Pages 1 through 48 redacted for the following reasons:
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MINISTRY OF JOBS, TOURISM AND SKILLS TRAINING
AND MINISTER RESPONSIBLE FOR LABOUR
MAJOR INVESTMENTS OFFICE

DECISION NOTE

Cliff #:

Date: November 15, 2012

PREPARED FOR: Dan Doyle, Chief of Staff, and Neil Sweeney, Deputy Minister, Corporate Priorities, Office of the Premier

ISSUE: Kitimat oil refinery proposal and related items--options for government action.

BACKGROUND:

Kitimat Clean, a Victoria-based company led by David Black, is proposing to construct a $13 billion oil refinery near Kitimat, British Columbia. The refinery would process diluted bitumen from the oil sands region in Alberta, creating "value added" fuel products such as gasoline, jet fuel and diesel fuel. The refined products would be shipped to market in Asia via tanker vessels. The proponent estimates the project would create 5,000 - 7,000 construction jobs and 3,000 operational jobs.

The proposed facility would have the capacity to process 550,000 barrels per day of diluted bitumen and would produce 240,000 barrels per day of diesel, 100,000 barrels per day of gasoline and 50,000 barrels of kerosene (aviation fuel). It would be the largest refinery on the west coast of North America and among the largest in the world. The current proposal calls for the refinery to receive its feedstock via the proposed Northern Gateway pipeline, though CN Rail has also indicated it could transport the resource. s13

s13

DISCUSSION:

s13

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OPTIONS:

s13, s17

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ATTACHMENTS: s13, s17

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Pages 53 through 71 redacted for the following reasons:
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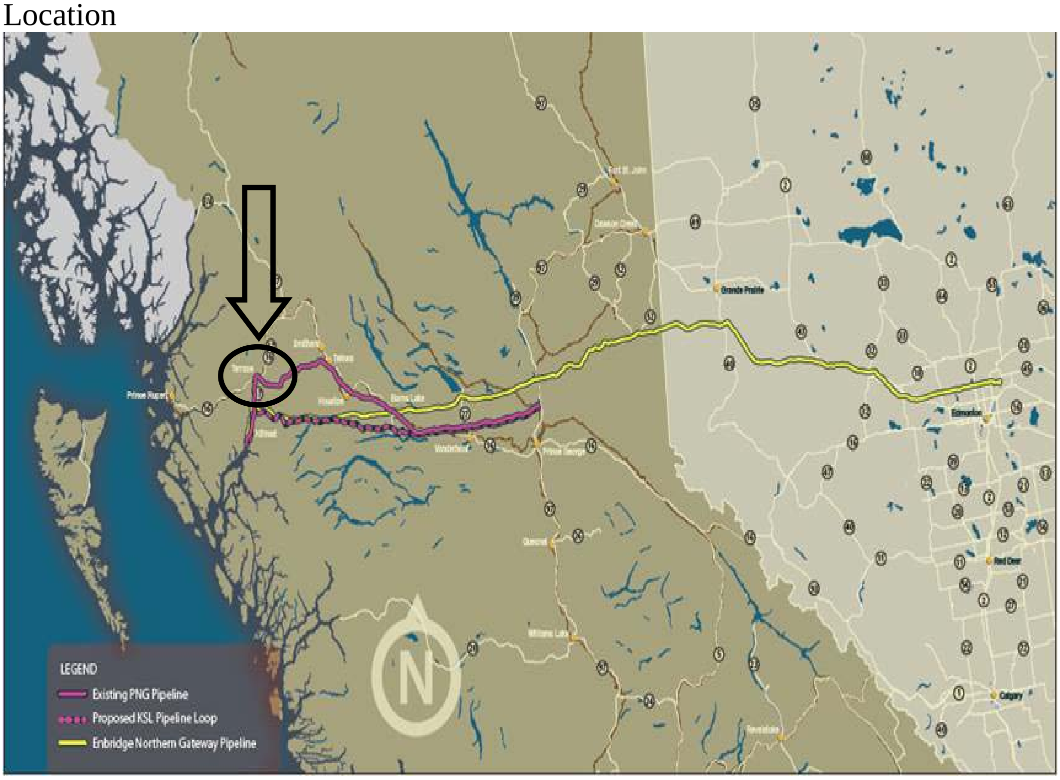
Kitimat Clean and the Proposed Refinery

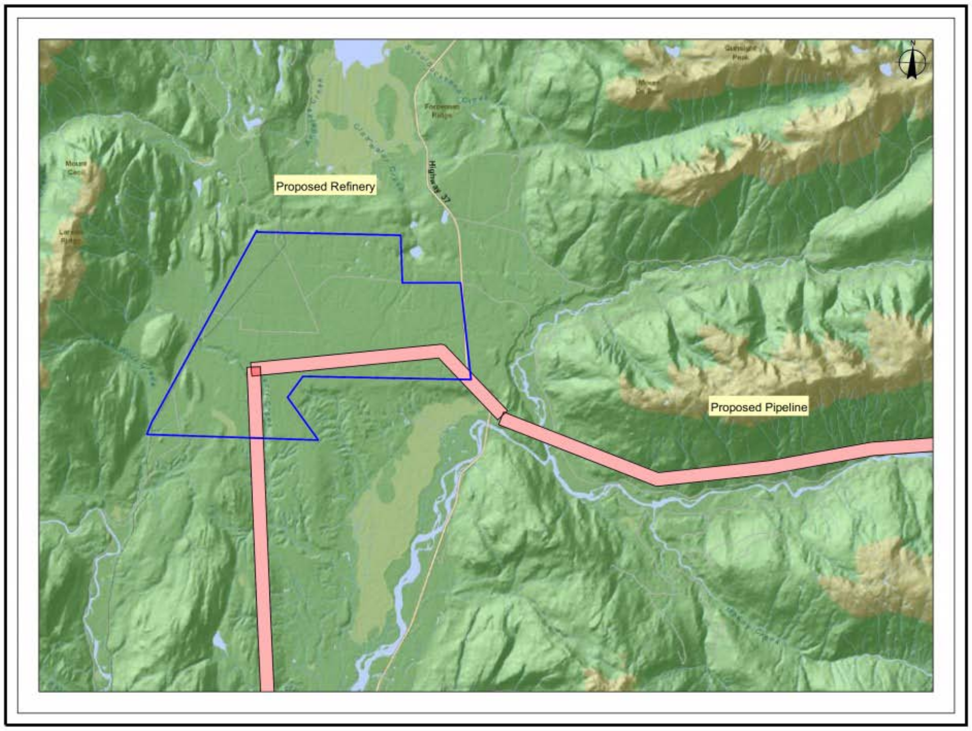
On Aug. 17, 2012, Mr. Black announced he is putting forth a proposal to build a $13.2 billion oil refinery in Kitimat, B.C. with his company, Kitimat Clean Ltd. The refinery would serve the Northern Gateway pipeline, proposed by Enbridge. The diluent will be extracted at the refinery and returned to Alberta. The bitumen will be processed into fuel products (gasoline, jet fuel and diesel fuel) primarily for export to Asian markets. The facility will have a capacity to process 550,000 barrels per day (87,445 cubic meters per day) of diluted bitumen. David Black committed to invest his own money (between $2 million and $3 million) for the environmental assessment. On September 14th Kitimat Clean Ltd. submitted a draft project description to the Environmental Assessment Office (EAO).

Kitimat Clean Ltd. is a privately held British Columbia company set up to plan, construct and operate an oil refinery on a 3,000 hectare site in the Kitimat-Stikine Regional District known as the Dubose site. The site is situated 25 km North of Kitimat and 25 km South of Terrace, and has available power and access to CN rail. The propsed Enbridge pipeline is planned to run through the Dubose site. Water licenses will be applied for along the Kitimat River to supply the refinery.

Map 1: North West Coast of BC Proposed Refinery Location



Map 2: Dubose site between Kitimat and Terrace, B.C.



The key environmental benefit for the refinery hinges on the significantly lower environmental impact of any potential spill of clean products versus bitumen. The major concern with the Northern Gateway Pipeline project is a potential spill of bitumen on the west coast. Crude oil, especially heavy oil and bitumen, have been shown to be difficult to recover and clean up from water and shorelines. In contrast, the effects of a spill of clean products such as gasoline, jet fuel and diesel fuel are much shorter-lived and reduced.

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MINISTRY OF JOBS, TOURISM AND SKILLS TRAINING
AND MINISTER RESPONSIBLE FOR LABOUR
INFORMATION NOTE

Cliff #:

Date: January 22, 2013

PREPARED FOR: Dave Byng, Deputy Minister

ISSUE: Update on David Black's refinery proposal

BACKGROUND:

Kitimat Clean, a Victoria-based company led by David Black, is proposing to construct a $13 billion oil refinery near Kitimat, British Columbia. The refinery would process diluted bitumen from the oil sands region in Alberta, creating "value added" fuel products such as gasoline, jet fuel and diesel fuel. The refined products would be shipped to market in Asia via tanker vessels. The proponent estimates the project would create 5,000 - 7,000 construction jobs and 3,000 operational jobs.

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DISCUSSION:

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CONCLUSION or **SUMMARY** or **NEXT STEPS:**

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MINISTRY OF JOBS, TOURISM AND SKILLS TRAINING
AND MINISTER RESPONSIBLE FOR LABOUR
INFORMATION NOTE

Cliff #:

Date: January 25, 2013

PREPARED FOR: John Dyble, Deputy Minister to the Premier and Dan Doyle, Chief of Staff, Office of the Premier

ISSUE: Update on David Black's refinery proposal: business plan development, investor meetings, land disposition and First Nations

BACKGROUND:

Kitimat Clean, a Victoria-based company led by David Black, is proposing to construct a $13 billion oil refinery near Kitimat, British Columbia. The refinery would process diluted bitumen from the oil sands region in Alberta, creating "value added" fuel products such as gasoline, jet fuel and diesel fuel. The refined products would be shipped to market in Asia via tanker vessels. The proponent estimates the project would create 5,000 - 7,000 construction jobs and 3,000 operational jobs.

