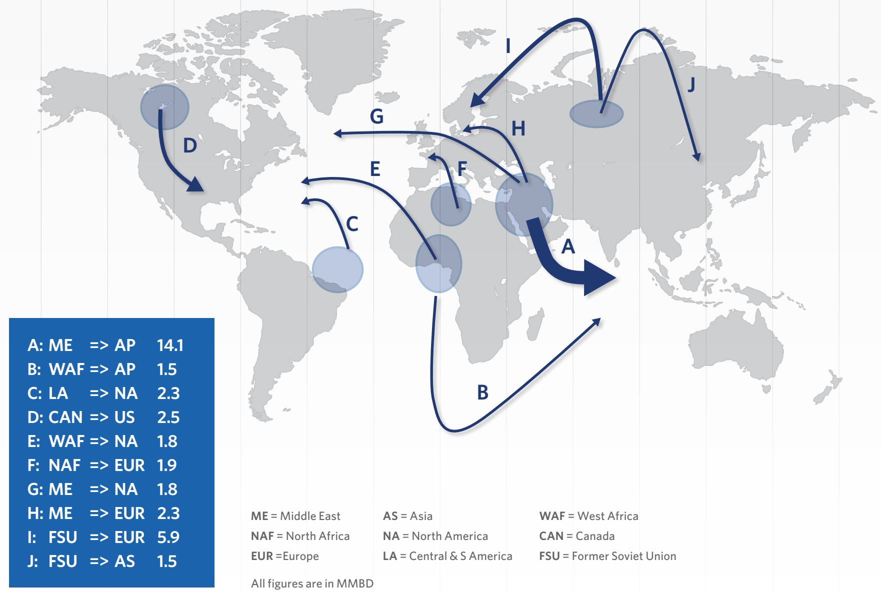
[1] *In the analysis that follows, Asia is defined so as to include Brunei, Cambodia, China, China Hong Kong SAR, Indonesia, Japan, Laos, Malaysia, Mongolia, North Korea, Philippines, Singapore, South Asia (Afghanistan, Bangladesh, India, Myanmar, Nepal, Pakistan and Sri Lanka), South Korea, Chinese Taipei, Thailand, Vietnam, Australia, New Zealand, Papua New Guinea and Oceania.*

[2] *The calculation is carried out by converting import and consumption figures for each of the 3 fuels into a common unit, millions of tones equivalent (Mtoe), before summing import and consumption figures across each fuel.*

STATUS OF ASIA-PACIFIC ENERGY TRADE

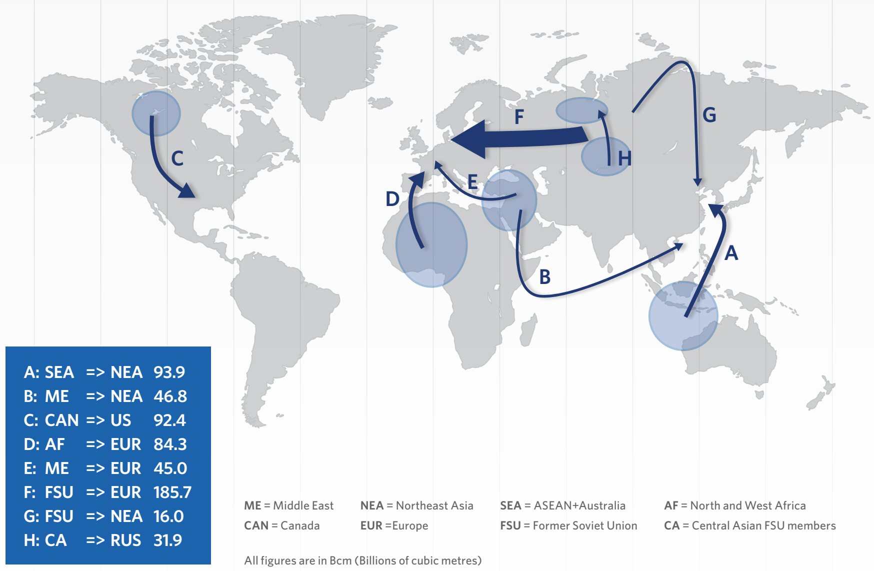
To place Asia-Pacific energy trade (specifically, fossil fuel energy imports of Asian economies) in context, it is useful to begin by looking at patterns of global energy trade. **Figure 3** demonstrates the major inter-regional oil flows in the global economy in 2010. By far the largest single flow of crude oil trade is from the Middle East (ME) to Asia (AS), of around 14.1 million MMBD; this reflects both the large base of demand in Asia and its limited domestic crudes. The only other significant inter-regional flows of crude into Asia are from West Africa (WAF) and from the Former Soviet Union (FSU), approximating 1.5 MMBD each. The North American market not only produces significant proportions of its own crude requirements, but also has access to short haul and long haul crudes from Latin and Central America (LA, 2.3 MMBD), Europe (EUR, 1.0 MMBD, not shown on the map), West Africa (1.8 MMBD) as well as the Middle East (1.8 MMBD). Europe is a recipient of FSU crude (5.9 MMBD), North African crude (1.9 MMBD) and ME crude (2.3 MMBD), apart from being an exporter of crude to other regions.

