

FINAL REPORT



Port Alberni Trans-Shipment Hub (PATH) Feasibility Study

Examination of Strategic & Business Requirements

Traffic Forecasts

Potential Logistics Cost Advantages

Economic Impacts and Other Benefits

Prepared for:

Port Alberni Port Authority

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Acknowledgements and Disclaimers

CPCS thanks the Port Alberni Port Authority (PAPA) for the opportunity to undertake this project.

The material in this report was developed in part through consultations with executives of major shipping lines currently serving the West Coast, terminal operators, among others. Their comments have not been attributed for reasons of commercial sensitivity, but the team recognizes their input.

The content relating to economic impacts of the PATH project was developed in part on the basis of PATH project capital and operating cost estimates provided by Hatch engineering consultants and PAPA.

Unless otherwise stated, the opinions provided herein are those of CPCS and they do not necessarily reflect the views of PAPA or the Canadian federal government.

This report should be treated as confidential as it may contain material deemed commercially sensitive.

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Acronyms / Abbreviations

Acronym	Definition
AM	Ante Meridiem
BC	British Columbia
COSCO	China Ocean Shipping Company
CSCL	China Shipping Container Lines Co.
CPCS	CPCS Transcom Limited
EPA	Environmental Protection Agency
FTE	Full Time Equivalent
GDP	Gross Domestic Product
HMT	Harbor Maintenance Tax
JIT	Just-In-Time
LA	Los Angeles
OSC	Ocean Shipping Consultants
OR	Oregon
PNW	Pacific North West
PSW	Pacific South West
PAPA	Port Alberni Port Authority
PATH	Port Alberni Trans-Shipment Hub
PMV	Port Metro Vancouver
PM	Post Meridiem
SSS	Short Sea Shipping
PAX	Transatlantic Services
TEU	Twenty Foot Equivalent Unit
ULCS	Ultra-Large Container Ships
UASC	United Arab Shipping Company
US	United States
WA	Washington
ZIM	ZIM Integrated Shipping Services

Executive Summary

Introduction

The Port Alberni Port Authority (PAPA) has identified an opportunity to develop a container trans-shipment hub to serve markets on the Canadian West Coast, including along the Fraser River, along the North West United States (together the Pacific North West, or PNW), and from there, further inland, including the US Mid-West.

The project, referred to as the Port Alberni Trans-Shipment Hub (PATH), is premised on a hub-and-spoke container trans-shipment operation concept.

The PATH concept envisages a terminal of 400 acres with an annual capacity of 3.5 million TEUs (hub). From PATH, coastal ports and terminals would primarily be served by feeder barge service (spokes). The PATH project could be operational by 2022.

This report informs a broader assessment of the overall feasibility of the PATH project.

Rationale for PATH

The rationale for the PATH project is predicated primarily on the following:

- The PATH facility could accommodate Ultra-Large Container Ships (ULCS) with capacities of over 10,000+ TEUs. Competing ports in the PNW, including Vancouver, Seattle and Tacoma, are also expected to be capable of handling ULCSs with future equipment investment, though the PATH facility could potentially be an early mover in accommodating ULCSs.
- Automation of terminal activities, with crane capabilities of 40 to 45 container moves per hour as contemplated at PATH, can lead to significant productivity, efficiency and associated cost advantages relative to competing terminals in the PNW, which are currently not automated. Being the first automated terminal in the PNW could provide PATH with a relative advantage in receiving ULCSs, specifically, since these ships tend to call at terminals with efficient unloading/loading operations.
- Port Alberni is closer to Asia compared to Vancouver, Seattle and Tacoma. The PATH concept could allow an efficient in and out to ocean ships in a single PNW call (full unload/load, for dedicated PNW services), avoiding the deviations and navigation time between ports to load and unload, and allowing the ocean ships to quickly make the

trip back and forth to and from Asia. These advantages could potentially extend to ships sailing onward to Pacific South West (PSW) ports.

- The feeder barge and/or short sea shipping (SSS) operations serving PATH could spread regional container handling capacity over a large number of coastal and inland terminals along the Fraser River and reduce hinterland congestion, particularly by avoiding, reducing and spreading truck transportation (drayage) in the BC Lower Mainland. This could in turn go some way in mitigating negative externalities associated with congestion in the region.
- The PATH project can also be viewed as a potentially lower cost option to investing in new container terminal capacity in BC's Lower Mainland (at Robert's Bank Terminal 2), or as a longer term option for increasing the capacity of the Asia-Pacific Gateway and Corridor, once new terminal capacity in the BC Lower Mainland becomes fully utilized.
- The PATH facility could also provide greater resiliency for the Asia-Pacific Gateway and Corridor, by providing an additional facility capable of handling containers.

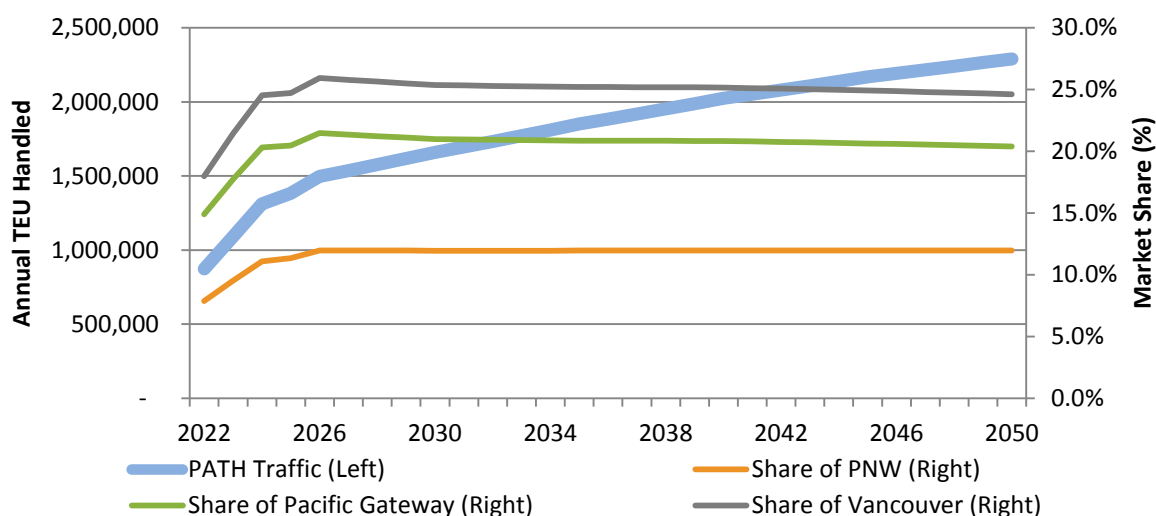
PATH Potential Market

The markets for a trans-shipment facility at Port-Alberni would likely be focused on those currently served by PNW ports. This market is fragmented, with more than a dozen large shipping lines and even more routes operating to these ports. There are no regularly scheduled ULCS ships serving the PNW at present, though this is expected to change over the coming decade.

In 2012, the total number of containers transiting through PNW ports (Port Metro Vancouver, Seattle, Tacoma, Portland and Everett) was about 6.5M TEUs. This market is expected to grow by over 5% per year over the medium term. In addition, the local market for containers on Vancouver Island provides a small but growing market which could be served directly by PATH.

We have developed a traffic forecast scenario for PATH based on the assumption that PATH can secure a weekly 14,000 TEU ship service by a major shipping line, or an alliance of shipping lines, starting in 2022, when the PATH facility would be in operations. Assuming that the service would fully-unload/load containers at PATH and a gradual ramp up of ship capacity utilization, CPCS estimates that PATH could handle approximately 1.5 million TEUs by 2026. This would represent about 12% of the PNW market (Figure ES-1) at that time.

Figure ES-1: PATH Container Traffic Forecast and Market Share, 2022-2050



Source: CPCS Analysis and OSC's Forecasts.

Strategic and Business Requirements and Configuration

To best align the PATH concept with shipping line strategic business requirements, and to realize the full potential value of the PATH project for shipping lines, its configuration should include:

- The ability to berth at least two ULCS ships at the same time (up to 475 meters each).
- Automated terminal handling to enable quick ship turnaround times. PATH could potentially be a first mover with automated handling in the PNW market to capture market share and attract ULCSs.
- At least six or seven ship-to-shore gantry cranes are needed, with a typical productivity of approximately 40-45 moves per hour (40-45 boxes, 40' or 20'). This would exceed typical crane productivity in West Coast terminals, which generally achieve 25-35 moves per hour.
- Barge feeder service comprising a fleet of tugs and up to 40 standardized 900-1000 TEU barges for each weekly service (assuming ULCS). Barge services should seek to reach as far inland as possible (this would require adequate container handling capabilities at river terminals). The ownership and operating structure of barge feeder services would need to be defined. It would likely be most practical, given cabotage regulations, to operate two separate barge services from PATH – the first, a Canadian-flagged barge service, serving Canadian ports, and the second, an international-flagged service, serving US ports.

- For long-distance inland markets, and in particular those served by rail such as Chicago or Eastern Canada, the barge service from PATH needs to connect to a terminal with on-dock rail service, either at one of the deep-sea terminals or, eventually, at docks adjacent to the rail container terminals.

The commercial feasibility of the whole PATH project is conditional on minimal traffic guarantees, in one form or another, from one or more shipping lines. PAPA would have to get a firm commitment from one or more shipping lines to bring ships to PATH, over a sufficiently long period to recover the project's costs. Having the shipping line invest in the terminal, alongside other partners (operational or financial) would also help secure traffic.

Potential Logistics Cost Advantage

Two operating scenarios were compared in assessing the potential logistics cost advantage:

- The PATH Single Port of Call Scenario assumes only a single port of call by an ocean liner, and a full unloading/loading of containers at PATH, under various ship size scenarios, with barge feeder connecting coastal ports, river terminals and inland terminals.
- The Status Quo Scenario, assumes an ocean shipping line, under various ship size scenarios, making calls at Vancouver and Seattle (as is common presently for trans-Pacific PNW services).

Other hybrid scenarios were considered, such as a sailings including a combined PATH and a US PNW call, but such scenarios offered limited additional cost advantages (as the onward sailing to another US Pacific NW port would largely neutralize any deviation savings associated with PATH), and have not been considered further. The scenario of a combined PATH/PNW and a PSW call was also considered. This could help attract ULCSs which could sever traffic for both PNW and PSW ports.

Ocean Shipping Line Cost Advantage

For the ocean shipping line, we estimate that the shorter deviation in the PATH Single Port of Call Scenario will save approximately 3 days when compared to a typical rotation (Asia-Vancouver-Seattle). This time saving, along with fuel savings associated with the shorter rotation, leads to savings of \$540,720 for a full rotation. This represents just over \$15 per TEU slot each way, assuming a 18,000 TEU ship. By comparison, if instead of 18,000 ships we were to compare 8,500 TEU ships in both the PATH Single Port of Call and Status Quo Scenarios, the overall savings are lower (\$351,355) due to lower capital cost and operating costs, but the savings per TEU slot are higher (\$20.67).

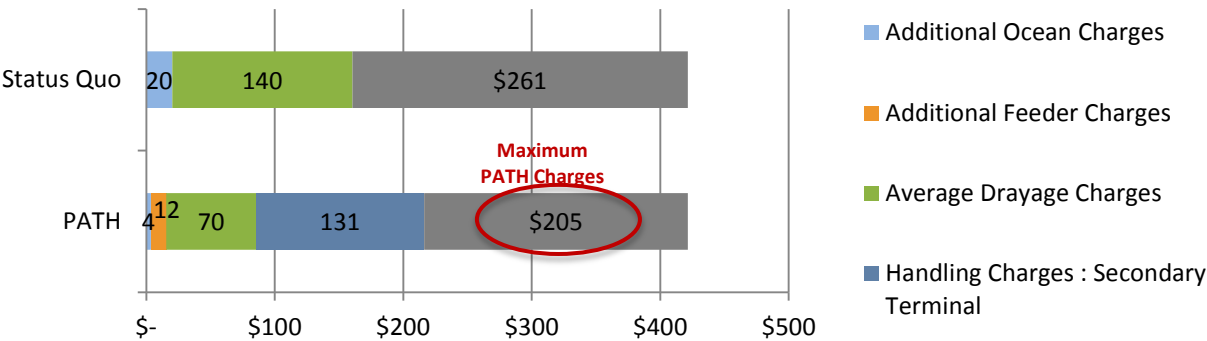
Total Shipper Supply Chain Price Differential

Until the PATH project capital and operating costs have been developed, and the project’s financing structure has been defined, it is not possible to compare total shipper supply chain costs to move cargo in the PATH Single Port of Call Scenario vs. the Status Quo Scenario.