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DISCUSSION:

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Review of the Proposed Kitimat Refinery Project

Technical Assessment and Asian Supply / Demand Analysis

Prepared for:
Government of British Columbia
Ministry of Jobs, Tourism and Skills Training,
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14 March 2013

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DEFINITIONS

CCR	continuous catalytic reformer
CDU	crude distillation unit
DWT	dead weight tonnes
EIA	US Energy Information Administration
FCC	fluidised catalytic cracker
GDP	gross domestic product
HC	hydrocracker
HDS	hydrodesulphurisation
HN	heavy naphtha
HT	hydro-treated or hydro-treater
HVGO	heavy vacuum gas oil
IEA	International Energy Agency
ISBL	inside battery limits
KCF	Kitimat Clean Fuels
LCO	light cycle oil (from catalytic cracking units)
LN	light naphtha
LNG	liquefied natural gas (mainly methane)
LPG	liquefied petroleum gas (mainly propane and / or butane)
LVGO	light vacuum gas oil
mbd	million barrels per day
MN	medium naphtha
MTBE	methyl tertiary butyl ether
NGL	natural gas liquids
OH	overheads (i.e. gases or light ends)
OSBL	outside battery limits
PSU	Indian Public Sector Undertaking (i.e. a state-owned company)
tbd	thousand barrels per day
VDU	vacuum distillation unit
VGO	vacuum gas oil
VLCC	very large crude carrier
VTB	vacuum tower bottoms

1. Executive Summary

To assist the Province of British Columbia with its appraisal of a proposed greenfield refinery on the west coast of Canada at Kitimat, Navigant Consulting, Inc. (Navigant) was retained to consider the following aspects of the project:

- Prepare a technical review, including an estimate the likely economic performance of the refinery; and
- Compile an assessment of the Asian fuel supply / demand balance and whether the output from Kitimat could be sold profitably to customers in four Asian countries (namely China, India, South Korea and Japan).

Navigant's view, based on the information available at the present time, is that building a refinery on the coast of British Columbia has economic merit and should be considered seriously by the Government of the Province. Such a refinery would provide incremental long term economic benefits to the region, compared to export of unfinished feedstock. In addition and equally importantly, if configured carefully and managed properly, the refinery would create sustainable margins that otherwise would be lost to Asian purchasers of Canada's oil sands production.

Furthermore, it is our recommendation that the Province approve a design for Kitimat that would make it capable of manufacturing fuel products for a myriad of countries around the Pacific Rim. This would preclude being tied into only a few destination markets (or perhaps just one).

It is Navigant's opinion that the refinery configuration recommended by Kitimat Clean Fuels (KCF) is technically sound. They have suggested using a combination of hydrocracking and delayed coking to process oil sands from Alberta into various clean fuels. This particular configuration is well-proven and widely employed in many locations around the world.

KCF has estimated the cost of a new refinery at Kitimat to be about $13 billion. Although we were provided with very little detail supporting this estimate, Navigant was able to compare to another proposal of similar size and configuration (albeit from 2006). We concluded that KCF's cost projection might be on the high side. It is also fair to say, however, that the 2006 case study is not fully representative of current costs, despite being similar in size and configuration to Kitimat, because:

- Expenditures for capital equipment and labour have risen since 2006;
- The remoteness of the Kitimat site will, without doubt, increase construction costs considerably. Navigant has not examined the magnitude of such an increase;
- The 2006 US refinery did not need a new plant for power generation, but one will be required at Kitimat; and
- The US example was not designed to process oil sands. Thus it is a somewhat imperfect comparator to Kitimat.

If these factors are taken into consideration, Navigant would expect the total installed cost of Kitimat (including the power plant) to exceed $7 billion. It is not possible at this stage to provide a more precise estimate. We would therefore recommend that a more detailed projection of capex for Kitimat be carried out.
We also analysed the fuel product supply and demand balance for each of the four target countries from 1990 to 2010, as well as for the entire Asia / Oceania region. Despite strong economic growth in some

Asian countries, the aggregate demand for product imports has been surprisingly stable at roughly two million barrels per day for about the last 15 years. Thus the output from Kitimat (0.5 million barrels per day) could be accommodated by markets in Asia / Oceania without major disruption to local spot markets.

We reviewed the history of the refining sector in the same four countries and compared the size and complexity of each of their industries to major developed economies (i.e. the US, Western Europe and Canada). Despite major and ongoing investments, the Asian refining industry lags the latter group, both in terms of technical upgrading capability, as well as absolute size (versus the US and Western Europe). Thus a sophisticated export refinery on the Pacific Rim could help fill the region's ongoing import needs.

2. Conclusions and Objectives of Report

2.1 Key Conclusions

Navigant's view, based on the information available at the present time, is that building a refinery on the coast of British Columbia has economic merit and should be considered seriously by the Government of the Province. Such a refinery would provide incremental long term economic benefits to the region, compared to export of unfinished feedstock. In addition and equally importantly, if configured carefully and managed properly, the refinery would generate sustainable margins that otherwise would be lost to Asian purchasers of Canada's oil sands production.

Furthermore, it is our recommendation that the Province select a design for Kitimat that would make it capable of manufacturing fuel products for a myriad of countries around the Pacific Rim. This would preclude being tied into only a few destination markets (or perhaps just one).

2.2 Background

The increase in output of "unconventional" oil and gas in Canada, combined with the remarkable impact of shale gas and shale oil in the United States, has fundamentally shifted the energy balance. The Federal Government and their Provincial counterparts are examining options to maximise value creation for Canada, due to the magnitude of changes in the North American energy mix and supply patterns.

British Columbia has requested further analysis of two options:

1. Exports of bitumen in large cargoes (up to VLCC) to refiners in Asia; or
2. Processing in a greenfield refinery at Kitimat in British Columbia, from which smaller cargoes of fuel products would be exported to customers in Asia or elsewhere on the American continents.

To assist the Province of BC with its assessment, Navigant was retained to consider certain aspects that are critical to the Kitimat project (i.e. option 2 above):

One of the key objectives of the study was to estimate the economic performance of the refining option, in light of contraction of the industry in the US. Another essential element is to examine is the potential to sell the output from Kitimat in Asian countries.

This study was based on a review of documents and literature in the public domain, certain information and sources of information available to Navigant and the knowledge and experience of the author.

3. The Refining Industry: Technology and Terminology

3.1 *Refinery Technology and Terminology*

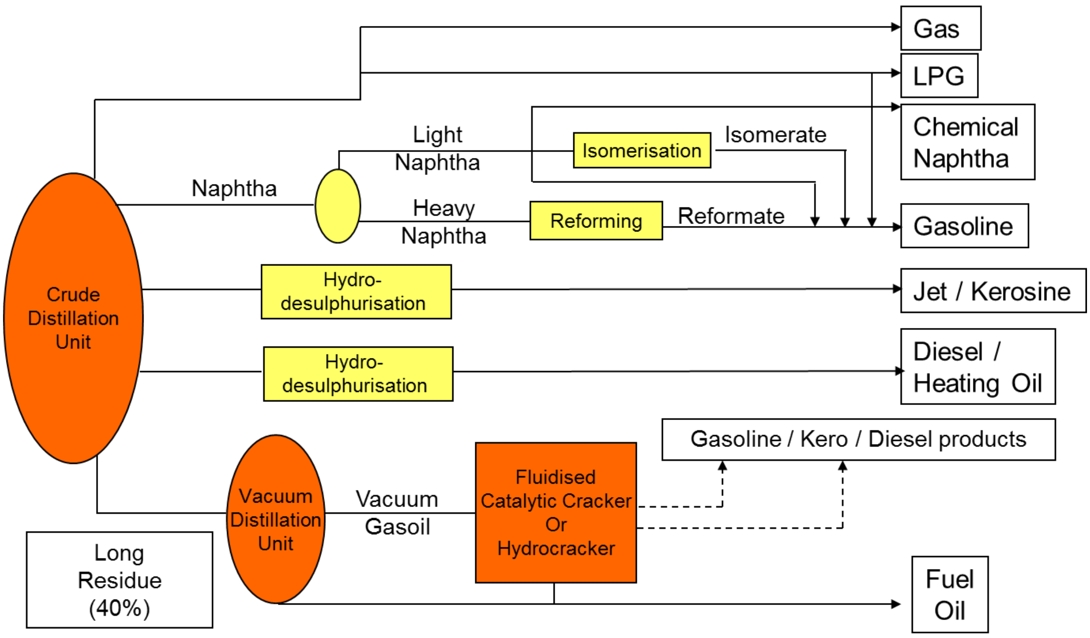
3.1.1 Introduction

To appreciate the commercial and technical issues relevant to the Kitimat project, it is important that readers develop a high level understanding of the key steps in refining, as well as the applicable terminology. In so doing, they will be better placed to consider Kitimat in the context of the global oil market in which it may eventually compete. This section therefore explains some of the technology employed to convert hydrocarbon feedstock, such crude oil or bitumen, into saleable products that can be used as fuel, lubricants or to manufacture chemicals.

Feedstock is a mixture of hydrocarbon molecules of various weights, sizes and shapes. To be converted into saleable products, they need to be separated into lighter fractions (through distillation), reshaped to more useful structures (reforming, mainly for gasoline) or broken into smaller molecules (cracking). Refiners use combinations of these processes to achieve the desire results.

The main steps are presented in Figure 1 below. They are explained in the text thereafter.

Figure 1: Key Processes in a 'Conversion' Refinery



3.1.2 Key Refining Processes

3.1.2.1 Atmospheric and Vacuum Distillation

In a crude distillation unit (CDU), crude oil is heated in a furnace and then fed into a vertical distillation column that contains horizontal trays. The trays are used separate the volatile hydrocarbons into a range of fractions, due variations in boiling points. For example, lighter molecules, such as gases (e.g. propane, butane, etc.) are taken out at the upper levels of a CDU. Heavier fractions migrate to the bottom. The densest residual material is extracted from the bottom of the atmospheric distillation unit (termed "heavy residue"). By heating and then distilling the residue in a column under reduced pressure (i.e. a vacuum distillation unit or VDU), it is quite straightforward to separate higher boiling range materials in the upper levels of the vacuum column. Side streams from the VDU include vacuum gasoil (VGO), which is the main feedstock for catalytic cracking units

Due to impurities, the products from atmospheric or vacuum distillation are rarely suitable for end use.

3.1.2.2 Cracking

Cracking units mix vacuum gas oil and highly specialised catalysts, under high pressure and heat, to break down the VGO into lighter, more valuable products. Generally speaking, there are two types of catalytic crackers:

- **Fluidised catalytic cracking** (FCC): catalysts are mixed to convert VGO into components suitable for gasoline and other products; and
- **Hydrocracking** (HC or hydrocracker): large quantities of hydrogen, again at very high temperatures and pressures, react over a catalyst with VGO to produce middle distillates, mainly diesel and jet fuel.

3.1.2.3 Catalytic Reforming

Reforming is a key process in gasoline production. Heavy naphtha from the distillation unit is treated with a catalyst at high temperatures. The molecules are reshaped ("reformed") which enhances the amount of energy that can be released when they are burned in gasoline engines. Not surprisingly, the main product of catalytic reforming is termed "reformate." It is a high octane blending component.