Figure 3: *Pattern of global oil trade in 2010*



Source: *BP Statistical Review of World Energy 2011*

Figure 4: *Pattern of global gas trade in 2010*



Source: *BP Statistical Review of World Energy 2011*

Figure 4 illustrates the major flows of natural gas (both pipeline and LNG) in the world in 2010. In contrast to oil, the global gas market is regionally segmented to a significant degree, and intra-regional flows of gas are important, with gas flows from Canada to US (92.4 Bcm), from Southeast Asia and Australia (SEA) to Northeast Asia (93.9 Bcm) and from Central Asia to Russia (31.9 Bcm). The largest flow of gas is from Russia and the Central Asian FSU countries to Europe (185.7 Bcm), though Europe also receives significant gas imports from Africa (84.3 Bcm) and the Middle East (45.0 Bcm). In addition to gas imports from SEA, Northeast Asia receives imports from the Middle East (46.8 Bcm) and, increasingly, from the Former Soviet Union as well (16.0 Bcm). Note that North and South America are effectively 'gas islands' isolated from the rest of the world, with few significant transpacific or transatlantic gas flows.

Figure 5: *Oil trading pattern in the Asian region in 2010*

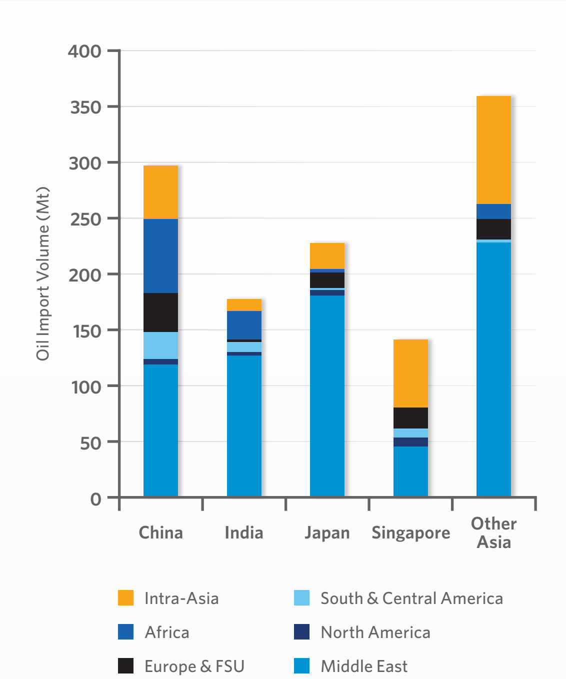


Figure 6: *Gas trading pattern in the Asian region in 2010*

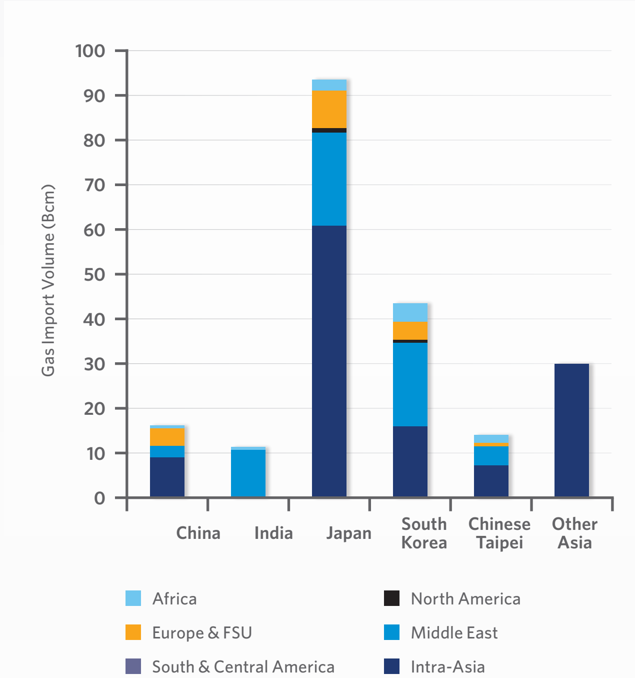


Figure 5 shows the areas from which major Asian oil importers obtain their product. The Middle East is by far the biggest source of oil imports, but there are also significant intra-regional flows, while China and India import some of their oil from Africa and China also imports oil from South and Central America.

Figure 6 illustrates where Asian economies source their gas imports. Intra-regional gas flows are the most important, with gas flowing from the Southeast Asia belt (Indonesia, Malaysia, Brunei, and Australia) to Northeast Asia (China, Japan, South Korea). The Middle East is the only other significant exporter into Asia, accounting for almost all of India's gas imports and a significant proportion of the gas imports of South Korea and, to a lesser extent, Japan.

Source: *BP Statistical Review of World Energy 2011*

The above figures demonstrate that transpacific energy trade (i.e. trade between North America and the Asian economies) is comparatively insignificant relative to both global energy trade and energy imports into the Asian region. Transpacific oil and natural gas trade are particularly limited in their scale, respectively accounting for only 1.2% of global oil trade and 0.3% of global natural gas trade in 2010 *(BP Statistical review of World Energy, June 2011)*. Transpacific coal trade is relatively more significant in global coal trade, but even so, accounts for only 4.6% of overall trade in coal. Aggregating across all 3 fuels, transpacific energy trade only accounts for 1.4% of global energy trade, more than two-thirds of which is from North America to Asia.