However, we can compare all other supply chain charges to establish the PATH handling charge threshold required to be more competitive than the Status Quo Scenario. We have assessed two inland market scenarios. The first (ES-2) compares the PATH Single Port of Call Scenario to the Status Quo Scenario for containers destined to their end market in the PNW region by truck. The second (ES-3) compares the PATH Single Port of Call Scenario to the Status Quo Scenario for containers destined to inland markets by rail, via a rail served facility.

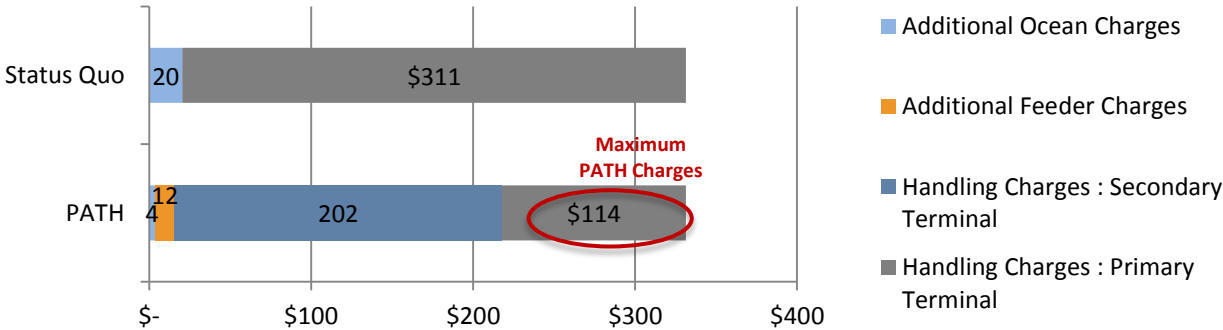
This analysis shows that to be competitive, PATH would need to have handling charges below \$205 per TEU for PNW market served by truck, and less than \$114 per TEU for inland markets served by rail via a rail-served marine terminal facility. PATH would have a natural advantage for traffic originating or destined on Vancouver Island, which would result in lower transportation costs for shippers and receivers on Vancouver Island.

Figure ES-2: Supply Chain Price Differential (from Deviation Point): Truck-Served Customers in Local Market



Source: CPCS estimates

Figure ES-3: Supply Chain Price Differential (from Deviation Point): Rail-Served Customers in Inland Market



Source: CPCS estimates.

By comparison, Deltaport's combined wharfage and throughput charges are currently \$311 per TEU for rail customers and \$261 per TEU for truck customers. This provides some room for offering a discount (but this would be contingent on overall lower operating costs at PATH, including appropriate coverage for capital costs, which is not addressed here).

Expected Economic Impacts and Other Benefits

Economic Impacts

The total expected economic impact related to both the construction¹ and operation² of the PATH project is estimated as follows:

Increase in Canadian GDP: **\$21.3 billion**

Of this, \$ 19 billion occurs in BC and close to \$20 billion occurs in Western Canada.

Increase in jobs in Canada: **288,079** (full-time equivalents, i.e. person years)

Of this, over 266,000 jobs are created in BC and 273,000 jobs in Western Canada.

Increase in tax revenue: **\$1.6 billion**

Of this over \$ 1.4 billion would be generated in BC and close to 1.5 billion would be generated in Western Canada.

The figure on the following page presents a summary of the Sarita Bay South Option A economic impacts.

¹ The total capital cost (including contingency) of the PATH project, located at Sarita Bay South (Option A) is \$1.63 billion.

² Assumes 50 year operating period, averaging PATH throughput of 1.5 million TEUs per year.

Figure A: Summary of Sarita Bay South Option A Economic Impact ⁽¹⁾

Construction Phase Impact (2)	
Total cost of construction (including contingency)	\$1.63 billion
GDP impact	\$1,282 million
Jobs impact	13,229
Tax impact	\$134 million
Operations Phase Impacts (3)	
Annual operating expense	\$271 million
Annual GDP impact	\$401 million
Annual Jobs impact	5,497
Annual Tax impact	\$30.1 million
Cumulative Impacts (4)	
GDP impact	\$21,332 million
Jobs impact	288,079
Tax impact	\$1,639 million
<p>(1) Impacts shown are for Canada as a whole, and are the total of direct, indirect and induced effects. Jobs impacts are full-time equivalent, full year jobs and thus equal to person-years of employment. Tax impacts include taxes on production and on products but not on incomes. Dollar figures are 2006 values reflecting the current version of Statistics Canada's Interprovincial Input-Output (I-O) Model.</p> <p>(2) Construction costs and impacts are totals relating to the entire construction period.</p> <p>(3) Operating expense and impacts relate to a single year in the operating life of the project.</p> <p>(4) Cumulative impacts are the sum of the impacts for the construction period and the entire 50 year operating life of the project.</p>	

Other Benefits of the PATH Project

Other benefits of the PATH project, relating to changes in congestion and traffic patterns could be in the order of **\$74.6 million per year**, or over \$30 per TEU.

Figure B: Estimated Value of Traffic-Related Benefits

Description of benefits	Value per Year (\$)	Value per TEU (\$)
Time Saved by Commuters	6,000,000	2.50
Fuel Saved by Commuters	370,000	0.15
Social Cost of Emissions by Commuters	67,500	0.03
Commercial Savings for Drayage	67,100,00	27.96
Social Cost of Drayage Emissions	1,100,000	0.46
Total	74,637,500	31.1

Source: CPCS estimates. Based on traffic generated by T2, with container volumes estimated at 2.4M TEU per year.

In addition to these savings, other potential benefits include:

- The lower cost of the PATH project relative to the T2 expansion which is expected to be over \$2 billion.
- Infrastructure and operating savings transferred to shippers or other supply chain stakeholders, which could increase their competitiveness, that of the region and the Asia Pacific Gateway and Corridor more broadly.
- Better utilization of existing assets in the BC Lower Mainland, including development of terminal capacity along the Fraser River.
- Potential for further economic development, both on Vancouver Island and along the Fraser River.
- Overall, the PATH project is a greener way to handle future container capacity constraints in the BC Lower Mainland and the Pacific North West.

Conclusions

The PATH concept is bold and could significantly alter container flows to and from PNW ports and terminals. It also has the potential to generate significant economic impacts and other benefits.

The market potential of the PATH project – which underlies the project’s feasibility - would likely be tied to a push by a major shipping line or shipping line alliance for a market share grab, by deploying larger ships and offering lower container slot costs for the PNW trade. Our consultations have suggested that this could be possible, and shipping lines are not closed to this possibility, though this scenario is largely contingent on the ability of the PATH concept to deliver handling cost savings, relative to competing PNW ports, which translate into lower overall transportation costs for shippers.

The commercial feasibility of the PATH project is conditional on minimal traffic guarantees, in one form or another, from one or more shipping lines. PAPA would have to get a firm commitment from one or more shipping lines to bring ships to the PATH, over a sufficiently long period to recover the project’s costs. Having the shipping line invest in the terminal, alongside other partners (operational or financial) would also help secure traffic.

1 Introduction

1.1 Background

The Port Alberni Port Authority (PAPA) has identified an opportunity to develop a container trans-shipment hub to serve markets on the Canadian West Coast, including along the Fraser River, along the North West United States, and further inland, including potentially the US Mid-West. The project, referred to as the Port Alberni Trans-Shipment Hub (PATH), is premised on a hub-and-spoke container trans-shipment operation concept.

CPCS is one of several consultants that have been retained to help assess the feasibility of the project, and its requirements to succeed.

1.2 Objectives

The objective of the CPCS component of the work is to assess the commercial and economic feasibility of the PATH project, including the potential market that could be served, the related cost advantage of routing cargo via PATH vis-à-vis the status quo, and the economic impacts and other public benefits of the project.

This feasibility study is intended to provide an independent assessment of the noted opportunity and guidance to PAPA on if and how to move forward with the PATH project.

1.3 Project Structure & Scope

This feasibility study, as defined in the Terms of Reference, is broken down into two parts. Part A addresses the potential market and related strategic and commercial considerations. Part B addresses technical considerations relating to the development of infrastructure, equipment, and operations.

The CPCS component of this work relates largely to Part A of the project, and the following three project phases, specifically:

- 2. Examination of strategic & business requirements
- 6. Cost and logistics modeling for container delivery
- 11. Economic impacts

This report is the output of the CPCS component of the project, covering the phases above.

1.4 Methodology

Phase 2: Examination of Strategic & Business Requirements

The strategic and business requirements component of this report was developed from the team's experience and knowledge of trans-shipment operations, in addition to documented research on latest trends, ship size evolution and their impact on port terminals.

Market data and other information were also obtained from public sources. Full references have been included, where appropriate.

Background interviews were also conducted with the other experts on the PAPA project team, including Zoran Knezevic, the CEO of PAPA, Harold Westerman of HATCH, who is conducting the technical engineering studies, and Al Flotre, an independent barge operations expert. Other meetings were held with other Canadian Port Authority executives to obtain additional information and input, on a confidential basis.

Interviews were also conducted with executives from the Canadian subsidiary of the largest shipping lines serving the Canadian West Coast, in order to get their impressions of the project, the key factors that would determine their interest in using PATH, and how such a project could play a role in their strategic development plans. Consultations were also undertaken with terminal operators on the Canadian West Coast.

Traffic Forecasts

Traffic forecasts are based on the assumption that PATH can secure a weekly ultra-large container ship (ULCS) service by a major shipping line, or an alliance of shipping lines, starting in 2022, when the PATH facility would be in operation.

Based on the assumption that a weekly ULCS service can be secured,³ CPCS developed assumptions on the characteristics of the service that would serve the PATH facility. This typical service was then used to estimate initial traffic at PATH in the first five years of the facility's operations.

In the longer-term, regional market growth consistent with forecasts prepared for the Port of Vancouver were assumed for PATH. The impact of the PATH facility on the regional market was also estimated based on these forecasts.

Phase 6: Cost and Logistics Modeling for Container Delivery

Based on the market and service configuration options developed in phase 2, CPCS developed alternative transportation routing scenarios. Drawing on economic literature of the

³ CPCS does not comment on likelihood that such a commitment could be secured, nor does it have sufficient information to do so.

advantages of the potential advantages of trans-shipment operation, potential logistics cost advantages of the PATH project were then assessed on the basis of:

- Mainline vessel deviation costs
- Feeder service and inland costs
- Container handling changes

Cost and transportation data was obtained from a number of sources, which have been referenced as appropriate. The team also made a number of assumptions and estimations where data was lacking, which have also been documented.

The team then developed a cost model to assess the potential logistics cost advantage of PATH relative to the status quo.

Phase 11: Economic Impacts

The approach taken to estimate the economic impact of the PATH project has been to make use of Statistics Canada's Interprovincial Input-Output (I-O) model.⁴ The related methodology is further described in section 7.1.

1.5 Limitations

This report does not on its own constitute a full analysis of the PATH project's feasibility. Its scope is limited to an assessment of the strategic and business requirements for the project's success, the potential market that could be served, as well as the potential logistics cost advantages of the PATH concept relative to the status quo. This is only one dimension of what will inform the overall feasibility of the PATH project. Other technical and capital cost considerations, among others, are being assessed separately by other consultants.