3.1.2.4 Hydrotreating or Hydrodesulphurisation

Fuel specifications around the world are requiring refiners to steadily reduce the amount of sulphur in fuels. Thus sulphur removal is one of the most essential steps in modern refineries. It also relies on the availability of large quantities of hydrogen.

More specifically, desulphurisation is achieved by reacting products and catalysts, in the presence of hydrogen, at elevated temperatures and pressures. This is referred to as "hydrodesulphurisation" and is carried out in an HDS unit.

3.1.3 Types of Refinery Configurations

It is worth noting that all oil refineries are unique, in the sense that each one was designed and built to meet the specific environment in which it operates. Thus not only are no two alike, but more importantly the levels of complexity and sophistication vary widely. Nevertheless, over time the industry has developed terminology to describe common combinations of process units (Table 1).

The simplest plants only possess atmospheric distillation units and are classified as "topping" refineries. If combined with a catalytic reformer and hydrodesulphurisation unit, they would then be described as "hydroskimming."

Other important refinery configurations are:

- **Conversion / Complex:** Include the same constituents as a hydroskimming plant, combined with catalytic cracking;
- **Deep Conversion / Highly Complex:** Refineries that completely convert heavy residues to lighter products. Thus little or no fuel oil is produced. Many refineries in North America are deep conversion because they use coking units to convert heavy residue into other products;
- **Lubes:** Some refineries are specifically designed to process heavy residues into lubricants. Others manufacture waxes and solvents;
- **Bitumen:** Similar to a lube refinery, but instead focused on output of asphalt and related products;
- **Petrochemical integration:** Utilises streams from oil refineries (especially light naphtha and certain gases) as feedstock for petrochemical production;
- **Toll processors:** Processes crude oil for third parties. In return for an agreed fee, provides the owners of the crude with a set product yield; and
- **Export Refineries:** Designed to export fuel products to multiple countries and / or regions. Such plants are configured to be able to meet a wide range of fuel specifications.

Table 1: Typical Refinery Configurations

Complexity	Description Used by Industry	Typical Process Units
Very simple	Topping	CDU
Simple	Hydroskimming	CDU, HDS, Reforming
Complex	Conversion	CDU, HDS, Reforming, VDU, FCC, HC, Isomerisation, Alkylation, MTBE, Visbreaking.
Highly complex	Deep conversion	CDU, HDS, Reforming VDU, FCC, HC, Isomerisation, Alkylation, MTBE, Visbreaking, Coking, Residue conversion or gasification.

3.1.4 Other Essential Terminology

The list below provides definitions of other parameters that are important in understanding the refining industry:

- **Refining Capacity:** The maximum quantity of crude oil that a refinery can process. Usually expressed either as barrels per day or million tonnes per year.
- **Refining Throughput:** The actual quantity of crude oil processed, again measured in barrels per day or million tonnes per year.
- **Utilisation:** The extent to which capacity is being utilised, assessed as a percentage of throughput capacity.
- **Shutdown:** Refers to a planned closure for maintenance work, normally called a "turnaround."

- **Refining Margin:** A measure of profitability, expressed as dollars per barrel or per metric tonne of crude.
- **Gross Margin:** The sum of the value of all products produced from a barrel of oil less the delivered cost of that barrel of oil to the refinery.
- **Variable Margin:** Gross Margin, less variable operating costs (usually chemicals, additives and utilities).
- **Cash Margin:** Variable Margin, less fixed costs (typically maintenance and labour).

(Note that it is standard industry practice to exclude depreciation and tax when assessing margins).

3.1.5 Refinery Economics

It should be apparent from the preceding paragraphs that refineries process a wide variety of feedstock using a complex combination of units. Thus unlike most manufacturing operations, it is virtually impossible to know the cost to produce a unit of output from a refinery. This does not pose a problem for the industry, however, because maximising profitability (i.e. margins) is of paramount importance. It is fair to say that refining margins generally depend on combinations of pricing, location and complexity. Locational differences are determined by the cost to deliver product from alternative sources of supply.

Over time, there has been a consistent trend to add ever more complex upgrading units, since they are better placed to deliver sustained profitability over the longer term.

It is worth noting that in unregulated markets there is generally a lag between increased crude oil prices and higher refined product prices. In general therefore, during periods of increasing crude prices, low refining margins are to be expected. The opposite trend occurs when oil prices decline; margins normally rise.

Crude prices have been stable in recent months. In general, refinery margins have improved since the 2009 / 10 recession, due to gradual economic recovery in developed countries, especially the United States. Profitability has also improved in Western Europe, partially due to reductions in capacity since numerous plants have been closed since 2008.

Development of an export refinery on the Pacific coast of British Columbia would not only create employment and economic benefits for the Province, but would also increase the overall value of Canada's natural resources, versus exports of crude oil and / or bitumen. It is for similar reasons that some oil exporting countries, such as Saudi Arabia, have developed fuel product export refineries.

Another important trend is that variable and fixed costs are relatively small, compared to product revenues and feedstock costs. Therefore refiners need to ensure that:

- Gross Margins are maximised by selection of an optimal feedstock slate that maximises output of more valuable lighter products, typically to be delivered to neighbouring markets; and
- Minimises fixed and variable costs.

Not surprisingly refiners need to acquire and process crudes that generate the best margins. These may not always be the cheapest or those which are readily available in the refiners' local region. To make the selection, traders and refiners utilise highly complex linear programme simulations of refinery operations that help identify relative values of alternative crude slates.

Other actions that are important to maximising margins are:

- Identify unit-by-unit operating strategies to achieve optimum gross margin. Typically this entails maximising throughput on the main conversion units;
- Optimise product blending, which again requires a linear programme;
- Maintain continuous operations. Unplanned shutdowns are to be avoided. Best practice is to maintain steady and optimal operations between major turnarounds (usually five years or more);
- Schedule turnarounds carefully to minimise the frequency and duration; and
- Manage inventories carefully within clearly specified and acceptable limits.

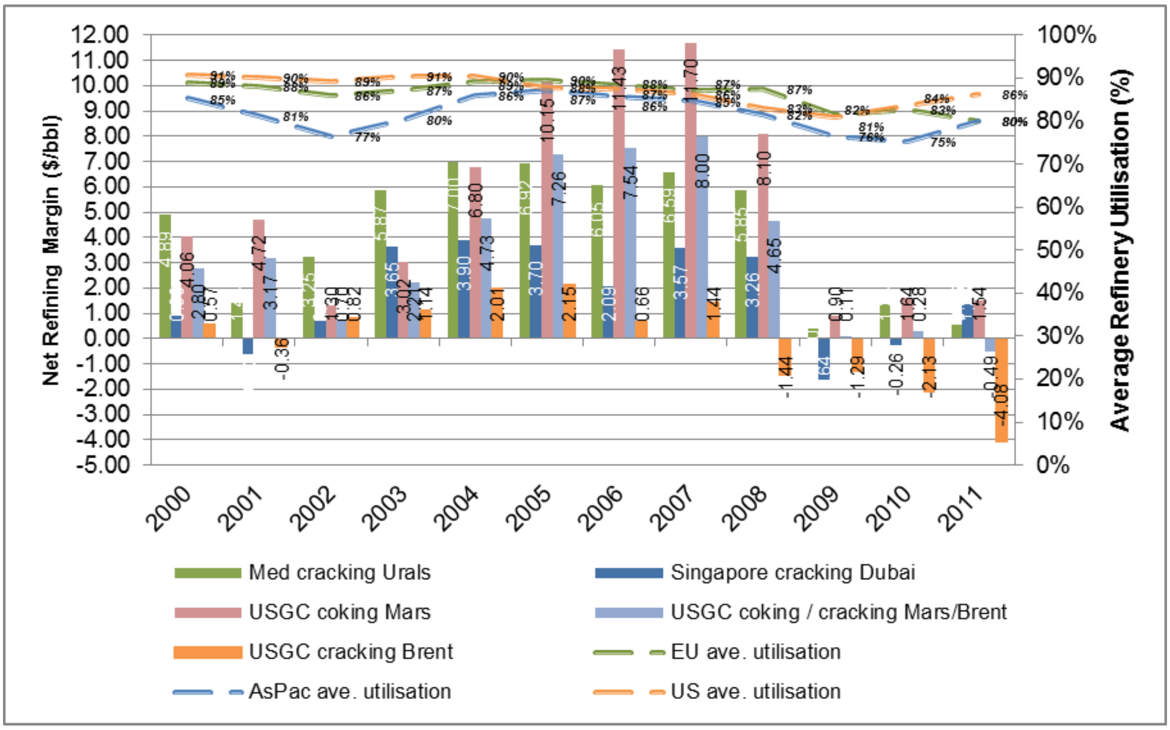
3.2 Refinery Utilisation and Profitability

It is well known that refinery profitability in recent years has been low. This occurred for a multitude of reasons, most notably the impact of the global recession on demand for oil-based fuels. Coupled with a shift away from gasoline in developed countries, especially the United States, the result has been closure and / or bankruptcy for many refineries. A good example was European Petroplus, which went into receivership in early 2012.

Nevertheless, financial losses in recent years do not mean that refining is a permanently unattractive industry. As can be seen in Figure 2, average utilisation in the economic downturn of 2001 / 2002 was very similar to 2009 – 2011, but margins during the latter years have been far worse. This suggests that the differences are due to a complex mixture of factors, among them changes in demand patterns in developed countries (in particular declining gasoline demand and increasing fuel efficiency of motor vehicles, as well as climate change policies to encourage lower consumption).

Thus when poor margins are ascribed, simplistically, to "surplus refinery capacity", it ignores many other factors related to supply and demand imbalances across the barrel and fluctuations in global oil prices.