SECTION 02

PROSPECTS FOR TRANSPACIFIC NATURAL GAS TRADE

ENERGY USE IN ASIA-PACIFIC ECONOMIES

Table 7: *Primary Natural Gas Demand by Region (bcm)*

				CAGR		SHARE	
	1980	2008	2035	1980-2008	2008-2035	2008	2035
OECD	**958**	**1,541**	**1,758**	**1.7%**	**0.5%**	**48.9%**	**38.8%**
North America	659	815	913	0.8%	0.4%	25.9%	20.1%
United States	581	662	664	0.5%	0.0%	21.0%	14.6%
Europe	264	555	628	2.7%	0.5%	17.6%	13.8%
Asia	35	170	216	5.8%	0.9%	5.4%	4.8%
Japan	25	100	117	5.1%	0.6%	3.2%	2.6%
Non-OECD	**559**	**1,608**	**2,777**	**3.8%**	**2.0%**	**51.1%**	**61.2%**
Asia	36	341	934	8.4%	3.8%	10.8%	20.6%
China	14	85	395	6.7%	5.9%	2.7%	8.7%
India	1	42	177	14.3%	5.5%	1.3%	3.9%
Middle East	36	335	608	8.3%	2.2%	10.6%	13.4%
World	**1,517**	**3,149**	**4,535**	**2.6%**	**1.4%**	**-**	**-**

Source: *IEA World Energy Outlook 2010 (New Policies Scenario)*

Compared to the markets in oil and coal, the natural gas market has traditionally been the least integrated, with the global market effectively segmented into three regions (Asia, Europe and North America) and trade largely occurring within these regions[3]. The scale of transpacific natural gas trade is particularly small in relation to global gas trade (0.3%), as opposed to 1.2% for oil and 4.6% for coal. Moreover, existing gas flows from North America to Asia were largely from the Kenai LNG export terminal in Alaska, which is scheduled to shut down later this year.

Recent developments in both gas demand and supply have led to a scenario where significant growth in LNG exports from North America to Asia has become a distinct possibility. On the demand side, natural gas demand in Asian economies is projected to grow substantially in the next 25 years, as **Table 7** above illustrates. One reason is simply the strong economic growth forecast for Asia's developing economies, in particular China and India, which consequently are expected to experience a higher than average CAGR (Compound Annual Growth Rate) in gas demand of over 5%. Indeed, recent estimates of China's future natural gas demand by the Institute for International Oil Politics are even more bullish, with demand projected to reach 450 bcm by 2020, compared to IEA's estimate of 395 bcm by 2035. Moreover, the implementation of greenhouse gas policies, even at a modest level (as in IEA's New Policies scenario), favors natural gas over other fossil fuels, which explains why the share of natural gas in Asia's energy mix is expected to nearly double by 2035.

[3] *This can be visually illustrated by comparing Figures 3 and 4.*

Two other factors could further boost Asia's future demand for LNG imports. First, Indonesia and Malaysia, two of the largest gas exporters in the region, are both experiencing dwindling supply from aging fields. Coupled with increasing domestic natural gas demand, both countries appear set to be transformed into LNG importers. Indeed, Indonesia's first import terminal is expected to begin operating in 2012, and private firms have already been given permission to import LNG. Malaysia has planned the construction of 3 LNG receiving terminals, and expects to begin importing LNG from 2014. As such, other Asian/Oceania economies that currently import gas from Indonesia and Malaysia may well have to scout for new import sources in the future.

Second is the impact of the earthquake in March this year on Japan's LNG demand. The earthquake not only resulted in the shutdown of much of Japan's nuclear generating capacity, in the aftermath of the Fukushima disaster, but also damaged oil and coal-fired thermal power stations. As Japan seeks to replace its lost thermal and nuclear capacity by running all its gas-fired units, Japan's LNG demand has increased and may be expected to continue to do so in the short-run. Whether Japan's LNG demand will grow even further beyond the next 5 years is less clear- while Wood Mackenzie forecasts relatively flat LNG demand for Japan in the next decade, Ziff Energy expects strong growth in demand.