Data and information used in this report include inputs from confidential sources, or from stakeholders that did not wish to be quoted. No references or attributions have been used where this is the case.

Unless otherwise stated, the opinions provided herein are those of CPCS and they do not necessarily reflect the views of PAPA or others involved in the broader PATH feasibility study.

⁴ See Statistics Canada product main page at <http://www.statcan.gc.ca/bsolc/olc-cel/olc-cel?catno=15F0009XDB&lang=eng>.

2

Port Alberni Trans-shipment Hub (PATH)

2.1 The Concept

The global container shipping industry has seen the emergence of massive trans-shipment hub ports at a variety of locales around the world, serving smaller regional “feeder” ports.⁵

The Port Alberni Trans-Shipment Hub (PATH) project is premised on a hub-and-spoke trans-shipment concept. Under a hub-and-spoke container transport arrangement, containers are transported to a central “hub” facility, then onwards to interacting nodes via a network of “spokes” and vice versa. Under this concept, containers are generally fully unloaded/loaded at the trans-shipment terminal, though the ship could also go on to serve other facilities elsewhere.

The PATH project envisages high efficiency and low cost automated container trans-shipment operations at Port Alberni (hub) to serve containers moving primarily between Asia and markets along the Canadian West Coast, the US Pacific North West (PNW) and potentially further inland.

Inbound containers arriving at PATH would be loaded onto barges or smaller vessels (spokes) for onward transportation to coastal ports and river terminals that provide connections to end markets. Outbound containers would conversely move from coastal ports and river terminals to PATH for onward shipping, primarily to Asia.

PATH Concept

According to documentation obtained from the Port Alberni Port Authority, the PATH concept would be a terminal of 400 acres with an annual capacity of 3.5 million TEUs. Inland markets would primarily be served by barge via inner harbours and river terminals along British Columbia’s Lower Mainland. Other regional and inland markets could also be served by PATH.⁶

⁵ CPCS, Hub and Spoke Container Trans-shipment Operations for the Marine Movement of Freight, Dec 2008

⁶ Presentation, Port Alberni, BC, “Canada Stats Here” (not dated)

Figure 2-1: PATH Concept



Source: Port Alberni Port Authority

2.2 Rationale for PATH Project

The PATH project is premised on the potential to improve the efficiency of trans-pacific trade, lowering transport costs for shipping lines and shippers, and mitigating congestion and other negative externalities relating to transportation pressures in British Columbia's (BC's) Lower Mainland. It can also be viewed as a potentially lower cost option to investing in new container terminal capacity in BC's Lower Mainland (at Robert's Bank Terminal 2 (T2)), or as a longer term option for increasing the capacity of the Asia-Pacific Gateway and Corridor, beyond the development of new capacity in BC's Lower Mainland.

In general, trans-shipment hub port operations are premised on: the capacity to receive larger ships and treat them efficiently, and the capacity to limit the deviation of these ships and thus minimize shipping line operational costs.

The global trend in global shipping is a move to ever larger container ships, capable of realizing greater economies of scale and reducing container slot costs.

Global Trend Increasing Size of Container Ships

Traffic growth and competitive pressure has been driving continuous growth in ship size over the last decade. This trend is continuing relentlessly, with Maersk having taken delivery of four of its 20 “Triple-E” class ships with a capacity exceeding 18,000 TEUs. China Shipping Container Lines Co. (CSCL) and United Arab Shipping Company (UASC) have also placed an order for 11 ships of similar capacity, with delivery expected in 2014-15.

The “Triple-E”-class ships have a beam of 59 meters and a length of 400 meters, challenging the height and the reach of cranes in existing terminals on the West Coast. Their capacity also requires at least six to seven cranes to load and unload containers. New crane designs push the beam over 60 meters.

Meanwhile, shipbuilding experts are expecting even larger ships, reaching 22,000 to 24,000 TEU, to begin sailing around 2018.

Not all container ports can accommodate these larger ships, due to physical constraints - lack of adequate water draft (depth), berth length, or in some cases air draft (clearance under bridges) – or due to equipment constraints - insufficient crane reach capabilities.

It is expected that natural and physical characteristics (water draft, air draft, etc.) will create natural competitive advantages for ports that can accommodate ULCSs, and disadvantages for ports that can't.

PATH is expected to be able to accommodate ULCSs.

Competing ports in the PNW, including Vancouver, Seattle and Tacoma, are also expected to be able to handle large ships, including 18,000 TEUs ships in the future, but would for the most part require further investment in equipment to do so. All three of these competing PNW ports have terminal depth above 15m,⁷ and available dock length of 400m (sufficient to accommodate ULCSs). They all have three cranes with the capacity to reach at least 22 containers wide. At Seattle, SSS Marine has cranes capable of reaching 24 containers wide⁸. Tacoma has recently received a ship over 10,000 TEUs from ZIM. Cranes at the ports of Vancouver, Seattle and Tacoma do not all have sufficient crane reach capacity to serve much

⁷ Effective draught for 14,500 TEUs vessels on the transpacific container trade in 2013 was 14.9 meters. See OSC's report “Port Metro Vancouver Container Forecasts” July 2013.

<http://www.robertsbankterminal2.com/information-centre/project-documents/>

⁸ See <http://www.ssamarine.com/07252012.html>

larger ships at present (e.g. an 18,000 TEU ship has a width that can accommodate 23 rows of containers). It could be expected that these ports can and will likely make investments in cranes with greater reach capacity over the next ten years as ULCS are deployed on trans-pacific trades.

In short, in the longer term, PATH is not expected to have a relative advantage in the size of ships that it could receive, though it could be an early mover in its ability to receive ULCSs.

The automation of terminal activities at PATH could potentially provide a productivity and efficiency advantage, and help attract ULCSs.

Automation of terminal activities, as contemplated at PATH, can lead to significant productivity, efficiency and associated cost advantages relative to non-automated terminals. This could also provide PATH with a relative advantage in receiving ULCS, specifically. Indeed, lower productivity at PNW terminals has been seen as one of the main reasons why ULCS deployment has largely focused on the Asia-Europe trade route so far rather than trans-pacific service.⁹

An automated terminal at PATH has the potential to be an important competitive differentiator relative to existing PNW terminals, particularly if PATH is a first mover in the introduction of automated handling in the PNW.

Figure 2-2: PATH Concept Automated Terminal Handling Equipment



Source: Port Alberni Port Authority

⁹ See “Are the terminals ready for ULCVs – indeed they are!” in DNV’s *Container Ship Update*, 01-2013

Port Alberni is closer to Asia compared to Vancouver, Seattle and Tacoma, which could lead to lower ocean transits and vessel deviations.

The PATH concept could allow an efficient in and out to ships in a single call (full unload/load), avoiding the deviations and navigation time between ports to load and unload, and allowing the ship to quickly make the trip back and forth to and from Asia.

Reduced deviation, alongside with a potential reduction in the number of port calls, could yield the following potential benefits:

- Efficient operations at the terminal, increasing ship turnaround time.
- Reduced ship travel time, reducing ship operational costs, pilotage and tug costs, as well as increasing ship utilization.
- Depending on the number of ports served in Asia, the use of a single hub on the Pacific North West Coast could allow the shipping line to provide a weekly service while using fewer ships. The shipping line could also go on to serve PSW ports.
- Potential for a reduction in handling costs, including feeder costs.

While the first three accrue directly to the shipping line and for which the importance critically depends on the operational strategy of the operator, the fourth is a supply chain saving that can benefit shippers.

The PATH concept could also enable a number of benefits associated with feeder services for inland distribution.

Feeder-type barge or short sea shipping (SSS) services for distribution to/from hub ports exist across the globe, with many associated with large ports whose operations are not focused solely on trans-shipment. Examples include the “classic” hub & spoke network, such as the Port of Hamburg, which serves as a hub for traffic destined to the Baltic (as well as a gateway to mainland Europe). Another configuration is the “pure” transshipment hub, such as Gioia Tauro in Italy, which has a transshipment incidence of over 95 percent with little or no gateway (immediate inland market) business.

When feeder services are an alternative to land transport, these can allow for lower per unit transportation costs, reduced land transportation congestion and lower environmental emissions. In the context of the PATH project, these benefits could be more limited given that Port Alberni is not connected by land transport to markets on the mainland. Nevertheless, the feeder barge and/or SSS operations serving PATH could spread container handling capacity,

and promote some of these benefits, particularly in moving containers to terminals along the Fraser River and avoiding or reducing some truck transportation (drayage) in the BC Lower Mainland. This could in turn go some way in mitigating negative externalities associated with congestion in the region.

PATH could help reduce hinterland congestion, particularly by avoiding, reducing and spreading truck transportation (drayage) in the BC Lower Mainland.

An additional benefit of the PATH concept is that it could help increase the overall resiliency of the Asia-Pacific Gateway and Corridor, by providing an additional facility capable of handling containers. This added capacity could provide a means of mitigating negative impacts relating to major disruptions at specific points within the Port of Vancouver.

Other Potential Opportunities

Other longer term value-added opportunities at Port Alberni could include developing container stuffing/de-stuffing and trans-loading operations (e.g. loading content of 40' marine containers into 53' domestic containers and vice versa), as well as other value-added logistics activity (sorting, packaging, labelling, etc.), consolidating and containerizing scrap material for export, etc.

The PATH concept is not without risks and challenges. Use of trans-shipment facilities can be discretionary and volatile, for lack of an immediate significant anchor market. The use of a container trans-shipment facility could also lead to increased cargo risks, transit times, and in some cases higher costs resulting from additional handling. These risks and challenges would need to be addressed or mitigated in the PATH operating plan.

3

PATH Potential Market

3.1 PATH Market: Pacific North West

The markets for a trans-shipment facility at Port-Alberni would likely be focused on those currently served by Pacific Northwest (PNW) ports.

This market is fragmented, with a large number of shipping lines and even more routes operating to these ports. More than a dozen large international shipping lines operate trans-Pacific routes that serve PNW and Pacific Southwest (PSW) markets, combined or separately. These include APL, MOL, OOCL (New World Alliance, G6), Hapag-Lloyd, Hyundai, NYK (Grand Alliance, G6), CMA-CGM, Maersk, MSC (P3 Alliance, if approved), Zim, “K” Line, Cosco and Hamburg Sud.

PNW strings call predominantly in Vancouver, Seattle, Tacoma and/or Prince Rupert. PSW strings mostly serve Oakland and Los Angeles-Long Beach. Appendix A lists all regular shipping line services to the PNW.

A significant number of shipping lines have rotations which include ports both in the PNW and the PSW. Some services, including those offered by members of the G6 Alliance, include PNW as well as PSW and transatlantic (PAX) services because of the strong export potential of PNW ports. Rotations including Prince Rupert also often include PSW ports (e.g. COSCO’s HPNW or K-Line’s CALCO-Q).

In either case (separate or combined PNW/PSW routes); PATH could be positioned to serve as a single port of call for the PNW region, with a predominant coverage that would include Vancouver (BC), Seattle (WA), Tacoma (WA), Portland (OR) and Everett (WA).

CMA-CGM and Maersk operate only one service out of Asia to PSW (TP9/Colombus). This string uses 17 ships of 8,500-TEU capacity¹⁰. Other shipping lines, including the G6 Alliance, generally offer at least two services, but with generally smaller ships. One exception is Hamburg Sud, which offers a service very similar to that of CMA-CGM/Maersk.

There are no regularly scheduled ULCS ships serving the PNW at present, though this is expected to change in the coming years.

¹⁰ This service is actually part of a pendulum that proceeds from Asia to the USEC through the Suez Canal, this section of the service being called TP11/Empire/Columbus Suez

3.2 Size of Container Market

Volumes currently using the ports of Vancouver, Seattle, Tacoma, Portland and Everett are suggested as being the most likely to represent the target market for PATH.