Figure 2: Regional Refining Net Margins and Average Utilisation



Source: Navigant Consulting analysis

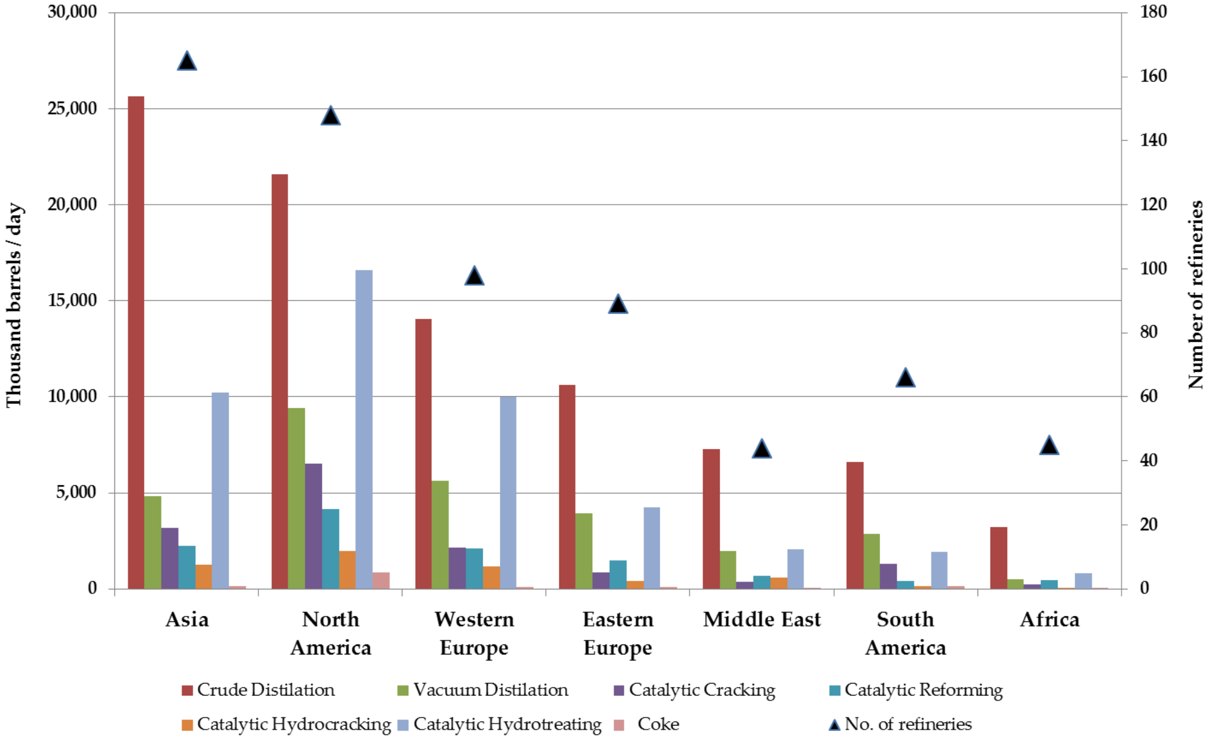
Figure 2 also makes it apparent that refineries with coking capability fared much better during the downturn. This is because deep conversion plants eliminate heavy fuel oil and maximise production of transport fuels.

As a further example, most complex refineries are configured such that the cracking units reach full capacity before their crude distillation units are fully utilised. Hence, there is generally some spare atmospheric distillation capacity in most North American and West European refineries. Whenever regional topping or hydroskimming margins rise above breakeven on a variable cost basis, complex refineries will increase throughput on their distillation units. As production rises, oversupply will suppress profitability and in turn, refiners will reduce runs and / or shut down distillation units.

Deep conversion refineries, such as proposed for Kitimat, will on average always have the highest profitability.

3.3 The Global Refining Industry

Figure 3: Global Refinery Capacity and Configuration



Source: Oil & Gas Journal, 2013 Worldwide Refinery Survey

Figure 3 above shows the capacity of different types of process units in each of the major regions of the world. Although Asia is now the largest, with more plants and the highest distillation capacity, it lags North America in upgrading (i.e. vacuum distillation, catalytic / hydrocracking and coking). The effect of the higher complexity is apparent in Figure 2, where net margins at US coking refineries were consistently highest.

3.4 Conclusions

Refineries are highly complex manufacturing operations. Their financial results arise from an inter play of a multitude of factors. It is for this reason that despite the overall downturn in global margins in recent years, the industry continued to do well in certain conditions, such as inland refiners with captive local markets, or large export plants capable of selling into a variety of end user markets.

4. Technical Review of the Proposed Refinery at Kitimat

4.1 Introduction

Kitimat Clean Limited has suggested an intriguing solution to increase the economic value of oil sands production in Alberta, while at the same time creating benefits for British Columbia. The Company's recommendation is to construct a 550,000 barrel / day greenfield, deep conversion refinery on the 3,000-hectare Dubose site, which is Crown land and located roughly midway between Kitimat and Terrace.

This Section will provide a very high level technical review of the proposed refinery. It is based on a limited amount of technical information, combined with insight and observations from other consulting assignments.

Feedstock for the Kitimat facility, if it were to be constructed, would consist of natural gas (for power generation and hydrogen production) and diluted bitumen. Finished products would include:

Product	Volume (barrels / day)
• Propane	details not available
• Gasoline	100,000
• Jet fuel / kerosene	50,000
• Diesel	240,000
• Petroleum coke	details not available
• Sulphur	details not available

The lack of fuel oil output confirms that the proposed process scheme is indeed deep conversion.

4.2 Process Flow Scheme

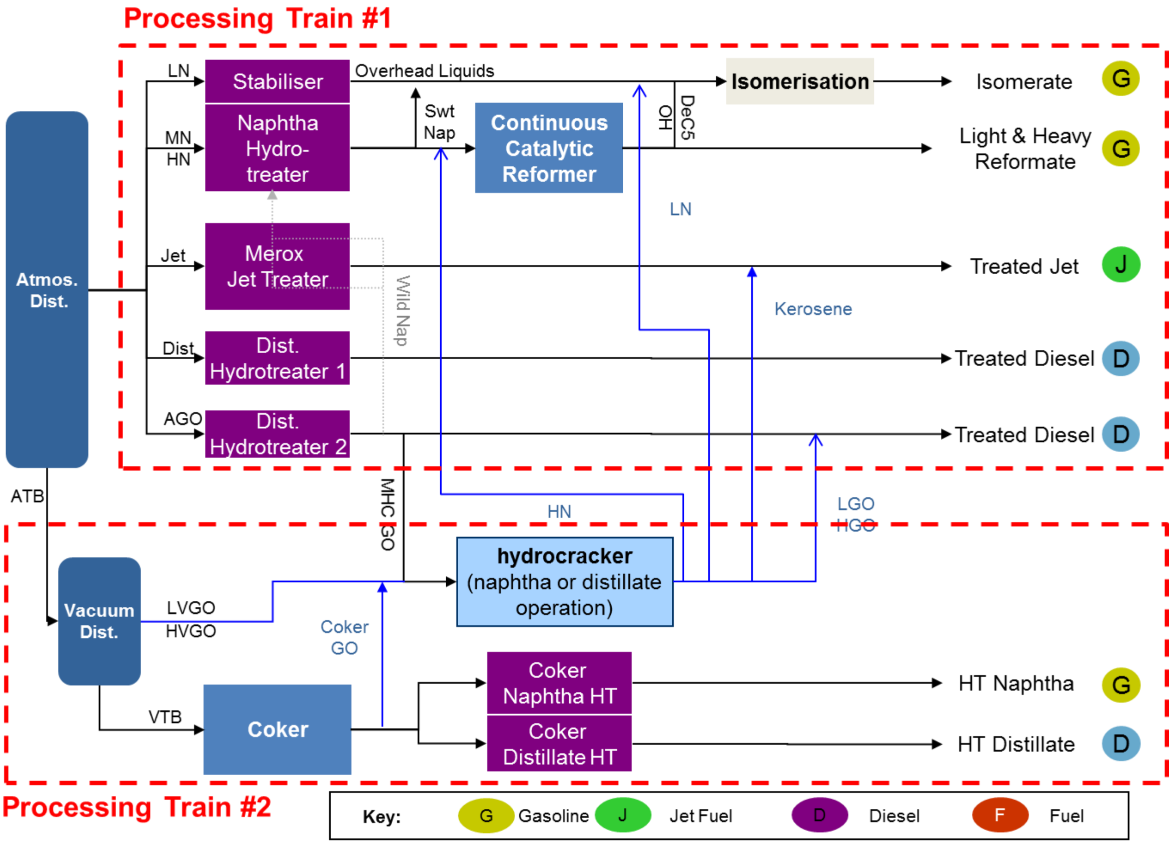
The key units at Kitimat are arranged in a format that has been applied successfully in numerous new refinery projects in recent years. The proposed process flow is commonly used and consists of crude and vacuum distillation, followed by a hydrocracker (for jet and diesel production), together with continuous catalytic reforming and isomerisation (for the manufacture of gasoline). A delayed coker would also be constructed to eliminate output of heavy fuel oil. A generic process flow diagram for this type of plant is presented in Figure 4.

It is worth noting that Kitimat resembles quite closely a greenfield refinery in Liaoning Province, China that was commissioned a few years ago. The author carried out extensive due diligence on this plant for a potential joint venture partner between 2008 and 2011. It started operations on schedule. Our due diligence concluded that the plant was very profitable (up to the first quarter of 2011, when negotiations ended).

Figure 4.1 of the Kitimat refinery *Project Description* (September 14, 2012) shows two processing trains. This is actually something of a misnomer, since in fact what was described is typical for a hydrocracking / coking refinery. Atmospheric distillation would produce gases (i.e. "light ends"), gasoline, jet fuel and gas oil (mainly diesel), while vacuum distillation generates VGO for the hydrocracker. The vacuum residue would then be fed to the delayed coker (Figure 4).

- *Processing Train #1*: Light ends processing, hydro-desulphurisation, isomerisation and catalytic reforming.
- *Processing Train #2*: Vacuum distillation, hydrocracking, coking.

Figure 4: Generic Process Flow Diagram of Hydrocracking / Coking Refinery



4.3 *Mass Balance*

Navigant understands that Kitimat Clean has not finalised its configuration and has not completed its filing at the British Columbia Environmental Assessment Office. Thus the information available to Navigant is limited. That being the case, it is hardly surprising that a detailed mass balance for the plant is not available. Nevertheless, we have been able to compare the estimated output from Kitimat shown above, to results prepared for other greenfield refinery projects.

Our analysis is presented in Table 2. The expected Kitimat yield, as shown in the September 14, 2012 *Project Description*, was converted to a volume percentage basis. It shows that the output from a generic model of a hydrocracking / coking deep conversion refinery, which was prepared for another assignment (running to maximise diesel production), is reasonably similar, given the uncertainties in the data, to the published estimate for Kitimat (red text). We therefore conclude that the output of Kitimat is likely to resemble what has been suggested, albeit at this early stage in development.

In addition, the developer's approach to reduce emissions of sulphur dioxide, nitrous oxides and other particulates is consistent with normal practice. The selection of hydrocracking as the main upgrading unit will also contribute to lower emissions of all such materials.