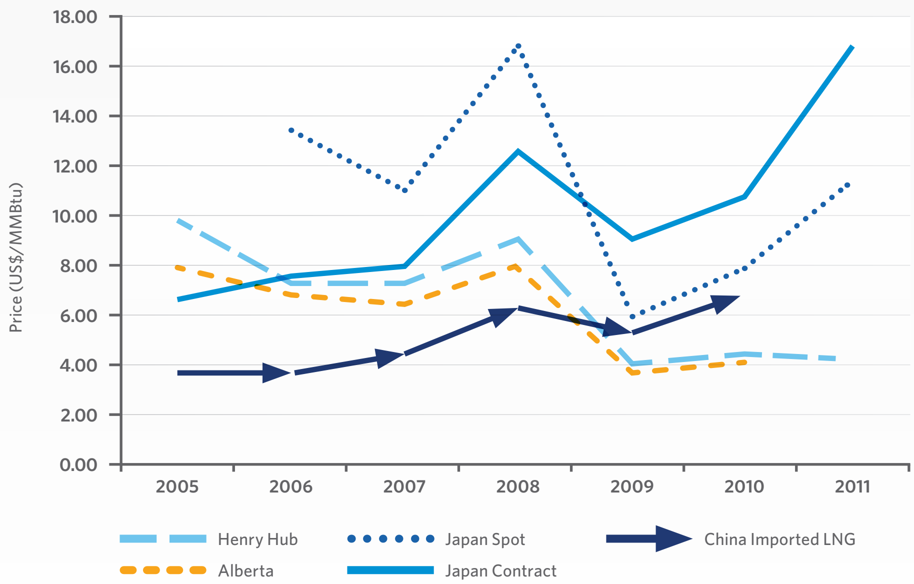
Growing demand in Asia for natural gas is also set to be accompanied by a large increase in North American gas production, driven by the shale gas revolution which has made feasible the extraction of vast reserves of unconventional gas in the US and Canada. An indication of the 'game-changing' nature of shale gas is provided by **Table 8** below, which presents the proved reserves of natural gas at the end of 2010. While proved dry-gas reserves of the US only amount to 273 tcf (4% of the world's total), the addition of potential gas reserves (as estimated by the Colorado School of Mines) inflates that figure to 2170 tcf (22% of the world's total); shale gas accounts for 687 Tcf of that figure. Similarly, Canada's recoverable gas reserves jump from 61 tcf to 1338-1407 tcf (14% of the world's total) if unconventional gas reserves are included. Thus, whereas the US was once expected to be a major LNG importer, the EIA now expects US LNG imports to decline progressively as gas demand is increasingly met by domestic production.

Table 8: *Natural Gas Proved Reserves, end 2010 (US & Canada unconventional gas included)*

	Tcf	Share of Total	R/P Ratio (yrs)
North America	**351**	**5.3%**	**12.0**
North America (incl. potential reserves)	**3525-3594**	**36-36.5%**	
US	272.5	4.1%	12.6
US (incl. potential reserves)	2170	22.0-22.2%	
Canada	61.0	0.9%	10.8
Canada (incl. potential reserves)	1,338-1,407	13.7-14.3%	
S. & Cent. America	**262**	**4.0%**	**45.9**
Europe & Eurásia	**2,228**	**33.7%**	**60.5**
Russian Federation	1,581	23.9%	76.0
Middle East	**2,677**	**40.5%**	**>100**
Iran	1,046	15.8%	>100
Qatar	894	13.5%	>100
Africa	**520**	**7.9%**	**70.5**
Asia / Oceania	**574**	**8.7%**	**37**
Australia	103	1.6%	58.0
Indonesia	108	1.6%	37.4
Malaysia	85	1.3%	36.1
World	**6,609**		**58.6**
World (incl. NA potential reserves)	**9,784-9,853**		

Sources: *BP Statistical Review of World Energy 2011, Colorado School of Mines (2011) as cited in WGI (World Gas Intelligence), 4 May 2011; Energy Futures Network and Canadian Society of Unconventional Gas (2011) as cited in WGI, 9 Mar 2011.*

Figure 9: *Natural gas prices in North America and Asia*



Sources: *Nexant (2011), WGI (various issues, 2010-2011), Petroleum Association of Japan (2011)*

Notes: *The Henry Hub and Japan spot prices for 2011 are the averages for the first six months of 2011. The Japan contract price for 2011 is calculated using the assumed formula: Contract price = 0.1485* Average JCC crude price for 1st 6 months of 2011 + 1.0. The formula is derived from Gary Eng (www.med.govt.nz/upload/65505/Formula_for_LNG_Pricing.pdf, 2008), and is consistent with recent estimates of the oil slope amounting to 0.14-0.1485 (WGI, 17 Aug 2011).*

Table 10: *Proposed LNG export projects in North America*

Project	Country	Location	Export Capacity (In million tons per year)	Expected Starting Date
Kitimat LNG	Canada	West Coast	10.0	2015
BC LNG	Canada	West Coast	15.0	2015
Petronas/Progress	Canada	West Coast	-	2016-18
Douglas Chanel LNG	Canada	West Coast	1.8	2014
Sabine Pass LNG (Cheniere)	USA	Gulf Coast	16.0	2015
Freeport LNG	USA	Gulf Coast	15.0	> 2015
Lake Charles (BG)	USA	Gulf Coast	17.6	-
Cove Point LNG (Dominion)	USA	East Coast	-	-
Jordan Cove LNG, Oregon	USA	West Coast	-	-