The total number of containers transiting through these PNW ports in 2012 was slightly about 6.5M TEUs, with a growth rate of 4% over 2011.

Prince Rupert Traffic Excluded from PATH Potential Market

The traffic currently moving via the Port of Prince Rupert (over 500,000 TEUs in 2013) is largely destined to/from inland markets including Chicago by rail. Prince Rupert has a distinct positioning based on a shorter navigation time across the Pacific and a very efficient rail access. An alternative routing through Port-Alberni is less likely and Prince Rupert traffic has not been included here, but PATH could potentially attract price-sensitive shippers if slot costs and handling costs provide a sufficient cost advantage.

Figure 3-1: Pacific NW Ports Container Troughput, TEUs (2011-12)*

Port	2012	2011
Port Metro Vancouver (BC)	2,713,160	2,507,032
Seattle (WA)	1,869,492	2,033,535
Tacoma (WA)	1,711,134	1,485,617
Portland (OR)	183,202	197,446
Everett (WA)	15,803	20,918
Pacific Northwest Total	6,492,791	6,244,548

Source: AAPA NAFTA Region Container Traffic

*2013 traffic data not yet available for all PNW ports.

Much of the inbound traffic moving via these PNW ports is destined to inland markets. For example, of the container imports arriving at the Port of Vancouver, over 60% is destined for Eastern or Central Canada (42%) and the US (20%). The picture is somewhat different for container exports via Vancouver: only about 25% of container exports originate in inland markets.¹¹

PATH well Positioned to Serve Vancouver Island Market

PATH would be very well positioned to serve the Vancouver Island market for inbound and outbound containers. Vancouver Island has a population of over 750,000 and growing. This consumer base creates a demand for containerized products. Currently, containers destined to/from Vancouver Island move via existing Port of Vancouver container terminal facilities. PATH could more efficiently serve the Vancouver Island market given its relative proximity and direct land connection.

¹¹ Ocean Shipping Consultants, Port Metro Vancouver Container Forecasts, July 2013

In addition, a share of bulk and break-bulk cargo moving to/from Vancouver Island could potentially be containerized, which could increase the market that could be served by PATH. In 2011 (the latest year for which Statistics Canada's Shipping in Canada database is available), Vancouver Island imported 376,000 tonnes of cargo, exported 2.6 million tonnes of cargo and handled close to another 1 million tonnes of domestic cargo. The share of this traffic destined to/from Asia and other distant markets (e.g. wood products destined to Asia) could potentially be containerized, though the total volume of related TEUs is not yet clear. The Port Alberni Port Authority believes that the Vancouver Island market for containers could be 500,000 TEUs per year, if adequate container facilities and operations were available.

In addition to international container trades, US domestic traffic currently moving to and from Alaska by barge through Seattle could be captured. These volumes are reflected in the table above in the Seattle traffic. Container traffic in Anchorage in 2012 was 454,777 TEUs. Being geographically closer to Anchorage, PATH would be well-positioned to handle trans-shipped traffic between Alaska and Asia.

Markets Further Afield

In order to increase the potential market, PATH could extend its coverage to Oakland CA. Traffic in Oakland was 2.3 M TEUs in 2012, basically stable compared to 2011. For PATH to capture traffic going to Oakland, it would need to convince shipping lines to decouple Oakland from PSW services, or skip Oakland on combined PNW/PSW strings and only stop in LA-Long Beach. Carriers might be willing to consider such an option if the service from PATH to Oakland is competitive and reliable. For the purposes of this feasibility study, we have assumed that the PATH would not serve Oakland given its distance from Port Alberni.

Overall PNW container market is expected to maintain a healthy growth rate of 5.5% in the coming years, driven by continued growing trade with Asia.

The Pacific Gateway, in Canada, will perform particularly well, driven by economic growth in Western Canada and a balanced trade supported by commodity exports. Overall, container traffic is expected to grow at an average rate of 5.5% per year between 2012 and 2025.¹²

With close to 6.5 million TEUs handled in 2012, PNW ports already represent a modest market at today's level. Expected growth in the coming years could bring this trade to over 8 million TEUs by 2016, or more than 9 million including expected traffic via Prince Rupert.

3.3 PNW Market Growth Implications

Market growth through PNW ports will have a number of implications, including increasing ship sizes serving the PNW and capacity constraints at existing port facilities.

3.3.1 Increasing Ship Sizes

Future growth in the PNW market will no doubt gradually increase the ship size on the PNW routes. Both shipping line executives and international shipping experts forecast 14,000 TEU ships will be used within the next few years and 18,000 TEU ships should enter this market by 2021¹³. This is unlikely to create a distinct market advantage for PATH, however, since other PNW ports are also likely to be able to accommodate these ULCS by the time these larger ships are deployed.

In any case, given the fragmented nature of the market serving the PNW, with many shipping lines and strings (Appendix A), the introduction of much larger ships may take time. In order to offer a service using 14,000 or 18,000 TEUs ships, one of the large alliances would likely need a significant market share increase, and/or to combine multiple services, using larger ships.

Shipping line cooperation has increased significantly following the 2008-2009 financial crisis. Facing overcapacity issues, declining traffic and bankruptcy fears, shipping lines have shown an unprecedented willingness to cooperate in order to fill their ships and allow rates to recover. The trend for further vessel sharing and consolidation is shown by the latest alliances, most notably the P3 network proposed by Maersk, MSC and CMA-CGM.

¹² See "Port Metro Vancouver Container Forecasts, #P120330-10 Final Updated Report", July 2013. Prepared for Vancouver Fraser Port Authority by: Ocean Shipping Consultants. Available online at <http://www.robertsbankterminal2.com/information-centre/project-documents/>

¹³ CPCS consultations, and DNV's *Container Ship Update*, 01-2013

PATH Opportunity: An Alliance Pushing to Grab Market Share

One of the alliances currently serving PNW could introduce a ULCS-based string, upgrading an existing service or consolidating separate services. It would use the efficiency gained from lower slot costs, higher productivity at PATH and reduced vessel deviation to lower rates in order to grab market share. This shipping line alliance could be interested in investing in PATH to make it almost a dedicated facility, in order to maximize productivity. Dedicated facilities are generally able to achieve higher productivity than common-user terminals, since ship scheduling is more tightly controlled, though the recent trend is away from dedicated facilities.

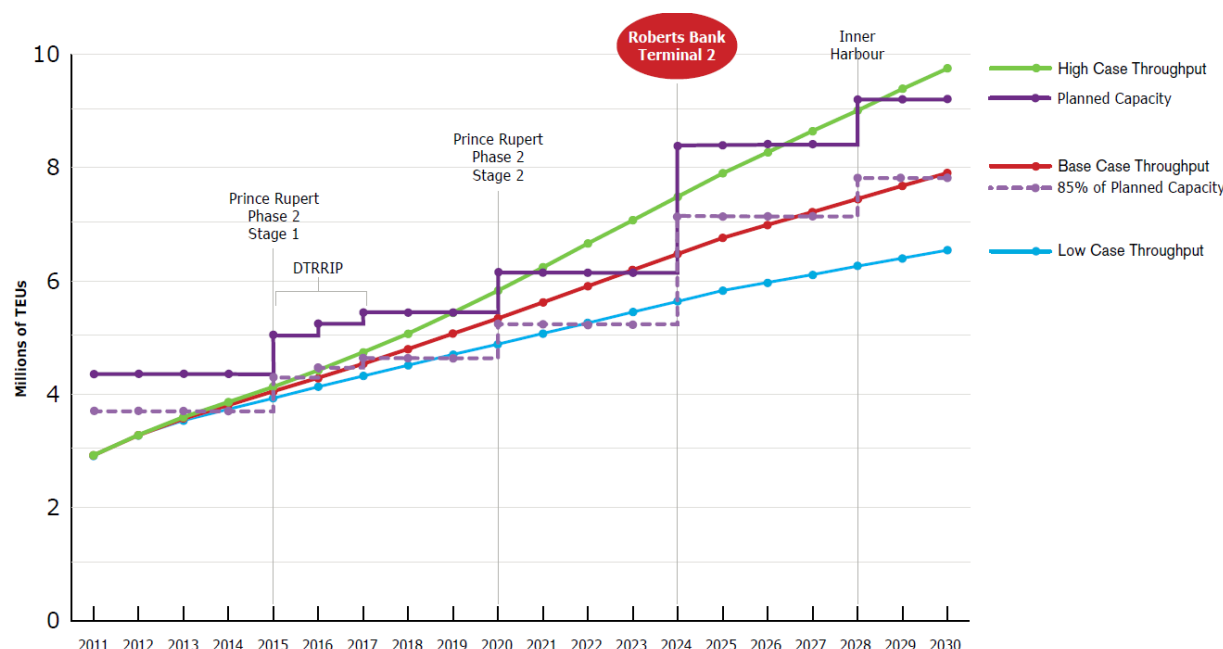
In such a scenario, the shipping line alliance may even consider operating the feeder network. Efficient feeder networks can commonly be found in Asia, Europe and even Africa, and shipping lines will often operate these vessels in order to secure the traffic filling their main service. In the case of a greenfield port such as PATH, the feeder network would have to be initiated from scratch, a situation that could persuade the alliance to actually start-up the service itself.

3.3.2 Pacific Gateway Capacity Constraints

Growth in container traffic in Vancouver is about to reach the total handling capacity of the port (approximately 3.1 million TEUs of operational capacity). Port Metro Vancouver (PMV) and its tenant terminals have been planning various capacity increase projects to accommodate growth in the short and medium term, such as the Deltaport Terminal Road and Rail Improvement Project.

But these efforts are likely not sufficient, as projected container traffic for the Pacific Gateway, based on a study commissioned by PMV, is expected to reach 7.5 million TEUs in 2030 under the base case, up from a little over 3 million TEUs today.

Figure 3-2: West Coast –Forecast and Planning Capacity Increases



Source: Port Metro Vancouver, consultation documents for Roberts Bank Terminal 2 project

Prince Rupert has a current capacity of 560,000 TEUs but also has capacity increase potential, with a two-phase approach that can bring the port to a capacity of 2M TEUs by 2020. But even considering these expansion projects, projected traffic growth in the Pacific Gateway still requires a longer term capacity increase.

This would be provided with PMV's Roberts Bank Terminal 2 project (T2). Under current traffic projections, T2 would be required in 2024. T2 is a three-berth terminal that could handle 2.4M TEUs, meeting capacity needs until 2030. PMV has begun consultations, but has not disclosed the total cost of the project. One concern is the potential hinterland impacts caused by traffic moving via T2, given existing congestion and land capacity constraints in the BC Lower Mainland.

Moreover, the introduction of ULCS into PNW services could create challenges for existing terminals and intermodal capacity on the roadways leading in and out of ports and rail service at ports. The PATH project could potentially mitigate this impact by spreading capacity with the use of short sea and feeder services to coastal ports.

In this context, PATH could be an alternative to T2, if cheaper to build¹⁴, or potentially an additional source of capacity in the longer term if growth exceeds expectations and outstrips new capacity on the mainland.

US PNW Port Capacity Expansion

Seattle and Tacoma also have capacity increase projects and potential for expansion, and they could offer an alternative to Canadian Pacific Gateway ports, but likely only to a limited extent. Container routing costs to the Midwest or East Coast markets are more competitive in Pacific Gateway ports than US PNW or PSW ports due to shorter sailing time (compared to PSW), better productivity and lower rail costs. In addition, US and Canadian markets have always shown a relatively low level of permeability, mainly due to customs issues, as well as organizational barriers within shipping lines. US PNW cargo remains predominantly routed through US PNW ports, and Canadian PNW cargo through Canadian PNW ports.

¹⁴ The total PATH capital costs will be developed by a separate consultant as part of the PATH Feasibility Study.