Table 2: Mass Balance Comparison

		Estimated mass balance from "*Project Description*"	Standard conversion factors	Estimated mass balance from "*Project Description*"	Yield from generic model of a hydrocracking / coking refinery
		Barrels / day	Barrels / tonne	Volume %	Weight %
Feedstock	Dilbit	550,000	?	n/a	n/a
Products	Propane	?	?	?	4.0%
	Gasoline	100,000	8.5	18.2%	24.0%
	Jet fuel / kerosene	50,000	8.0	9.1%	13.0%
	Diesel	240,000	7.5	43.6%	47.0%
	Coke	?	n/a	?	9.0%
	Sulphur	?	n/a	?	-
	Fuel and loss	?	n/a	?	3.0%
	Total:	390,000			100.0%

4.4 *Offsites and Logistics*

Figure 5.1 of the Kitimat *Project Description* sets out a "conceptual facility layout" for the main components at the refinery. It resembles the arrangement that we have seen at other hydrocracking / coking refineries. Items of particular note are:

- The tankage for feedstock is separated from product storage. This is good operating practice, since fire risk is always somewhat higher with finished fuel products.
- Coke handling and rail loading are adjacent to Processing Train 2, which includes the delayed coking unit. Again this is best practice, since it minimises the distance that coke must be transported before loading and thus reduces the likelihood of particulate pollution.
- The Administration and Maintenance centre is physically separated from the main process units. We would assume that the main control room would be positioned with Administration. Such an arrangement is normal to ensure the control room is protected, should explosions or fires occur in the main process units.

Most refineries and petrochemical plants use their own feedstock to generate some of the electric power, stream and water required for safe and successful operations. Navigant understand that Kitimat intends to construct a gas-fired cogeneration plant to produce utilities.

It is our understanding that if the refinery is not constructed, Enbridge has suggested that a marine terminal be constructed on the Douglas Channel. Presumably this will entail large crude oil tankers to handle the bitumen. These are expected to range from Aframax 80,000 – 120,000 dead weight tonnes (DWT), to VLCC >200,000 DWT.

One advantage to a refinery, versus exports of bitumen, is that vessels used to export products would, on average, be considerably smaller. We would envisage that the largest would be Long Range II (70,000 to

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100,000+ tonnes) product tankers. Given the smaller parcel sizes with products, however, the number of vessel movements would by necessity have to increase.

4.5 *Estimated Capital Cost*

In 2006 the author developed an estimate of the total installed cost of a greenfield refinery in the western US. Similar in size and configuration to Kitimat (i.e. 500,000 barrels per day with hydrocracking and delayed coking), capex (ISBL and OSBL) for the US plant was projected to be $4.2 billion.

This is significantly less than $13.0 billion estimate for the BC refinery, as compiled by Kitimat Clean Fuels in 2011, as shown below (Table 3).

Table 3: Capital Cost Comparison

	Kitimat Clean Capital Cost Projection				Grassroots 500,000 bbl / day US refinery			
Component	**Capacity (barrel / day)**	**Units**	**ISBL capex ($ million)**	**Comment**	**Capacity (barrel / day)**	**ISBL capex ($ million)**	**Comment**	**% change, '06- '11**
CDU	290,000	barrel / day	$390	Kitimat assumed an integrated unit	500,000	$450		-54%
VDU						$150		
Delayed coker	92,300	"	$610			$450	Includes coker naphtha and coker distillate HDS	36%
Hydrocracker	91,900	"	$660			$500	Includes LCO HDS	32%
Distillate HDS	70,500	"	$173			$100		73%
Naphtha HDS	30,450	"				$275	Includes stabiliser and Unibon	
CCR	24,450	"	$297			$250		-94%
Isom / benzene saturation	20,475	"				$50		
Hydrogen	190	MMSCF / day	$180				Assume part of OSBL	
Sulphur	3600	LT / day	$513					
Catalysts and chemicals			$110				Should be one off charge in cash flow statement	
Gasoline and jet fuel treatment						$150		
Train 1			$2,933			$2,375		23%
Train 2			$2,933	Identical to Train 1, which is incorrect				
OSBL + utilities			$1,670	30% of ISBL (error 30% would be $1,760)		$1,800	75% of ISBL	
ISBL + OSBL capex			$7,536			$4,175		81%
Power generation			$500				Wasn't required in the US	
Contingency			$804	10%			Preliminary estimate assumed to be + / - 30%	
Project and construction mgmt			$402	5%			Would normally evaluate in cash flow model	
Escalation			$804	10%			Would normally evaluate in cash flow model	
Location factor			$1,205	15%			Location adjustment included in OSBL capex	
			$11,251					
Owner's costs			$1,814	About 25% of ISBL + OSBL capex			US refinery included 10% owner's cost	
			$13,065					

Important points to note are as follows:

- As discussed in Section 4.2, KC's *Process Scheme 1* and *Process Scheme* 2 are actually different elements within a single hydrocracking / delayed coking refinery. KC's capital cost projection, was incorrectly developed by simply replicating the capex for a single 290,000 barrel HC / coking refinery. If the duplicate refinery were eliminated, KC's ISBL + OSBL capex estimate would then be $3.8 billion for much smaller refinery than for the US southwest refinery.
- Another reason for the discrepancy was cost inflation between 2006 and 2011. For the items that are easiest to compare (i.e. the delayed coker, hydrocracker and distillate hydrotreater), capex increased by 30% to 70% from 2006 to 2011. The total cost of KC's Train 1 is 25% more than the US plant, despite having 260,000 barrels / day less atmospheric distillation capacity.
- OSBL costs for the western US were 75% of ISBL. OSBL costs for KC were only 30% of ISBL and thus seem low.
- ISBL + OSBL for the US plant included owner's costs (**10%** of ISBL + OSBL), plus a 10% contingency and a location adjustment. In contrast, owner's costs at Kitimat are **25%** of ISBL+OSBL, which is high, relative to the US example.
- It was assumed for the US refinery that a large proportion of its utility requirements would be purchased locally, with a certain amount of refinery fuel produced internally. In contrast, $500 million was added for power generation at Kitimat.

In the limited time available to carry out this analysis, we identified numerous issues which led us to wonder whether Kitimat Clean's capital cost estimate might be on the high side. It is also fair to say, however, that the 2006 case study is not fully representative of current costs, despite being similar in size and configuration to Kitimat, because:

- Equipment and labour costs have risen since 2006;
- The remoteness of the Kitimat site will, without doubt, increase construction costs considerably. Navigant has not examined the magnitude of such an increase;
- The 2006 southwestern US refinery did not need a new plant for power generation, while one will be required at Kitimat; and
- The US example was not designed to process oilsands. Thus it is a somewhat imperfect comparator to Kitimat.

If these factors are taken into consideration, Navigant would expect the total installed cost of Kitimat (including the power plant) to exceed $7 billion. It is not possible at this stage to provide a more precise estimate. We would therefore recommend that a more detailed projection of capex for Kitimat be carried out.

4.6 Economics

Minimising capital costs is essential to ensuring that a process industry project will be economically viable. For example, total installed cost is a major driver financing requirements. Thus an accurate estimate of the capex needed to build Kitimat will be essential to maximising cash margins.

Having said that, it should be clear that the markets to which the output of Kitimat will be targeted have not been determined and that profitability will be dependent on market selection. Since its production could, in theory, be delivered to any of the importing countries around the Pacific Rim, one approach to maximise margin would be to design the refinery so ensure that it can blend finished products to meet the likely specifications in any of these countries. Such an approach has been used successfully in many export refineries around the world, particularly in resources-rich countries of the Middle East. Shell and ExxonMobil have operated profitable joint venture export refineries in Saudi Arabia since the mid-1980s.

4.7 Operational Models and Target Markets

In effect, therefore, Kitimat as an oil refiner has two choices for its preferring operating model.

It could on the one hand focus marketing efforts on only a few countries, or perhaps just one (e.g. China). Such an approach has the advantage of reducing the marketing and trading skills that would need to be acquired by the export refiner, since the seller would not need to find and supply products to the optimal mixture of customers and markets. Thus to enter such a structure, however, would require the buyer to be willing to pay a premium to the seller (in this case Kitimat), because the latter has given up the flexibility and ability to optimise margins across markets.

The other alternative, as mentioned previously, would be to develop the capabilities needed to be an export refinery, able to sell its output to a multitude of end-user markets. To do so successfully would require a sophisticated mix of operational, marketing, trading and oil supply skills. These are essential, given the ever-shifting relative differences in price levels and product qualities between countries.

There are many successful examples where resource-rich nations, with relatively small populations, have built export refineries and process plants that are jointly owned by the producing country and a multinational partner. Examples include:

- Saudi Arabia: Aramco with ExxonMobil (Yanbu);
- Saudi Arabia: Aramco with Shell (Jubail);
- Qatar: Qatar Petroleum with Sasol (Oryx GTL);
- Qatar: Qatar Petroleum with Shell (Pearl; and
- Qatar: Qatar Petroleum with ExxonMobil (RasGas).

4.8 Conclusions

Navigant's view, based on the information available at the present time, is that building a refinery on the coast of British Columbia has economic merit and should be considered seriously by the Government of the Province. Such a refinery would provide incremental long term economic benefits to the region, compared to export of unfinished feedstock. In addition and equally importantly, if configured carefully and managed properly, the refinery would create sustainable margins that otherwise would be lost to Asian purchasers of Canada's oil sands production.

Furthermore, it is our recommendation that the Province approve a design for Kitimat that would make it capable of manufacturing fuel products for a myriad of countries around the Pacific Rim. This would preclude being tied to only a few destination markets (or perhaps just one).

5. Asian Fuel Product Supply and Demand

5.1 Introduction

This Section will examine the fuel product supply and demand balance in key Asian countries, namely China, India, South Korea and Japan. Historic and current data for each will be compared to the Asia / Oceania region overall, as well as to the level of product exports from Canada.

Our analysis will show that, despite strong economic growth in some Asian countries, for about the last 15 years the aggregate demand for product imports has been surprisingly stable at roughly 2 million barrels per day. Thus the output from Kitimat (0.5 million barrels per day) could be accommodated by markets in Asia / Oceania without major disruption to local spot markets.

Please note that in this Section, "fuel products" are defined as LPG, gasoline, jet fuel, kerosene, gas oil, diesel, heavy fuel oil and "other" (lubricants, waxes, etc.).