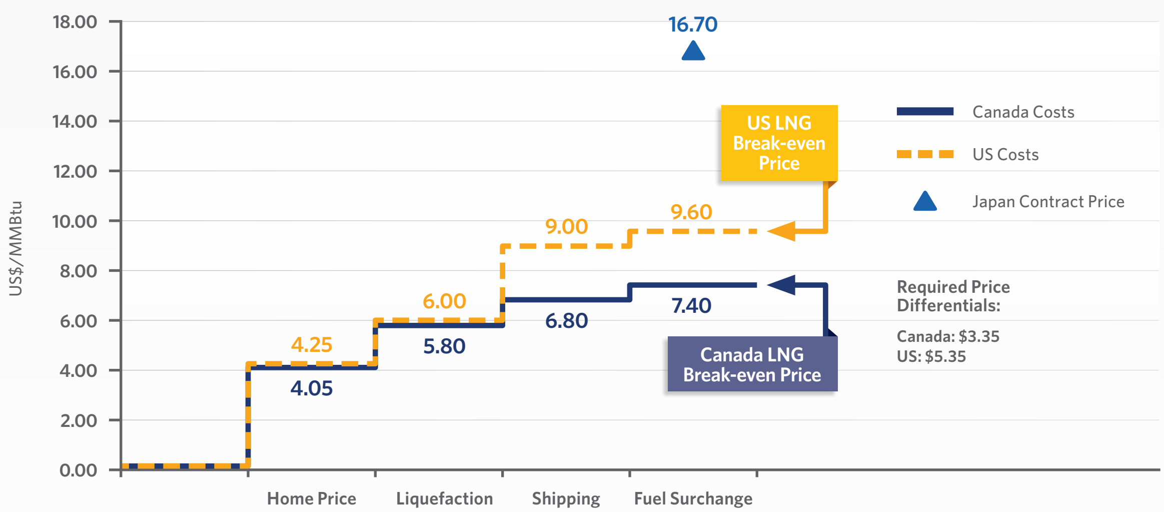
Sources: *WGI (24 Nov 2010), WGI (02 Feb 2011), WGI (23 Mar 2011), WGI (20 Apr 2011), WGI (11 May 2011), Nexant (May 2011), Oregon Live (16 Jul 2011), WGI (17 Aug 2011)*

The effect of the North American gas glut coupled with the Asian demand surge has been to widen natural gas price differentials between North America and Asia. Historically, natural gas in the Asia-Pacific region has been priced at a premium relative to North American natural gas **(see Figure 9)**. Several factors have contributed to the Asian premium- the absence of multiple import sources, the fact that gas is purchased under long-term contracts and finally the use of oil-indexed formulas to determine the prices of natural gas contracts. As **Figure 9** illustrates, however, in the last few years the price differentials have widened considerably. The difference between the Japan contract price and the Henry Hub price in 2010 was approximately $6.40, and is estimated to have increased even further in 2011 to around $12.50 due to the oil price hike as well as the increase in Japan's LNG demand following the Fukushima disaster.

With such large price differentials, gas exports from North America to Asia are increasingly attractive to investors, resulting in a number of export projects in both the US and Canada **(Table 10)**. All of the projects proposed in Canada are new terminals to be located on the West Coast in British Columbia, with access to the vast reserves of mostly unconventional gas in the Western Canadian Sedimentary Basin (WCSB) that span over the provinces of Alberta and British Columbia. In contrast, the US export projects largely involve re-purposing existing import terminals on the Gulf and East Coast into bi-directional terminals that can both export and import LNG.

OUTLOOK FOR NORTH AMERICAN LNG EXPORTS TO ASIA

Figure 11: *Cost buildup for breakeven prices for US and Canada LNG exports to Japan, 2011*



In evaluating the outlook for North American LNG export projects, a key question is whether exports from the USA or Canada to Asia are economically viable. The step-chart in **Figure 11** illustrates the estimated prices at which LNG exported by US and Canada break even, and compares it to the actual price that LNG exporters can hope to obtain if they sell LNG to Japan under long-term contracts. At current prices, the break-even export price is approximately $9.60/MMBtu for US Gulf Coast terminals and $7.40/MMBtu for Canadian export terminals, both of which are considerably less than the estimated Japanese contract price of $16.70. Thus, at current prices it makes economic sense for gas producers in North America to export LNG to Asia as opposed to selling the gas domestically, with estimated profit margins of $9.35/MMBtu for Canadian exporters and $7.15/MMBtu for US exporters.

Independent of the price of natural gas in North America and Asia, it is estimated that US terminals will require a minimum price differential of US$5.35/MMBtu (between Henry Hub prices and Asian LNG prices) for US LNG exports to be economically feasible[4], while the corresponding price differential required for Canadian terminals (i.e. the difference between Alberta prices and Asian LNG prices) is US$3.35/MMBtu. Canadian terminals (and any terminals on the US West Coast) thus have a substantial cost advantage over terminals on the US Gulf Coast due to the difference in shipping distances to Asia -- transportation costs for West Coast export terminals are only $1/MMBtu versus $3/MMBtu for the Gulf Coast terminals. The impetus for Canada to export gas is also greater than for the US due to the presence of domestic push factors. Most of the gas demand in North America is in the U.S., and with US gas production increasing Canada's gas exports to the US have been steadily declining.