4

Traffic Forecasts

4.1 Key Assumptions

Any forecast for a project such as this are, by nature, highly speculative. It is thus particularly important to set out the assumptions driving the forecasts.

The market feasibility of the PATH project, as proposed, relies on the commitment of at least one large shipping line, or an alliance of shipping lines.¹⁵ Without this, it would be very difficult to justify the project on commercial terms.

For the purpose of the forecasts, we have assumed that one shipping line commits a weekly ULCS service to PATH.

In order to maximize returns and grab market share, it is safe to assume that the shipping line that uses PATH would use larger ships (in the 14,000 to 18,000 TEUs range) and will do a full load-unload cycle at PATH to maximize ship utilization. The first year of traffic in Port Alberni is assumed to be 2022, or after the project facilities are built.

Of course, different services scenarios are possible – including a combined PNW-PSW service, or services by more, smaller ships. For simplicity, the forecast herein assumes a single weekly ULCS service.

In order to contextualize the traffic forecast, we rely on the forecasts prepared by OSC for Port Metro Vancouver.¹⁶ These forecasts, which were prepared for PMV and regional planning purposes, are assumed to be reasonable.

¹⁵ We do not comment on the likelihood of such a commitment (which is contingent on a number of factors including potential cost savings of routing traffic via PATH, a shipping line's aggressive market share grab strategy, among other factors).

¹⁶ See OSC's report "Port Metro Vancouver Container Forecasts" July 2013.
<http://www.robertsbankterminal2.com/information-centre/project-documents/>

4.2 Port Alberni Traffic Forecast

4.2.1 Detailed Assumptions

As it generally the case with new facilities and new services, the new shipping line rotation is unlikely to reach full ship capacity utilization in its first year. Given the risks associated with the Port Alberni model, and in particular the short-sea shipping portion, some shippers may prefer to stay on the sidelines initially to assess how the service is performing.

Hence, we assume the service would first be serviced by a 14,000 TEU ship and initial ramp up period. We consider a three-year ramp-up period, during which the rotation rapidly increased from an average of 60% ship utilization to 90% ship utilization, a 15% point increase year-over-year. In the fourth year, the ship would reach 95% capacity utilization. In the fifth year, a larger ship (18,000 TEU) would be introduced. Traffic would then jump to 85% of the new ship's capacity. Traffic at Port Alberni would then continue to grow along with regional container growth. The structure of the service would likely change in future years, with a second weekly rotation introduced, but that would either be spread across smaller ships, or reflect traffic coming from partial unload/load at Port Alberni from services also serving the PSW.

The possibility for additional shipping lines opting for Port Alberni is possible, but given the likely competition in the region we consider that a single shipping line scenario in the first five-years is most likely.

4.2.2 Results and Context

Figure 4-1 present the traffic forecast for PATH.

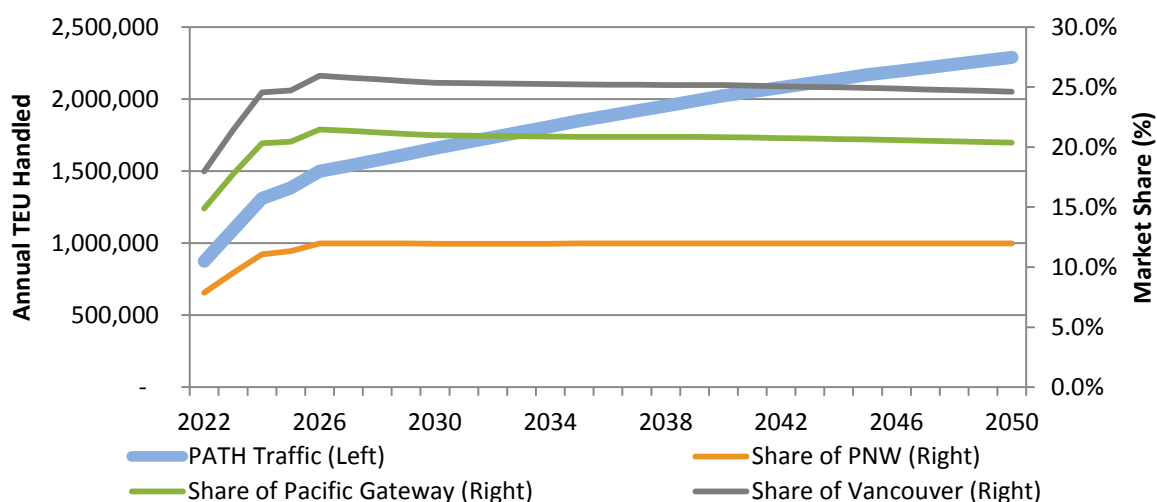
Based on the scenario presented, about 874,000 TEUs would be handled at PATH in the first year of operation.

Of course, half would be unloaded and half loaded. This reflects the 60% ship utilization for a weekly service with a 14,000 TEUs ship capacity.

These volumes increase significantly in the first five years, reaching about 1.5 million TEUs in 2026.

They then follow the PNW market growth rate, which is 2.6% annually to 2030, then 2.2% annually to 2035, 1.8% to 2040, 1.4% to 2045 and 1.1% to 2050.

Figure 4-1: PATH Container Traffic Forecast and Market Share, 2022-2050



Source: CPCS Analysis and OSC's Forecasts.

While these volumes may appear significant at first glance, they should be interpreted in the context PNW traffic forecasts. Indeed, in 2022 are forecasted to handle 11.1 million TEUs. Hence, the share of PATH in the first year is less than 8% of that market.

At maturity, PATH would handle 12% of the PNW market.

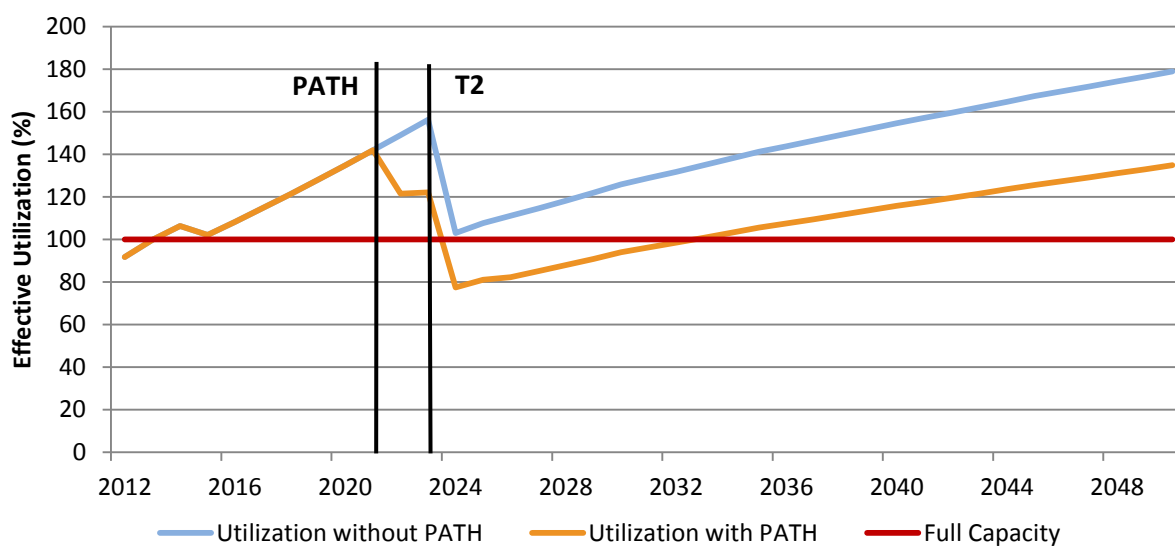
For Canada's Pacific Gateway, PATH would handle 21.5% of forecasted TEUs in 2026, and 25.9% of the Port of Vancouver's projected traffic. These shares would diminish over time since Canadian ports are expected to experience higher growth than the region as a whole.

All these estimates do not account for the fact that containers would nonetheless need to be handled at mainland facilities. This would effectively increase the number of TEUs handled in the region. In other words, PATH would not reduce Port of Vancouver's traffic, but would rather modify the Port of Vancouver's operations. They do, however, provide an estimate of the magnitude of the market that would potentially be captured by PATH and its proponents.

4.2.3 Impact on Gateway Capacity

If PATH were to effectively ship containers inland by by-passing major container terminals currently in operation in Vancouver, it would effectively increase the capacity of the Pacific Gateway. Figure 4-2 displays the future capacity shortfall in Vancouver as documented by OSC (including T2 in 2024), and the impact of PATH if all its volumes represented a decline in demand at Vancouver.

Figure 4-2: Impact of PATH on the Capacity Utilization of PMV, 2012-2050



Source: CPCS Analysis and OSC's Forecasts.

In the scenario presented, it appears that the PATH facility would be needed to alleviate the capacity shortfall in the longer term, assuming that there are limited new capacity expansion opportunities in the BC Lower Mainland.

Even with PATH, Pacific Gateway port container capacity falls short of market demand as early as 2033.

Moreover, since PATH is likely to relieve pressure on other ports (Seattle, Tacoma), capacity shortfall in Canada could occur even earlier.

Also of note, an additional benefit of the PATH concept is that it could help increase the overall resiliency of the Asia-Pacific Gateway and Corridor, by providing an additional facility capable of handling containers. This added capacity could provide a means of mitigating negative impacts relating to major disruptions at specific points within the Port of Vancouver.

5 Strategic and Business Requirements

Port-of-call decisions are made by shipping lines. To succeed, the PATH project will have to secure support and traffic commitment from one or more shipping lines. The strategic and business requirements of the PATH project should accordingly be oriented to satisfying the business requirements of shipping lines.

5.1 Shipping Line Requirements

The primary shipping line business requirements are outlined below, along with a discussion of how the PATH project could provide value to shipping lines. .

5.1.1 Ship Time Value

Most shipping lines currently have an oversupply of ship capacity to serve demand, and yet many lines are expected to take delivery of more ships in the coming year. Each new ULCS delivery displaces existing ships from the Asia-Europe route, where average ship size now exceeds 11,000 TEUs, according to Drewry. Smaller ships in the 8,000 TEU range are now cascading down to other routes, including the Pacific.

In such a context, ship time is not perceived as valuable, and the perspective of reducing days at sea is not a convincing argument in favour of a trans-shipment port. Indeed, many shipping lines have moved all their strings to slow steaming¹⁷ to make use of available capacity and lower fuel costs while maintaining frequency of service.

Nevertheless, the days at sea have a cost, including fuel consumption, ship operating costs, crew and supplies. The number of days saved using a trans-shipment port depends on the number of stops included in a string. Most PNW strings today can have 2 to 4 stops on the West Coast (Prince Rupert, Vancouver, Seattle and/or Tacoma), and making a single stop in a trans-shipment port such as PATH could potentially save 2 to 4 days at sea.

Eventually, as ULCS new builds are delivered and deployed on the Pacific routes, the value of days at sea will be perceived as more significant again, making the trans-shipment port proposition more attractive. This could play well for PATH.

¹⁷ While common speeds used to be 20-22 knots, ships can now super-slow steam down to 13 knots. As an illustration, the TP9/Columbus service operated by Maersk and CMA-CGM has been slowed twice, in 2012 and 2013, with the number of ships deployed going from 15 to 17.

5.1.2 Handling Costs

Shipping lines deploy ULCS to take advantage of their lower slot costs in order to capture market share from operators who use smaller, less efficient ships. They certainly would not want handling costs in a trans-shipment terminal to erode this advantage due to the additional move to a barge for delivery to/from the continent.

Shipping line executives have stressed that total handling costs to move a container through the PATH terminal should not be higher than the existing routing.

Handling cost savings at PATH would have to be greater than the incremental cost associated with additional handling and feeder services to coastal ports.