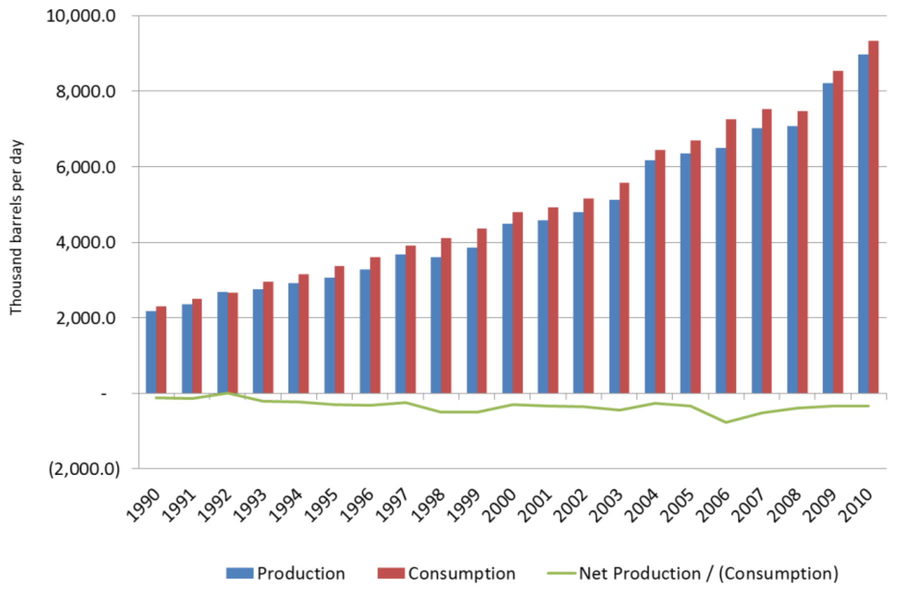
We will also consider the structure of the refining sector in China, India, South Korea and Japan. The size and complexity of each of their industries will then be compared to major developed economies (i.e. the US, Western Europe and Canada). Despite major and ongoing investments, the Asian refining industry lags the latter group, both in terms of technical upgrading capability, as well as absolute size (versus the US and Western Europe).

5.2 China

5.2.1 Chinese Supply and Demand

The impact on fuel product demand of the steady growth of the Chinese economy can be readily seen in Figure 5. Domestic production has consistently lagged demand. Despite major investment and expansion of refining sector, China's fuel imports remain at about 500,000 barrels / day.

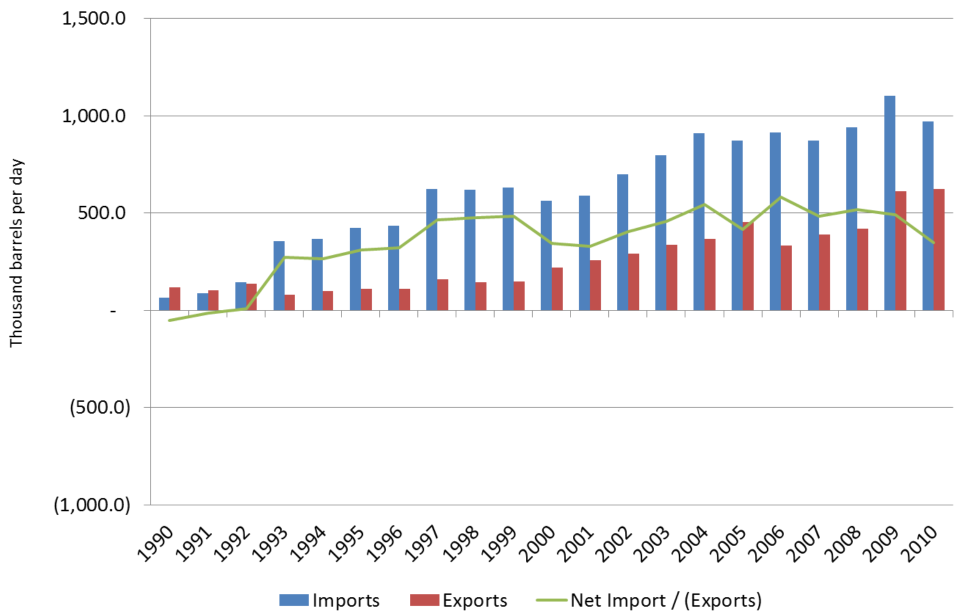
Figure 5: China – Fuel Product Output and Consumption



Source: US Energy Information Administration

Figure 6 provides more detail. Net imports correlate closely to China's GDP growth rate. It is apparent that China's imports began to rise sharply from the mid-1990s.

Figure 6: Fuel China – Product Imports and Exports



Source: US Energy Information Administration

5.2.2 The Chinese Refining Industry

Chinese refining capacity has been expanding dramatically to help meet growing domestic consumption; approximately 1.1 Mbd of distillation capacity was added in the five years between 2008 and 2013. The industry is largely state-owned. One of the Government's policy objectives is to eliminate many of the small topping and hydroskimming refineries in favour of larger, more complex sites. Thus the Government began to approve foreign investment in Chinese refineries in early 2007. Participants in either operational or planned joint ventures within China include BP, Shell and BASF, Saudi Aramco, ExxonMobil and Qatar Petroleum. Many other companies hope to expand in the country, given the potential opportunities that it presents.

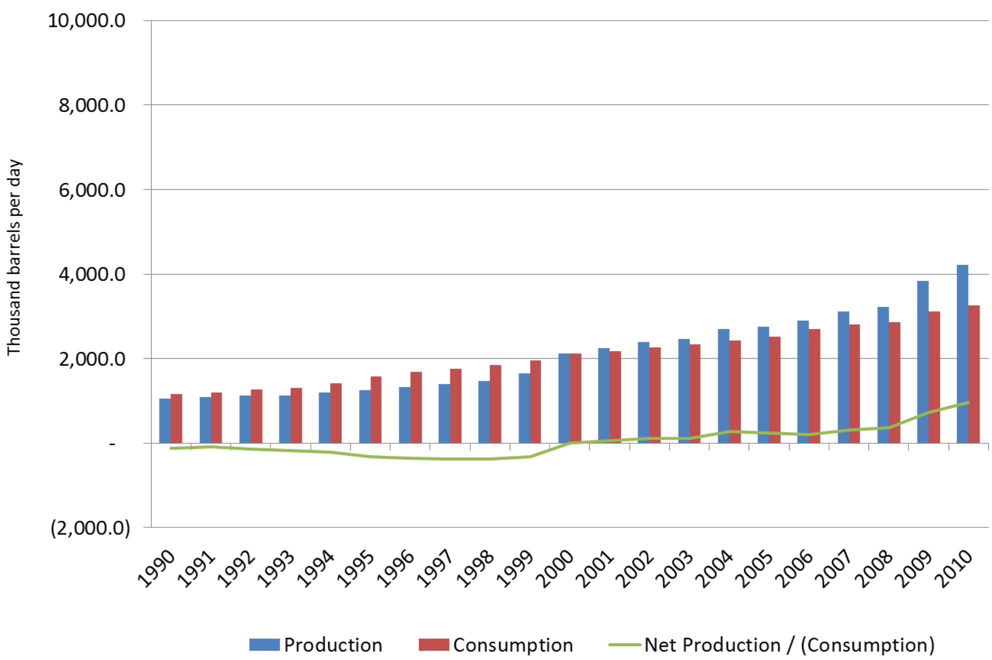
Domestic fuel prices in China are regulated by the central government. Price controls have resulted in extensive financial losses by Chinese refiners in recent years. This has encouraged imports.

5.3 India

5.3.1 Indian Supply and Demand

The supply / demand balance of India has shifted significantly since the beginning of the economic reform programme in 1991. Prior to that time the country's strategy was to endeavour to be "self-sufficient." As reforms took hold, however, fuel demand began to increase, which was partially met by higher levels of imports (Figure 7).

Figure 7: India – Fuel Product Output and Consumption



Source: US Energy Information Administration

5.3.2 The Indian Refining Industry

An essential distinction between India and China that should be emphasised is ownership of the refining industry. Although much of the latter is state-owned, a few large multi-national companies have managed to participate in joint ventures with such companies as Sinopec and CNPC.

India is radically different; in the early 1990s most of the sector was owned by Indian Public Sector Undertakings (PSUs), such as Indian Oil, Hindustan Petroleum, Bharat Petroleum and others. Over the last decade however, activity by privately-held refineries has risen sharply (Table 4).

Private Indian refiners have increased domestic production sharply, since one of their objectives has been to supply products to other Asian markets. This export-driven strategy is motivated in part by Indian price controls, which tend to limit refining margins. The results are clearly demonstrated in Figure 8. Since 2000, net product exports have gone from zero to nearly 1 million barrels per day.

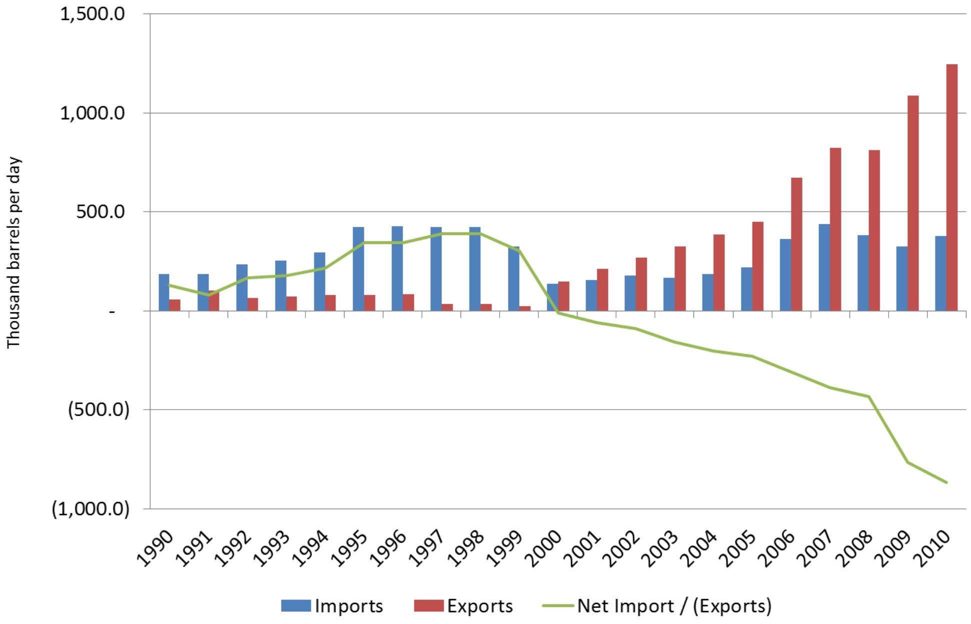
China is unlikely to follow suit, given that most of the refining sector remains state-owned.