In view of the large reserves of unconventional gas in both Canada and the US **(Table 8)**, there are unlikely to be any physical constraints on gas production. Liquefaction capacity, however, is the key capacity constraint. Projected liquefaction capacities of Canada and the US are presented in **Table 12** together with those of Qatar, Australia and Russia (which are likely to be the other key competitors in the Asia-Pacific LNG market).

[4] *Note that this is consistent with the $5.40/MMBtu that Cheniere Energy (operator of Sabine Pass LNG) estimates will be added to Henry Hub prices when gas is exported to Asia (WGI, 20 Apr 2011).*

Sources:

Nexant (May 2011),
Platts (13 Apr 2011),
WGI (various issues, 2011),
Petroleum Association of Japan (2011)

Notes:

The Japan contract price and the Henry Hub price (i.e. home price for the US) refer to 2011 and are calculated as described in the notes to Figure 9. The home price for Canada refers to the Alberta average spot price for 2010 (Nexant, 2011). The costs of liquefaction, shipping and fuel surcharge are estimated by Barclays (Platts, 13 Apr 2011). The fuel surcharge is a fee paid to the hauler to cover the fuel costs incurred while shipping and is calculated as a fixed percentage of fuel prices so as to cushion the hauler from changes in fuel prices.

Despite the wide variability in the estimates, it is clear that the liquefaction capacity of Qatar and Australia will exceed that of North America in the medium-term (i.e. up to 2016) and quite likely in the long-run as well. Nevertheless, even conservative estimates of North America's liquefaction capacity represent a sizeable chunk of the total liquefaction capacity that is to be used to direct LNG exports to Asia[5]. Thus, the possibility of profitable exports to Asia, coupled with growing liquefaction capacity, underscores the significant *potential* for large volumes of transpacific gas trade.

The actual volume of transpacific LNG trade in the medium-term may be constrained by the cost advantage of existing LNG suppliers such as Qatar (and to a lesser extent, Australia), who have the luxury of reducing their prices to aggressively compete against North American exporters as well as the "first mover" advantage of existing suppliers to enter into long-term contracts for the rapidly growing demand for LNG, especially for Japan, in the wake of the Fukushima disaster. However, a desire for energy security on the part of Asian buyers might lead to significant North American LNG exports despite higher prices compared to existing supplies. Buying North American gas would allow Asian buyers possibilities for diversification by including multiple indices in their gas portfolio, and might further reduce risks for buyers given that North American gas prices (e.g. Henry Hub prices) are less volatile than the JCC crude price.

There are also regulatory risks in Canada and the United States related to environmental concerns around the hydraulic fracking process that is used in the recovery of shale gas, and opposition from large buyers of natural gas in the US, including Dow Chemical and American Public Gas Association, which have opposed LNG export plans on the grounds that they would lead to higher domestic prices and expose the domestic gas market to the potentially unstable global crude oil market.

[5] *Note that Australia exports LNG almost exclusively to Asia / Oceania (BP, 2011); Asia / Oceania remains the most attractive market for Qatar while Russia's Northeast Asian LNG export terminals are very likely to cater only to Asia and Oceania.*

Table 12: *Liquefaction capacities of potential exporters to Asia (million tons per year)*

Country	Capacity in 2011	Projected Capacity (2015-16)	Projected Capacity (2020+)
Qatar	77	77	77
Australia	20	60-70	60-160
North America	2	12-34	26-113
Canada	0	5-27	10-50
US	2	7	16-63
Russia (Northeast Asia)	10	10-15	10-25

Sources: *Capacity estimates for Qatar were compiled from Petroleum Economist (Feb 2011) and Nexant (2011); for Australia from Nexant (2011), Petroleum Economist (Jul 2011), APPEA and Deutsche Bank (both cited in Business Times, 12 Apr 2011); for Russia from Nexant (2011) and WGI (30 Mar 2011) and for North America from Nexant (2011), WGI (17 Aug 2011) and Table 10 in this paper.*

For the lower bounds of the 2015 and 2020 estimates, we assume that Kitimat LNG in Canada and Sabine Pass LNG are partially operational by 2015 and fully operational by 2020. For the upper bounds, we assume that all proposed projects are completed on schedule.

IMPACT ON GAS AND OIL PRICE DIFFERENTIALS

Regardless of actual export volumes, the prospect of significant North American LNG exports is likely to have an impact on gas price differentials and oil-gas price differentials in the region.

Asian LNG importers currently do not have access to a competitive market. Japan and South Korea source their LNG imports from a limited number of countries which hold significant market power. This market power is further enhanced by the pricing formulas of most long-term LNG contracts, which tie natural gas prices to the price of crude oil. While oil indexing was logical in the 1960s when natural gas used to be a substitute for home heating oil, natural gas today tends not to be a substitute for oil and the earlier logic behind indexation no longer holds. Instead, oil-indexed prices allow suppliers to assert their market power by charging high prices, partly because of high crude prices but also because such formulas can serve to aggregate the market power of a number of producers by providing an implicit collusive mechanism -- if all suppliers utilize oil-indexation (and crude oil prices are high enough), LNG prices will be maintained at high levels, to the benefit of all LNG exporters and LNG exporting countries.