5.1.3 Additional Risks in the Supply Chain

In fact, the additional move implied in a trans-shipment terminal brings additional risk into the supply chain. This could bring disruptions, reduce reliability or lengthen cycle times. It also requires additional insurance to cover the cargo during this additional leg. Handling costs should therefore be lower in the PATH to compensate shipping lines and cargo owners for the additional risk.

While total transit cost is a key decision factor for a majority of shippers, other considerations will influence their routing decisions. For high-value cargo, the delivery time will have an impact on total transit cost because of the working capital required while the cargo is in transit. For just-in-time (JIT) production systems, reliability of delivery is more important than the actual transit time. Some shippers will include these factors in their contracts, with penalties for the carrier if the parameters are not met. In case of repeated misses, the shipper will switch providers. The additional risks implied in adding a move in the supply chain can therefore translate in additional costs (penalties) or revenue losses (losing the business) for the carrier, but also production downtime or incremental capital costs for the shipper.

Control and Liability for Cargo on Feeder Services

The trans-shipment model introduces added complications with respect to issues of cargo control and liability. Specifically, who bears the risk and associated liability for the movement of the container on the feeder service between PATH and coastal ports? This would to some extent depend on whether feeder services are operated by the ocean shipping lines as part of an integrated service, or contracted to independent barge service providers. This issue is not irreconcilable – indeed, shipping lines use hub-and-spoke trans-shipment facilities elsewhere globally - but this creates another layer of complexity for the PATH operating concept, which will need to be addressed. Certainly, the feeder model should seek to mitigate the introduction of new risks for cargo owners relative to the status quo.

5.1.4 Ship Utilization and Routing

The slot cost advantage of a ULCS quickly vanishes if the ship is not full. Traffic projections for the Pacific Gateway are showing healthy growth, but is the PNW market sufficient to regularly fill these ships? Would the route include stops in the PATH, and then Oakland and/or LA-Long Beach? Current routings by most shipping lines, as well as the proposed P3 Network presented by the new Maersk-CMA CGM-MSK alliance, indicate that PNW and PSW are often served separately. The P3 network includes a single weekly service to Vancouver and Seattle, connecting to 7 ports in Japan, Korea, China and Malaysia. The extent to which the market potential for PATH is sufficient is largely predicated on a push by a major shipping line or shipping line alliance for a market share grab – by deploying larger ships and offering lower container slot costs for PNW trades to capture new traffic.

5.1.5 Cargo Transit Time

The additional move from the trans-shipment terminal to the coast should not increase cargo transit time. Shipping lines will favor ports that are able to move containers and hand them off efficiently to the next intermodal leg (rail or truck).

With congestion in the system at PMV, it can take up to a week to get the containers out of Vancouver according to shipping line executives consulted.¹⁸ PATH must be able to take advantage of this transit time weakness and propose a system that can reliably deliver rapid transit times. It can potentially do this by serving other, less congested facilities along the Fraser River by barge or smaller ship.

5.1.6 Ultra Large Container Ship Deployment Opportunity

Some industry observers consider that shipping lines are still hesitant to deploy ULCS ships on the Pacific due to the insufficient productivity in US West Coast ports and their inability to set up automated terminals because of longshoremen union resistance.

The PATH would therefore represent an opportunity for such a deployment by answering their needs in the more favorable Canadian context.

One shipping line executive consulted for this study bluntly admitted he was hoping ULCSs would not find their way onto the Pacific anytime soon, too aware that his company was already running behind in the global ship size race.

¹⁸ Average container port dwell time in Vancouver are 2.5-3 days, but shipping lines look at the total time to leave the gateway, including rail yard dwell times or truck gate and road congestion delays.

5.2 Aligning PATH Concept with Strategic and Business Requirements

PATH service configuration options should align with the strategic and business requirements. This section outlines some key configuration parameters for PATH. These will be further developed by another consultant team advising PAPA on the technical feasibility and design of the PATH concept.

5.2.1 Berth Infrastructure and Laydown

The Maersk “Triple-E” ships have a length of 400 meters, but upcoming ULCSSs are expected to exceed 475 meters. In order to maximize berth utilization, the terminal should have the ability to berth at least two ULCSSs at the same time.

5.2.2 Automated Handling

In order to provide the required capacity and productivity to handle ULCSSs, Port-Alberni is proposing an automated terminal that would be able to provide a quick turnaround.

The increased productivity of automated facilities could be a major draw for shipping lines serving the PNW, particularly when contemplating deploying ULCSSs on these routes, which favour automated facilities.

There is resistance to automated facilities by port labour in North America, but there have been examples where automated facilities have been introduced – such as in Virginia (first in North America) and the TRAPAC container facility at the Port of Los Angeles (first on West Coast). Other PSW terminals are currently testing automated equipment. An automated terminal is also envisaged for T2 in Vancouver.

PATH could potentially be a first mover with automated handling in the PNW market to capture market share and attract ULCSSs.

5.2.3 Sufficient Equipment

Shipping lines will usually expect a ship to be unloaded in 24 hours. To unload ULCS ships within that timeframe, at least six or seven ship-to-shore gantry cranes are needed, given a typical productivity of approximately 35 moves per hour (35 boxes, 40’ or 20’. Actual TEU productivity will depend on mix). The PATH concept, as envisaged, would provide this level of equipment. Crane productivity should also reach 40 moves per hour, as seen in most Asian and European ports. Typically, cranes in US West Coast ports are known to only achieve 25-35 moves per hour.

5.2.4 Feeder Barge Service, Advantages and Capacity

Use of Feeder Barges vs. Short Sea Shipping Vessels

Barge handling from PATH to coastal ports has been considered the most likely option given a number of advantages. Barges will have lower operating costs, don't require pilotage and tugs to berth, and they provide maximum flexibility in terms of the terminals they can serve. A standardized barge fleet for PATH could even allow some level of automation in the barge loading process.

Newer ships that require smaller crews could approach barge operating costs, but they would still incur pilotage and tug costs, and they would not offer as much flexibility.

Using existing ships that would otherwise be idled by the shipping line would reduce the actual cost of the vessel and the capital costs of the project, but operating costs would then be higher, and the loading process would not allow automation since the ships would most probably be of different sizes and shapes.

Barge feeder services would take the containers from PATH to ports on the coast and river system terminals, and vice versa. Barge services would reach as far inland as possible, allowing:

- Use of nearly a dozen barge terminals, increasing handling capacity in the system without the need for additional infrastructure.
- Service to docks adjacent to the main rail yards in Thornton and Port Coquitlam to provide efficient intermodal handoffs.
- Direct service to some cargo owner facilities equipped to handle barges.
- Service to nearby US ports in Seattle, Tacoma, Everett (WA) and Portland (OR).
- Avoiding pilotage costs, since barges do not require pilotage.



Container on Barge Source: http://valleyridgebarnes.net/savannah_trip.htm

Barges could reach most Lower Mainland (Vancouver) and Puget Sound (Seattle, Tacoma) destinations within 18 to 24 hours. Characteristics of the barge fleet would include:

- Capacity to handle 900 to 1000 TEU per barge.
- Standardized barge fleet would allow automation of the barge loading operations.
- Tugs would bring barges from PATH to the coastal terminals, leave them and proceed back with previously filled barges. This would require a sufficient number of barges to maintain an uninterrupted movement.
- Since one 18,000 TEU ULCS carries a load equivalent to 18 to 20 barges, the fleet should be composed of at least 40 barges for each weekly service. The barge fleet size would need to be adjusted according to the number of shipping lines/routes calling into PATH. Barges are carried by tugs to their destination, and left in the coastal terminal for loading/unloading in order to give the terminal the time to turn it around while keeping the tugs fully occupied.

- The tug fleet would need to be adjusted to allow the movement of the entire load to coastal ports in a single wave. Otherwise, the time required to complete the additional move (from trans-shipment port to coastal ports) would reach 3-4 days, reducing the competitiveness of the project.

To increase throughput, two barges (maximum on the open sea) could be hooked to a single tug, though this would have a negative impact on the speed of the convoy.

Barge Rotation Illustration

In one barge rotation scenario, approximately 20 barges of export containers are collected from 8 to 12 inland terminals, and are brought to PATH while import cargo is unloaded from the ship.

Export cargo is unloaded into the terminal and import cargo is then loaded onto the emptied barges. Tugs take these filled barges back to coastal ports, where the second half of the barge fleet has been waiting to be filled. Tugs then leave barges filled with import cargo, and head back to PATH with loaded barges filled with new export cargo.

Cargo is unloaded from a ship at PATH in one day, requires one day to reach the coastal ports and one half to one day to be unloaded and handed off to the chosen land transportation mode, for a “port dwell time” comparable to the 2.5 to 3 days currently observed in PMV.

The implementation of the barge service out of PATH represents a sizable investment. The ownership and operating structure of barge feeder services would need to be defined. This could be led by ocean shipping lines (as is sometimes done in Asia), or a third party barge operator, though the preferred approach would require further consideration.

Feeder Service Regulatory Considerations

Cabotage regulations would require that the movement of barges from Port Alberni directly to the Canadian coastal and river terminals be handled by Canadian-flagged, Canadian-crewed vessels (see cabotage regulations in the box below). Cabotage regulations would not apply to the movement of cargo between Port Alberni and US Coasts. It would likely be most economical to operate two separate barge services from PATH – the first, a Canadian-flagged barge service, serving Canadian ports, and the second, an international-flagged service, serving US ports. The movement of containers to/from PATH could also be served by Canadian or US flagged ships (only for PATH-US port service), though this would be more costly due to the costs associated with Canadian and US cabotage regimes (e.g. Canadian crew for Canadian-flagged ships, US crew for US-flagged ships, which must also be US build and owned under the US Jones Act).

Cabotage Regulations

Cabotage regulations prevent the movement of persons or cargo between two domestic points by foreign entities.

The Canadian Coasting Trade Act restricts the movement of cargo between any two Canadian ports to ships which are Canadian-flagged, owned and crewed. Similarly, in the US, the Jones Act restricts the movement of cargo between two US ports to ships which are US-flagged, US owned and crewed by US citizens or permanent residents.

In Canada, a temporary Coasting Trade license can be granted to allow the entry of a foreign –flagged vessel into Canadian cabotage trades, where it is determined that no Canadian-flagged vessel is suitable or available to perform the activity described in the application.¹⁹

Traffic moving from PATH to US coasts will be subject to US Harbor Maintenance Tax (HMT), an ad valorem tax of 0.125%, applied on the value of all cargo being transported. The HMT is charged on the basis of the value of commercial cargo loaded or unloaded from a vessel, and it applies to imported cargo, domestic cargo and the transport of passengers moving through US ports. Containers currently moving through US ports, including Seattle and Tacoma are already subject to the HMT. Cargo moving from PATH to Vancouver for onward distribution to US markets by truck would not be subject to the HMT, but these routings are likely to be more expensive given the higher cost of truck transportation.

In addition, barge operators will need to provide a 24 hour advanced notice for US-bound containers (as is the case for all US-bound international maritime traffic). This could add a complication for cargo routing via PATH destined to the US, where the barge journey is less than 24 hours, though this issue is not insurmountable.

¹⁹ Coasting Trade License, <http://www.tc.gc.ca/eng/policy/acf-acfs-menu-licences-2219.htm>

5.3 Commercial Feasibility Likely Requires Traffic Guarantees

The commercial feasibility of the whole project is conditional on minimal traffic guarantees, in one form or another, from one or more shipping lines. Trans-shipment traffic, by nature, is highly volatile and discretionary, since trans-shipment facilities are generally not anchored to an adjacent market.

PAPA would have to get a firm commitment from one or more shipping lines to bring ships to the PATH, over a sufficient long period to recover the project's costs.

Having the shipping line invest in the terminal, alongside other partners (operational or financial) would also help secure the traffic.

“Pure player” terminal operators (not linked to a shipping line group) such as PSA, DP World and Hutchison, may be able to obtain such commitments from shipping lines, having often developed their relationship across their portfolio of properties. But these commitments remain confidential and are rarely publicized.