Table 4: Ownership of Indian Refineries

Refineries		2007	2008	2009	2010	2011	2012
Distillation capacity	(Mtpa)						
PSUs		105.5	105.5	105.5	112.9	122.9	135.0
Joint venture / private		43.5	43.5	72.5	72.5	70.5	78.1
Total:		**149.0**	**149.0**	**178.0**	**185.4**	**193.4**	**213.1**

Source: Ministry of Petroleum and Natural Gas, Petroleum Planning and Analysis Unit

Figure 8: India – Fuel Product Imports and Exports



Source: US Energy Information Administration

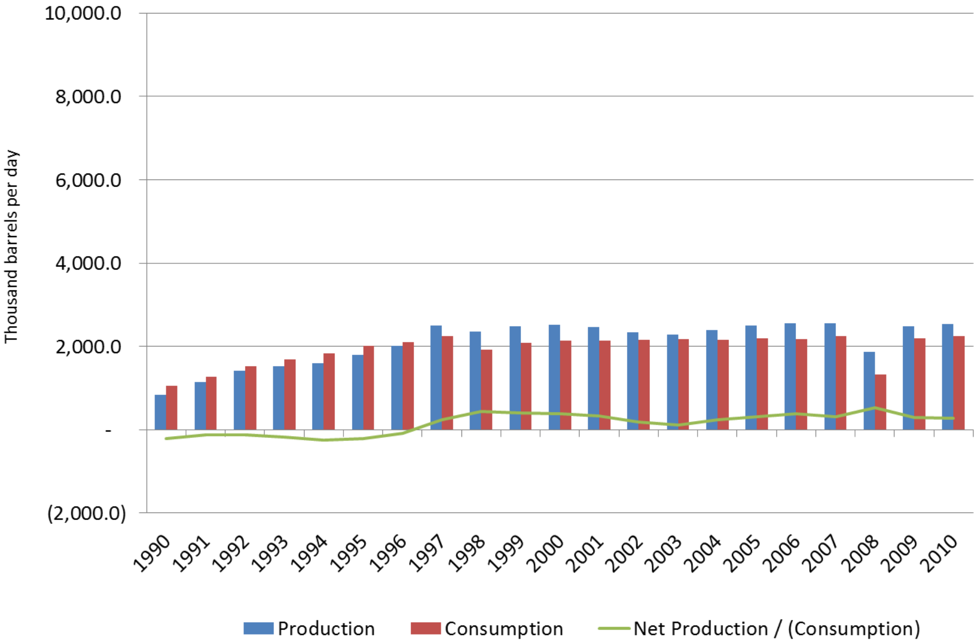
5.4 *South Korea*

5.4.1 South Korean Supply and Demand

Figure 9 provides an overview of the Korean supply / demand balance since 1990. Consumption grew strongly in the 1990s. Although the country's refiners were expanding at the same time, they were not able keep up until later in the decade, when demand growth stabilised at slightly more than two million barrels per day.

Since then Korean refiners have continued to invest in upgrading projects, so much so that for the last 15 years South Korea has been a net exporter of fuels. This effect was particularly pronounced during the recession in 2008 and 2009.

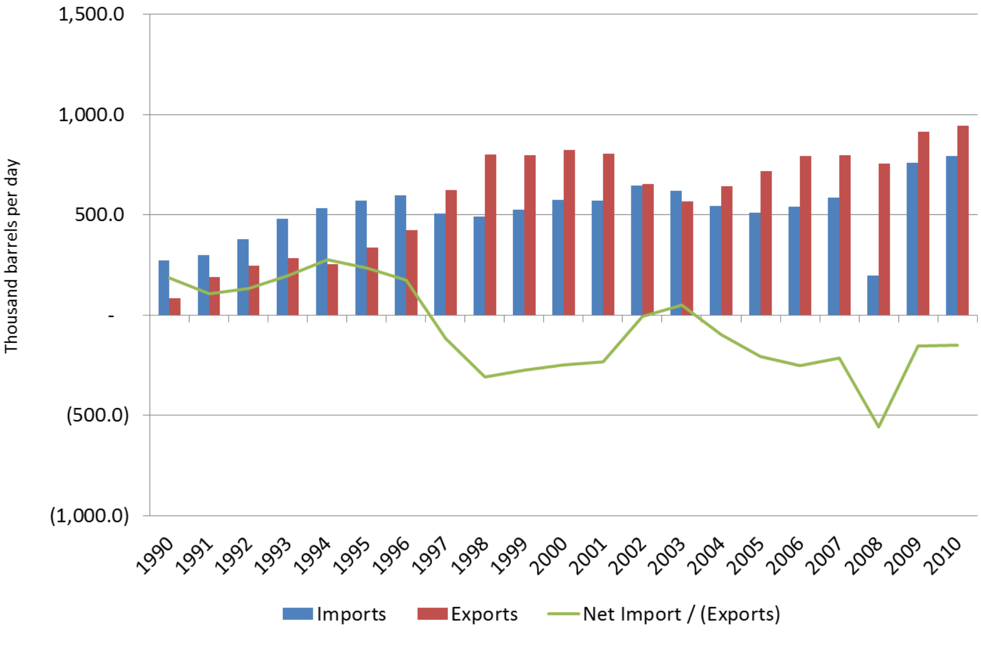
Figure 9: South Korea – Fuel Product Output and Consumption



Source: US Energy Information Administration

Although South Korean presently exports a relatively small quantity of surplus output (about 250,000 barrels / day, per Figure 10), it would appear to be more a result of the need to balance the domestic market, rather than a specific export-driven strategy by private refiners (as appears to be the case with India).

Figure 10: South Korea – Fuel Product Imports and Exports



Source: US Energy Information Administration

5.4.2 The South Korean Refining Industry

The South Korean refining industry is owned entirely by private companies. In fact it is quite concentrated. All are listed on the Korean stock market, apart from Hyundai (Table 5):

Table 5: Ownership of South Korean Refineries

Company	Number of Fuel Refineries	Distillation Capacity (barrels / day)
SK Energy	2	1,115,000
S-Oil	1	669,000
GS Caltex	1	775,000
Hyundai Oil	1	390,000
	5	**2,949,000**

Source: Oil & Gas Journal, 2013 Worldwide Refinery Survey, Company Annual Reports

In much the same way as India, these Korean companies have invested heavily in the last five years. Approximately $5 billion has been spent on fuel upgrading, petrochemicals and lube expansion projects in the last five years. This effort has been successful, since the Korean industry is now technically more complex than China, India or Japan (

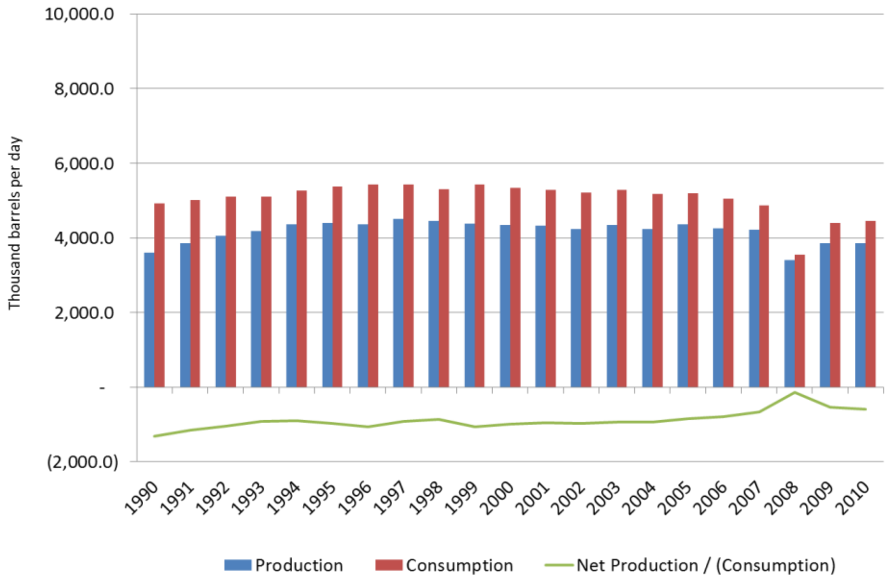
Figure 15).

5.5 *Japan*

5.5.1 Japanese Supply and Demand

For several years economic growth in Japan has been static at best. This is reflected in fuel consumption, which began a steady decline in the late 1990s (Figure 11). There was a very severe downturn in the 2008 / 2009, from which Japan has never fully recovered. Thus Japan resembles the United States more closely than any of the other countries examined for this report.

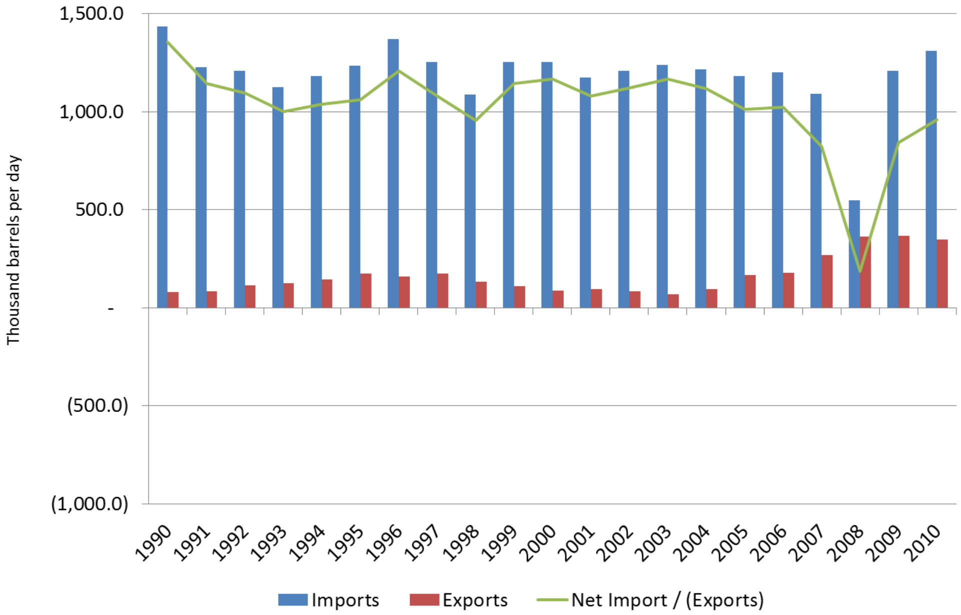
Figure 11: Japan – Fuel Product Output and Consumption



Source: US Energy Information Administration

Despite these difficulties, Japan still imports a consistent volume of product, which until the recent recession averaged around 1 million barrels / day (Figure 12).

Figure 12: Japan – Fuel Product Imports and Exports



Source: US Energy Information Administration

5.5.2 The Japanese Refining Industry

As a country, Japan's strategy for many decades has been to encourage domestic refining as a source of product supply, rather than stimulate fuel product imports. The main motivation has been to capture a perceived benefit arising from lower freight costs. Thus product exports are only used to balance the system.