Given the oligopolistic nature of the Asian LNG market and the high Asian gas price, the entry of North American producers into the Asian LNG market will challenge the market power of existing producers and threaten to capture some of their market share. At the same time, though, the break-even prices for North American producers are higher than those for producers from countries such as Qatar. In such a scenario, a rational response by existing producers will be to reduce the price they charge Asian buyers, so as to price North American producers out of the market while continuing to maintain their share of the market (albeit with lower prices and therefore lower profits). There are already indications that Qatari gas producers behave in the manner described above. In response to the growing threat of Australian competition, Qatar has recently reduced its price demands towards Japan even in spite of the post-Fukushima surge in Japan's LNG demand.

One way Asian prices might decrease, in response to the entry of North American producers, is through adjustments to oil-indexation formulas (e.g. a decrease in the slope in a typical formula). What is unique about the North American gas supply push, however, is that it may eventually challenge the very basis of Asian LNG pricing- the use of oil-indexed formulas. North American gas prices are not oil-indexed and thus provide their own alternative benchmarks for pricing (e.g. Henry Hub pricing). Given the large differential between oil and gas prices in North America, prices of North American LNG based on gas-hub indices are likely to be much lower than prices determined using traditional oil-indexed formulas, which could lead buyers to increasingly explore alternative pricing mechanisms for contract LNG. Although oil-indexation formulas are likely to stay, if pricing based on North American gas-hub prices is adopted at some point in the future due to the influx of North American exports, Asian prices (and therefore price differentials between Asia and North America) are likely to fall, independently of whether sellers pursue a strategy of lowering prices in order to maintain market share.

Furthermore, price differentials can be expected to decline because of a potential shift in the balance between contract and spot LNG prices used by Asian buyers. While contracted LNG has been the traditional mainstay, a number of economies have recently demonstrated an increased openness to purchasing spot LNG. For instance, in the aftermath of the March earthquake, Japanese buyers have tended not to rush into new long-term contracts, relying instead on spot LNG and LNG from short-term contracts to cover up for lost nuclear and thermal capacity. North America's entry into the Asian LNG market, by providing Asian buyers with an additional source of LNG supplies, might persuade them to buy a greater proportion of their LNG from spot markets. The fact that Henry Hub spot prices are far lower than contract LNG prices would mean that the *average* price paid by Asian buyers for their LNG would decline (even if contract prices remained the same).

SECTION 03

PROSPECTS FOR TRANSPACIFIC OIL AND COAL TRADE

In general, prospects for transpacific oil and coal trade are relatively muted in comparison to natural gas trade. According to IEA's projections, the share of coal in the energy mix of all the major Asian economies will decline substantially, as we saw in ***Figure 2***. On the other hand, in absolute terms, Asia's coal consumption is projected to increase substantially (from 2601 Mtce in 2008 to 4081 Mtce in 2035), driven by increases in coal consumption in China, India and Indonesia. While consumers of coal have not been as reliant on imports as oil and natural gas consumers (recall that only 14.9% of the Asia's coal needs are met by imports), the importance of imports to coal has been rising in this region, with China becoming a net coal importer in 2009 for the first time. By contrast, OECD countries such as the USA and Japan will reduce their coal demand over the next 25 years (*World Energy Outlook 2010*, International Energy Agency), thus increasing the supply of coal available for exports in such countries. The combination of the growth in demand in Asia (largely China and India) and the increased net supply in North America (largely USA) raises the possibility of transpacific coal trade, with the USA potentially selling coal on a major basis to China.

However, the Energy Information Administration (2010) points out a number of reasons why a significant rise in US coal exports to China is unlikely. The main reason is that the US produces coal at a relatively high cost, and is thus a "swing" supplier in the international coal trade market, only exporting to other countries when the price increases. Geographical factors also come into play- the global coal market is effectively segmented into the Atlantic and the Pacific regions, and the US is only a marginal player in the former whilst rarely participating in the latter. Exporting coal from the West Coast, an attractive idea in theory since it would result in reduced transportation costs, is rendered unlikely by the absence of a large dedicated coal terminal on the West Coast. As for China's new status as an importer, it is likely to import its coal requirements from Australia, Russia, Mongolia and Mozambique, rather than from the US.

Prospects for transpacific oil trade are somewhat more upbeat, in particular for Canada which has plentiful oil sands deposits in the state of Alberta. In fact, according to IEA, even the US has the potential to become an oil exporter, with an additional production of 500,000 barrels a day from oil shale fields in Texas and North Dakota (*New York Times*, 16 Jun 2011). However, given that the US continues to import significant quantities of oil from the Middle East, Africa and Latin America ***(see Figure 3)***, increased US oil production is more likely to be substituted for imports rather than exported.

Canada seems the more likely candidate to export oil to Asia. Canada can increase its oil production by 1.3 million barrels a day according to IEA, so supply is certainly not an issue. The key choice for Canadian oil producers is between exporting oil south to the US and west to Asia. Currently Canada is almost entirely reliant on a single market- the US - for selling its oil, with exports to US accounting for close to 98% of its overall oil exports (*BP Statistical Review of World Energy*, June 2011). Exporting oil to Asia would provide Canada with the benefits of diversification and reduce its reliance on a single market for oil.