Shipping lines such as, for example, CMA CGM, Hanjin, COSCO and MSC have their own terminal operator division that can invest in port development projects alongside the shipping line. For instance, in the past few years, MSC has invested in a terminal expansion in Marseille-Fos. MSC also owns a minority shareholding in the Termont terminal in the Port of Montreal. The Maersk group (A.P. Møller-Mærsk) also has a terminal operation subsidiary, APM Terminals, the third largest terminal operator in the world. Given its size and the size of the group, APMT is considered fairly autonomous from its sister company, Maersk Line.

Once such guarantees are obtained, the terminal and the whole trans-shipment system would be in a better position to be realized and succeed.

6

Potential Supply Chain Cost Advantage

6.1 Conceptual Operating Scenarios

In order to compare supply chain charges, it is essential to have a clear understanding of the respective operating scenarios being compared. In this section, we divide the operating scenario in two components. First, we identify deep-sea operating scenarios (Asia to PATH vs. PNW Ports). These provide the most likely competitive operating scenarios for carriers operating on the Asia-PNW corridor. Second, we outline the operating scenario for the final distribution, including barge feeder services from PATH to PNW ports and terminals and onward to inland markets, relative to the status quo.

6.1.1 Deep-Sea Operating Scenarios (Asia to PATH/PNW)

We primarily compared two scenarios:

PATH Single Port of Call Scenario

This scenario assumes that PATH is the single port of call for trans-pacific service to the PNW and that all containers are unloaded/loaded at PATH. For ocean shipping lines, this reduces sailing times and time at port compared to rotations with additional ports of call.

Status Quo Call Scenario

In order to evaluate savings associated with the PATH project, we also need to establish the status quo scenario. In general, shipping lines call two ports in the PNW region. A select few call only a single port and continue on to PSW ports, while some call all three major ports in the PNW. Given current rotations, we assume that a service akin to what is operated by the Maersk and CMA-CGM is a reasonable status quo assumption. Hence, the status quo assumes a rotation serving Vancouver and Seattle.²⁰

Alternative Scenarios

In order to be comprehensive, other scenarios were considered. For example, CPCS considered the possibility that shipping lines would also call a US port as part of a PNW rotation including PATH (e.g. a PATH-Tacoma rotation).²¹ It was established, however, that

²⁰ It is interesting to note that the comparison stands irrespective of whether or not the rotation includes other ports before or after the Vancouver-Seattle-Tacoma region. For example, if we compare a Prince Rupert / Vancouver / Seattle rotation to a Prince Rupert / Port Alberni rotation, the results would still stand. Same thing is true if PSW ports were to be included in either rotation.

²¹ While considering the viability of the Port Alberni solution, one should consider how other supply chain participants will react. In particular, US ports may frown upon a trans-shipment service which would limit the number of large vessels calling at their port. In turn, they may lobby shipping lines for a direct call, especially given that they are not physically constrained and have scope for expansion (especially Tacoma). Given that their physical capacity to handle such vessels is not in doubt, it is easy to imagine a shipping line deciding to call both PATH and Tacoma, for example.

such a service would generate little to no deviation benefits, and as a result was not explored further.

Alternative scenarios considering competition between different ship sizes were also analyzed to provide additional context.

6.1.2 Feeder Service Scenarios (PATH to Coastal and Inland Markets)

At a high level, there are two feeder service scenarios.

- Cargo could move from PATH to one or more of the Port of Vancouver major deep-sea terminals (Delta, Vanterm, Centerm, Fraser Surrey Docks (FSD)), and likewise to deep sea facilities at Seattle or Tacoma.
- Alternatively, cargo could move from PATH to inland barge terminal closer to interim and/or final destination along the Fraser River, the Snohomish River or others.

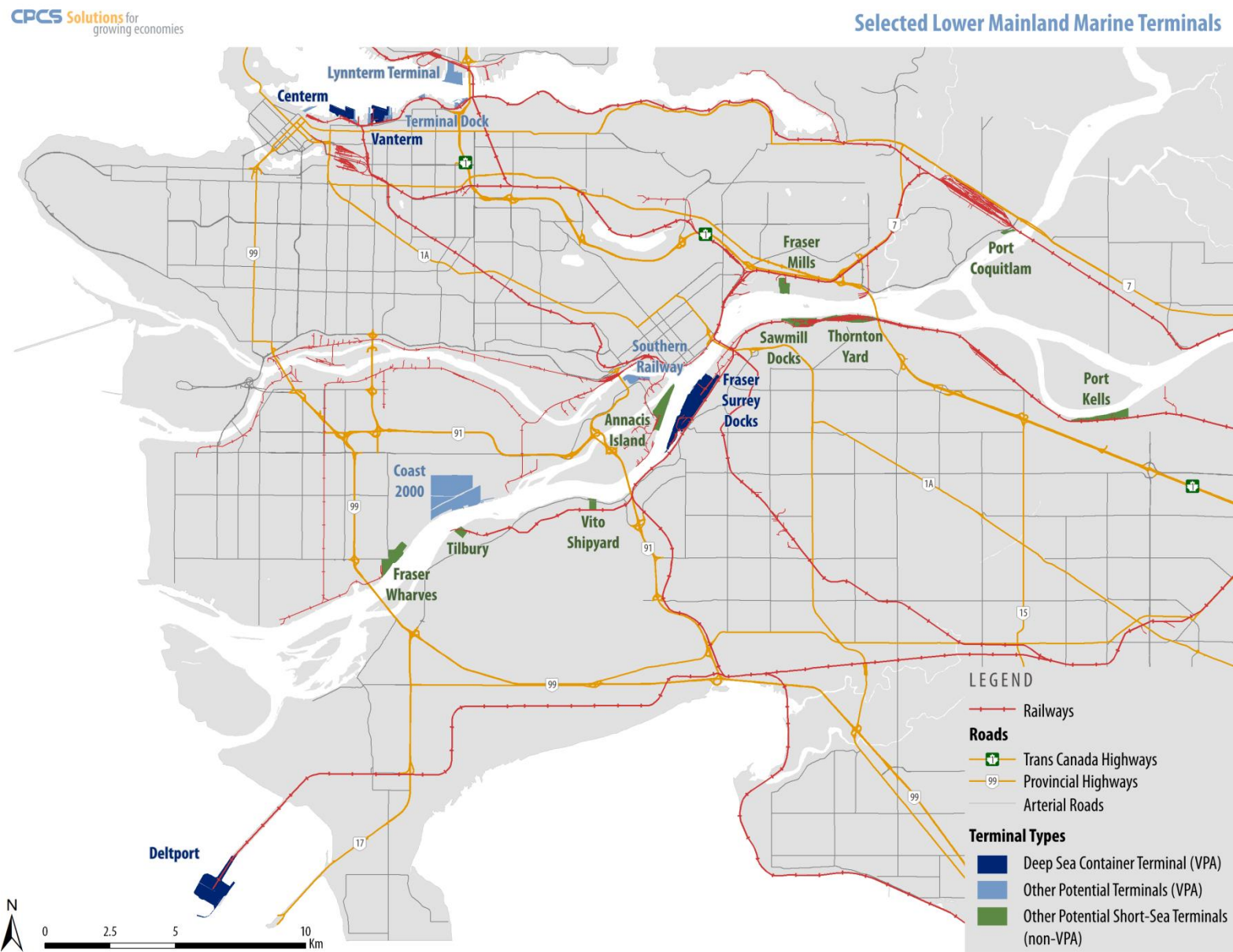
Figure 6-1 provides a list of terminal with potential for barge capacity on the Fraser River. Except for existing container terminals that can handle containers from/to barge today, other terminals would most likely require investments in equipment to handle container barges.

For long-distance inland markets, and in particular those served by rail such as Chicago or Eastern Canada, the PATH barge feeder service needs to reach a dock with on-dock rail service, either at one of the deep-sea terminal or, eventually, at a dock adjacent to a rail container terminals. Rail-related investments may be necessary for some operations.

For other markets, key destinations in Vancouver are stuffing/de-stuffing facilities, as well as other logistics customers. These are located in a variety of places and service could be provided at many docks on the Fraser River. In most cases, these docks would require investment for new cranes and other container handling equipment, but these investments are not included in our analysis (we assume simply that terminals would make these investments if there was a business case to do so). We assume that relatively low cost docks are available for barge loading / unloading.

Of note, while we do not pinpoint the exact locations of such docks, it is important to note that their ultimate location in relation to customers is critical in assessing the value proposition of the PATH concept, since they directly impact the drayage requirements and associated costs. For the purposes of the analysis herein, we propose some high-level assumptions which allow us to provide order-of-magnitude supply chain costs.

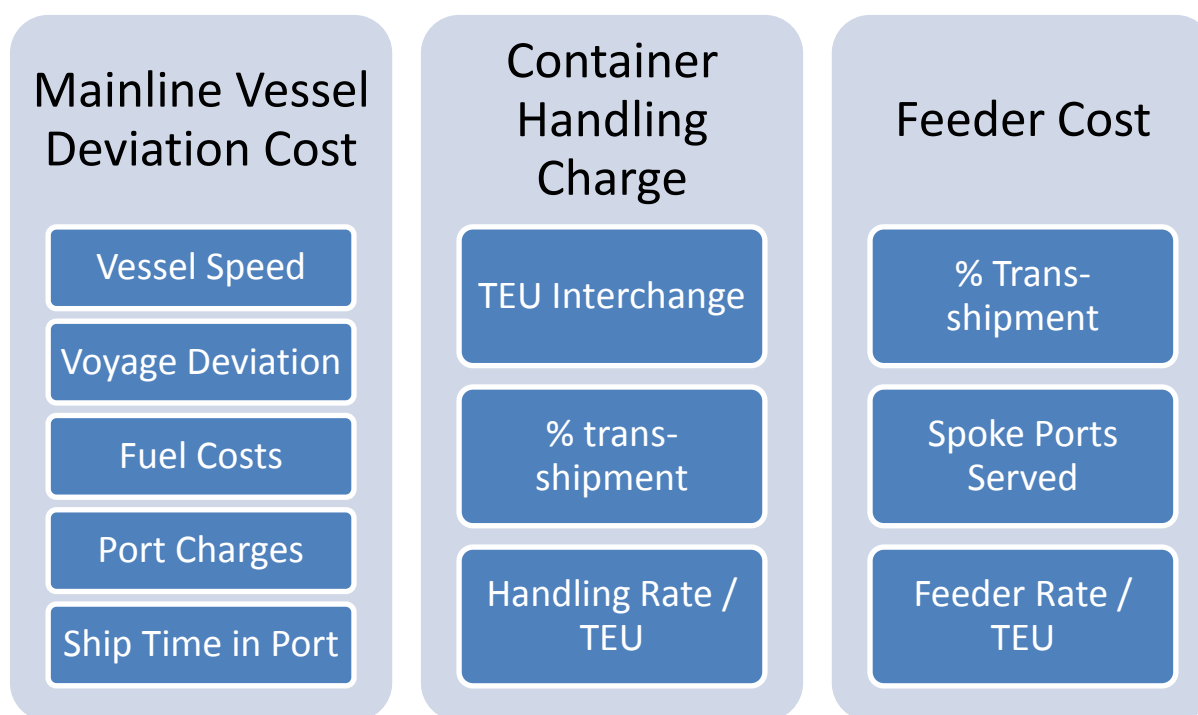
Figure 6-1: Container Terminals with Barge Capacity, BC Lower Mainland



6.2 Trans-shipment Hub – Logistics Cost Model Analytical Framework

There is significant literature on the rationale for marine trans-shipment hubs. One of the foremost experts on the subject, Alfred J. Baird, wrote a number of articles focusing on the economics of such facilities, their optimal locations and potential technical solutions. In his article “The Economics of Container Transshipment in Northern Europe”, he proposes a detailed cost model to assess the economic viability of new trans-shipment operations. This model is reproduced below.