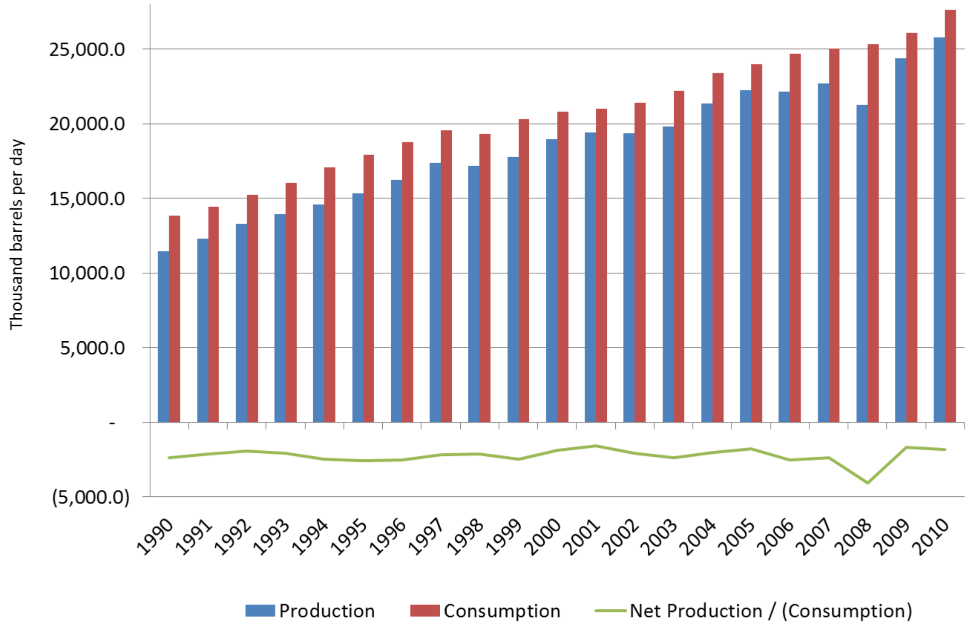
Given the steady decline in Japanese product demand, refinery utilisation has dropped concurrently, despite ongoing efforts at capacity rationalisation. Throughput peaked at 87% in 2005 and has been falling ever since. Japanese refiners ran at 74% of capacity in 2011. It should come as no surprise that Japan is no longer considered a high priority market to some of the major international oil companies. ExxonMobil sold its Japanese downstream subsidiary in 2012 for $ 3 billion to Japanese refiner and marketer TonenGeneral Sekiyu.

5.6 Asia / Oceania

5.6.1 Asian / Oceania Supply and Demand

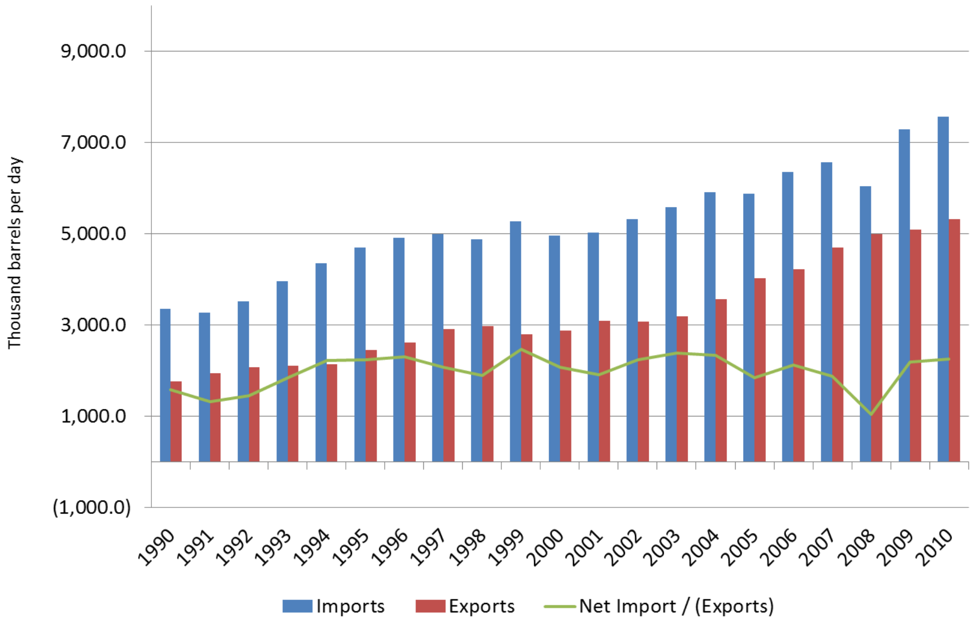
Navigant also compiled product supply and demand data for the countries of the Asia / Oceania region, as defined the US Energy Information Administration. The results are presented in Figure 13 and Figure 14. These charts demonstrate that despite economic success in parts of the region and significant differences between the refining sectors of the largest countries, the overall level of imports has remained stable at about two million barrels / day. This suggests that the Asian region could easily accommodate the output from Kitimat, should it be constructed as an export refinery.

Figure 13: Asia / Oceania – Fuel Product Output and Consumption



Source: US Energy Information Administration

Figure 14: Asia / Oceania – Fuel Product Imports and Exports



Source: US Energy Information Administration

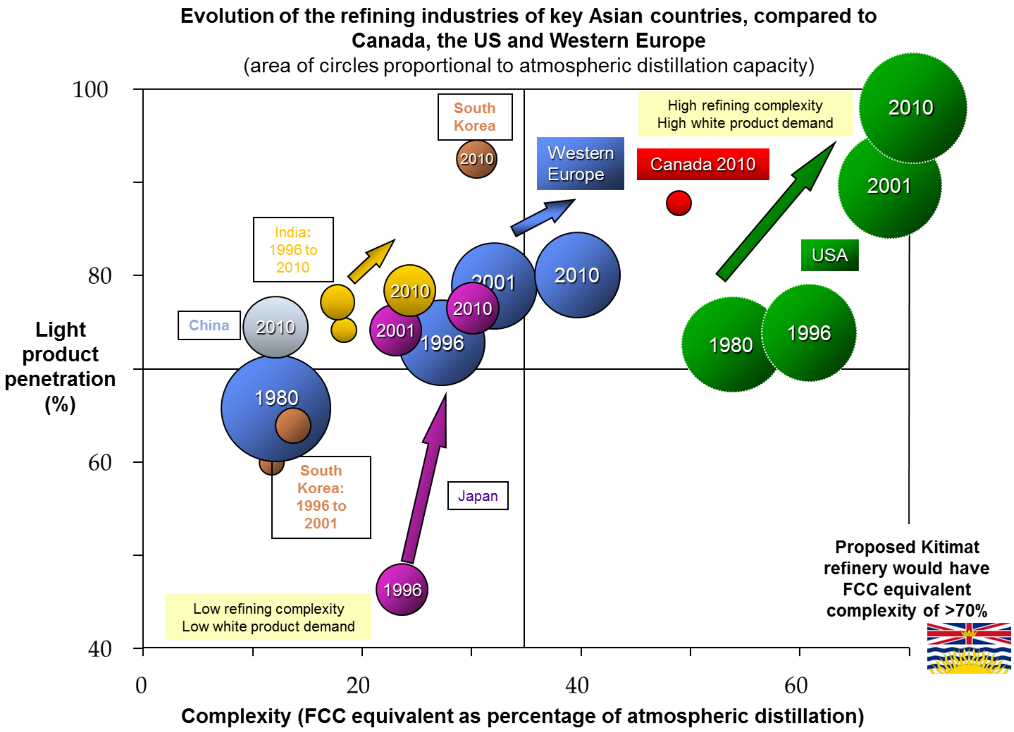
5.7 *Evolution of the Refining Industry in Key Countries*

To place the foregoing analysis in context, Navigant compiled data on the countries studied in this report, together with the US, Canada and Western Europe. Information was collected on:

- Atmospheric distillation capacity at various points since 1980;
- The proportion of transport fuel consumption ("light products" - gasoline, diesel, jet, etc.), out of total demand, at these same times; and
- The complexity of the refining industry in each country / region. This was estimated by comparing atmospheric distillation to the size of the main conversion units (catalytic crackers, cokers, etc.) after adjusting to an "FCC Equivalent" basis. [1]

Results are shown in
Figure **15**. Several useful trends are apparent.

Figure 15: Comparison of Refining Complexity, Industry Size and Market Structure



Source: Oil & Gas Journal, 2013 Worldwide Refinery Survey. US Energy Information Administration. *Petroleum Refining: Operations and Management*, Jean-Pierre Favennec.

As economies become more sophisticated, they shift from low white product demand and low refining complexity, to high proportions of both light product consumption and upgrading capability. This effect has been particularly pronounced in the US (green) and Western Europe (blue), even as the European industry has continued to rationalise and close capacity.

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[1] Conversion ratio compares atmospheric distillation to upgrading units, which are adjusted to an FCC equivalent basis. Non-FCC upgrading capacity therefore is adjusted using coefficients that estimate their ability to convert heavy products into lighter ones. The capacity of the other upgrading units is multiplied by the applicable factors: FCC = 1.0, hydrocracker = 1.2, thermal cracking = 0.65, coking = 1.7, visbreaking = 0.33, deep conversion 2.1.

The linkage is not surprising, since upgrading is essential to deliver the higher quantities of transport fuels which tend to accompany economic growth. Nevertheless, it is useful to point out that despite massive investment, none of the four Asian countries examined for this study have yet to attain the complexity possessed by Western Europe over ten years ago.

More importantly, the analysis also suggests that the refining sectors of China, India, South Korea and Japan are not yet sufficiently complex to meet the upgrading needs and increasingly stringent product quality of their home markets. Therefore a sophisticated export refinery on the Pacific Rim could help fill this market requirement.

It is essential to note that markets in Japan, South Korea and China are not easy for outsiders to penetrate. For a west coast refiner to do, collaboration with one or more local refining, petrochemical or LPG distribution companies might make sense. Interestingly Navigant understands from some of our contacts in the region that Korean refiners and chemical players are frequently seeking opportunities to locate secure sources of supplies (i.e. of naphtha diesel, LPG and aromatics), possibly as minority investors in a refinery on the west coast of North America.

5.8 Conclusions

Navigant concluded from our assessment of the fuel product balance in Asia that exports from a refinery at Kitimat could probably be accommodated in the Asian market without disrupting local spot prices. It was also clear that demand patterns in each of the four countries examined in detail have developed quite differently. The respective markets are served by local refiners that have distinct differences. Some are state-owned, others private or a mixture of the two. Thus it is difficult to generalise, other than to point out that their western counterparts in the US, Canada and Western Europe are more technically complex and likely to remain that way for many years.

Pages 137 through 139 redacted for the following reasons:
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s13, s17