There are also purely economic reasons favoring export of oil from Canada to Asia. Firstly, the costs of transporting oil to China, Japan, S Korea and Chinese Taipei (via pipeline and tanker) are lower than the costs of transporting oil to US (via pipeline). Secondly, while crude market prices generally tend to match each other quite closely, in the past year or so a differential has opened up between WTI prices and crude oil prices in the rest of the world. Starting from 2010, the JCC crude price has inched ahead of the WTI price. The new oil price differential (a result of the relative oil supply glut in North America and in particular Canada), though small in relative terms, also favors Canadian oil exports to Asia. The economic advantages of Canadian oil exports to Asia, however, must be balanced against the fact that oil produced from oil sands is less fungible than sweeter grades from traditional sources.

The biggest obstacles to Canadian oil exports to Asia, however, have to do with environmental and regulatory issues. There is domestic and international opposition to the oil sands in general due to the environmental impacts, even though these concerns are highly unlikely to bring further development of the oil sands to a complete standstill. The more immediate roadblock is opposition to the proposed Northern Gateway Pipeline that would transport oil from the Athabasca oil-sands in Alberta to Kitimat, British Columbia on the Pacific coast, for onward shipment to Asia.

If North American crude oil exporting capacity can be achieved, it is likely that there will be a narrowing of the differential in WTI and Brent/JCC crude prices, similar to the reduction in natural gas price differentials between North America and Asia. The price spread in crude oil is a relatively recent phenomenon, but it is a function of the same fundamental causes that affect gas price differentials, namely surplus energy supply in North America coupled with the very limited ability (especially for Canada) to export oil to destinations outside the continent. In recent months, the spread between Brent and WTI prices has widened to as much as US$25 a barrel.

SECTION 04

ASIAN INVESTMENTS IN NORTH AMERICAN OIL AND GAS INDUSTRY

In addition to growing interest in transpacific energy exports from North America to Asia, the past few years have also featured a trend of increasing capital and equity investments by Asian state-owned oil & gas companies in the North American oil and gas industry. ***Table 13*** below summarizes some of the key recent investments that have been made. Almost all of the investments have been in unconventional oil and gas resources.

Most of these investments are likely motivated by straightforward profit-maximizing interests that take into account the growth prospects of shale gas and oil, as well as oil sands. In the case of oil sands, rising crude oil prices imply greater profits from those investments. Investments in shale gas are harder to defend from a profit-maximizing perspective, given the low price of natural gas in North America, if there is no intention of exporting the gas to higher paying markets.

It is likely, therefore, that some of the Asian investments in unconventional gas are motivated by broader objectives. One source of motivation could be the desire to acquire experience and technical know-how to develop similar unconventional gas fields in home economies. China, for example, is known to have substantial shale gas reserves, even though these are in remote areas that do not have access to the vast amounts of water that are needed for hydraulic fracking.

Furthermore, some of the investments appear to be tailored towards securing Asian oil and gas imports. Sinopec's investment in the Northern Gateway Pipeline (which, if completed, would allow the transport of heavy oil to the west cost for onward shipment to Asia) appears to be motivated by a desire to secure a new import source for oil. In the same way, the recent initiative by Petronas to set up an LNG export terminal in Canada ***(see Table 10 above)*** is likely motivated by a similar desire to for access to a secure long-term energy source.

Hence there are important synergies between the North American drive to export LNG to Asia, and the Asian drive to invest in the North American oil and gas industry. Both these trends point to an important conclusion - North America and Asia are becoming increasingly interdependent in energy terms, with each having a stake in the other's energy sector. North American LNG exports to Asia could mean that the Asian and North American gas markets will no longer be disconnected, with prices in one market affecting prices in the other. By the same token, Asian investments in North American unconventional oil and gas industry will mean that both Asia and North America will have a stake in how the unconventional gas boom in North America plays out.

Table 13: *Investments by Asian oil & gas companies in North American oil and gas industry*

Date	Category	Investing country	Investing company	Recipient country	Project/ company	Valuation (in billion US$)
May-05	Oil sands	China	CNOOC	Canada	MEG	0.2
Aug-06	Oil sands	S Korea	KNOC	Canada	Black Gold	1.7
Apr-10	Oil sands	China	Sinopec	Canada	Syncrude	4.6
Nov-10	Oil sands	Thailand	PTT	Canada	Kai Kos Dehseh	2.3
Jan-11	Shale gas & oil	China	CNOOC	USA	Chesapeake	0.6
Jan-11	Pipeline	China	Sinopec	Canada	Northern Gateway Pipeline	2.3
Feb-11	Shale gas	China	Petrochina	Canada	Encana	6.9
Feb-11	Shale gas	India	Reliance	USA	Atlas, Chevron	3.2
Mar-11	Shale gas & oil	S Korea	KNOC	USA	Anadarko	1.6
Jul-11	Oil sands	China	CNOOC	Canada	OPTI Canada	2.1

Source: *Wall Street Journal (31 Jan 2011), Business Times (11 Feb 2011), Financial Times (22 Mar 2011), Financial Times (13 Apr 2011), and Wall Street Journal (20 Jul 2011)*

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