Figure 6-2: Mainline Vessel ‘Deviation Cost’ Model



Source: Reproduced from Figure 1 of Alfred J. Baird, “The Economics of Container Transshipment in Northern Europe”, International Journal of Maritime Economics, 2002, 4, p. 249-280.

As Baird emphasizes, in order to generate trans-shipment benefits, location is determinant:

“In simple terms, location is a key determinant of the competitiveness of a region's transshipment ports. **The extent of the deviation** from the east-west shipping routes for mainline vessels, **plus the distance from each hub port to the various spoke ports will play an important role**. In this sense, rather than ‘centrality’ being important as it formerly was in the case of traditional ports, the notion of a terminals ‘intermediacy’ becomes significant.” (p.270)

In the case of the PATH concept, there are deviation benefits though these are limited in light of the geographic location of PATH with respect to coastal ports in the PNW and the small number of port calls for PNW services (generally two). Moreover, since existing PNW

container ports are not themselves trans-shipment ports (e.g. they do not ship significant amount of goods onwards to other ports by marine feeder services), they do not incur significant trans-shipments and feeder costs, unlike the ports under study by Baird (e.g. Rotterdam).²² As a result, other benefits of the project, namely benefits generally associated with barge feeder services, will be critical to the logistics cost analysis.

In our analysis, we thus supplement Baird's framework for trans-shipment hubs by considering drayage costs in Vancouver. We assume that by using barges the PATH model will be able to directly serve a portion of the clientele in the Vancouver region, along the Fraser River, avoiding or limiting costly final mile delivery costs.

Other benefits of barge feeder services, namely reduced congestion and environmental impacts (e.g. reduced CO₂ emissions), while not evaluated here (they are not supply chain costs), should also be considered. They will be the subject of a more detailed evaluation in a future phase (Impact analysis) of the project.

6.3 Ocean Voyage Savings

6.3.1 Measuring Deviation

The first step in assessing deviation costs is to measure the extent of the deviation. To measure deviation, we use as an anchor the point (deviation point) on the Asia-Vancouver route where ships would start deviating if they were instead to move cargo via PATH. From that point, we can compare the steaming distance to PATH, Vancouver, Seattle, and Tacoma. These distances are indicative of the deviation required to provide two direct calls instead of serving PATH as a single port of call.

Figure 6-3: Deviation Point



Figure 6-4 provides a summary of total deviation for different operating scenarios. In the PATH single port of call scenario, the PATH generates a two-way deviation saving of approximately 436 nautical miles (nm) when compared to a typical Vancouver-Seattle service (difference between 480 and 44nm).²³ In the alternative scenario, deviation savings are trivial. These distance savings do not, however, account for savings in terms of port time or port charges. These are incorporated in our valuation of deviation savings in the next sub-section.

²² One key exception are containers transhipped between Vancouver Island and Vancouver. For shippers located on Vancouver Island, the benefits of PATH are very significant.

²³ It is useful to note that when calculating savings, we will be using one-way deviation. Since our results are reported on a per TEU basis, this does not affect the findings in any way.

Figure 6-4 : Two-Way Travel Distance for Key Routes

Route	Deviation (nm)
PATH: Deviation Point to Port Alberni to Deviation Point	44
Deviation Point to Port Alberni	22
Port Alberni to Deviation Point	22
STATUS QUO: Deviation Point to Seattle to Vancouver (via Brotchie) to Deviation Point	480
Deviation Point to Seattle/Tacoma	173
Seattle/Tacoma to Vancouver via Brotchie	145
Vancouver to Deviation Point	162
Two-Way Savings	336

Source: CPCS estimation

6.3.2 Valuing Deviation

To value deviation, it is necessary to include both voyage and port-related expenses. In terms of voyage expenses, the capital, operating and fuel cost of the ship must be estimated. For port-related expenses, we need to add port charges to the aforementioned. Figure 6-5 summarizes the deviation savings estimated by CPCS. Key assumptions are noted below the table.

Figure 6-5: Deviation Cost Modelling for PATH Operations, Triple-E Ship Design

Item	PATH	Status Quo: Vancouver / Seattle
Voyage Deviation Estimation		
Deviation (nm)	44	480
Ship Speed (knots)	16	16
Time used for deviation (hours)	2.8	30.0
Ship Capital Expenses (\$)	\$ 6,850	\$ 74,724
Ship Operating Expense (\$)	\$ 1,328	\$ 14,491
Fuel Costs (\$)	\$ 13,839	\$ 179,274
Total Voyage Deviation Costs (\$)	\$ 22,017	\$ 268,489
Port Deviation Estimation		
Direct Port Charges	\$23,149	\$ 186,980
Total Time at Port (hours)	24	66
Ship Capital Expense	\$ 59,779	\$ 164,392
Ship Operating Expense	\$ 11,593	\$ 31,881
Fuel Costs	\$ 3,152	\$ 8,667
Total Port Deviation Costs	\$ 97,673	\$ 391,920
Total Deviation Costs	\$ 119,689	\$ 660,409
Results		
Savings in Basic Scenario (two-way)	\$ 540,720	
Savings in Basic Scenario (one-way)	\$ 270,360	

Source: CPCS estimates from various sources.

Ship costs and fuel consumption taken from OSC report "Port Metro Vancouver Container Forecasts" July 2013, based on Maersk 18,000 TEU ship design. In particular, capital cost per day is assumed to be \$59,779, while operating costs are assumed to be \$11,593. In June 26th, fuel costs were \$895.25/tonne for low-sulfur fuel oil (LS IFO 180) and \$1,050.50/tonne for marine gas oil (MGO), both delivered in Vancouver (see Platts Bunkerwire for Wednesday, June 26th). Price fluctuate significantly, but indices for bunker prices are slightly lower today than they were in June 2013 (see www.bunkerworld.com) Consumption is estimated at 6.675 tonnes per hour while steaming (LSFO) and 0.125 tonnes per hours at port (MDO).

Port charges were estimated by CPCS and include estimated harbour dues pilotage, berthage, tying up and letting go fees and gateway infrastructure fees, but exclude wharfage fees and container handling related charges. Pilotage fees (\$28,450) were estimated using the Pacific Pilotage Authority Pro Forma calculator, and assumed pilots are on board for a total of 15 hours. It includes two boarding charges, launch charge, transportation charges and pilotage units charge based on the dimensions of the Emma Maersk. Harbour dues (\$16,050), berthage (\$5,500), and Gateway Infrastructure fees (\$8,400 each way) were estimated using the Port of Vancouver published rates. Tug costs (\$24,000) were also added. Harbour dues and berthage fees are based on the base rate and the dimensions of the Emma Maersk. Gateway infrastructure fees are based on a 14,000 TEU unload at an assumed fee of \$0.60 for the Roberts Bank Rail Corridor trade area. Tying up and letting go fees (\$2,680) are based on Deltaport rates. Port charges for Vancouver (\$93,490) were doubled to provide an estimation of rates in Seattle. Port charges for Port Alberni are assumed as follows, based on information received from the Port Authority: pilotage (\$3,400), harbour dues (\$ 981), berthage (\$2,088), tie up and let go (\$2,680) and tug cost (\$14,000).

PATH is assumed to have much higher productivity than either Vancouver or Seattle (24 hours at PATH compared to 32 hours at both Vancouver and Seattle, with only half as much volume unloaded at Vancouver or Seattle). Two hours is also assumed to be lost on stand-by.

Overall we estimate that PATH Single Port of Call Scenario will save approximately 3 days when compared to a typical rotation (Status Quo Scenario). This time saving, along with fuel savings associated with the shorter rotation, leads to savings of \$540,720 for a full rotation. This represents just over \$15 per TEU slot each way, assuming a 18,000 TEU ship.

PATH will save shipping lines approximately 3 days when compared to a typical rotation, generating operational and capital costs savings of \$540,720, or about \$15 per slot.

These savings are only theoretical, especially in the context of ship over-capacity and slow steaming practices. In the longer-term, however, one can expect they would be realized as the shipping market re-balances.

Combination of PNW and PSW services

PATH could favour the introduction of rotation serving both PNW and PSW. This would mean that only a partial load/unload would be done at PATH. The vessel would then continue to other ports in the PSW. In such a case, total deviation savings would remain identical (\$540,720), but they would be spread across a lower number of TEUs. For example, if only 9,000 TEUs were unloaded and loaded for the PNW region, savings per TEU would be doubled at \$30 per TEU.

Under such a scenario, shipping lines would also be much more likely to adopt PATH as a port of call, since it would not require them to capture a very large market share (unlike in a full load/unload scenario). At least in the interim, before volumes to the PNW increase significantly, the combination of PNW and PSW services for some shipping lines is a real possibility, and it would play to PATH's advantages.

Finally, it must be noted that establishing with certainty the impact of a complete realignment of services for shipping lines is, of course, not possible within the scope provided for this project. As such, the impact of combining PSW and PNW services on overall shipping line costs, excluding the impact of PATH, is not known.

6.3.3 Implications of Ship Size and Alternative Scenarios

If instead of 18,000 ships we were to compare 8,500 TEU ships on both routes (PATH and Status Quo), the overall savings are lower (\$351,355) due to lower capital cost, operating and port costs. The savings per slot, however, is higher (\$20.67).

Based on OOCL NWX service between Ningbo and Tacoma (20 days transit time), the theoretical savings between an 18,000 TEU and a 22,000 TEU ship would be \$27.80 per slot.²⁴

Figure 6-6 shows savings for other ship size comparisons. In general, these savings are reduced in TEU terms since it is harder to attain high capacity utilization for larger ships.

Figure 6-6: Potential Slot Cost Savings for Typical Asia-Vancouver Sailing for Incremental Ship Sizes

Ship Size	12,500 TEU	18,000 TEU	22,000 TEU	24,000 TEU
12,500 TEU	0	\$ 29.40	\$ 47.80	\$ 57.80
18,000 TEU		0	\$ 18.40	\$ 27.80
22,000 TEU			0	\$ 9.40
24,000 TEU				0

Source: CPCS calculations based on OSC estimates of slot cost per day and an estimated 20 day transit.

²⁴ According to Ocean Shipping Consultants, the slot cost on an 18,000 TEU vessel would be \$10.96 per TEU, per day at sea. A 22,000 TEU vessel would cost \$10.04 per TEU per day at sea, and a 24,000 TEU ship is calculated to cost \$9.57 per TEU per day at sea. In contrast, a 12,500 TEU ship is currently calculated to cost \$12.43 per TEU per day at sea. The 18,000 TEU ship therefore allows cost savings of 11.8% over an already sizeable ship.

6.4 Feeder Distribution Costs

6.4.1 Barge Feeder Costs

The PATH concept is predicated on barge feeder services moving cargo to and from ports and terminals along the PNW coast and river terminals to reach regional and inland markets. These associated barge feeder services represent an additional supply chain cost relative to the status quo.²⁵

Consequently, we focus solely on the feeder costs from PATH. In a later section, we analyze drayage costs to the final destination within the BC Lower Mainland.

Based on an analysis by another consultant working with PAPA,²⁶ the following information was obtained:

- Proposed barges should be able to carry around 1,000 TEUs each.
- Tugs with higher horsepower would be required to operate reliably. Tugs with 5,000 horsepower should be able to tow two barges.

Hence, feeder costs assume a purpose-built fleet of barges with 5,000 horsepower tugs and 1,000 TEUs barges. The tug price is assumed to be \$12,000,000, with a barge price of \$2,000,000. This is based on recent industry prices for tugs. In particular, Ocean ordered a new 4,000 HP Twin Z-drive tug in 2012, with a length of 25m and ice-reinforced, for \$10.6 million.²⁷ The final design of the tug would, of course, affect the final price.

Useful lives are assumed to be 25 years for the tugs and barges, with financing costs at 5% per year. They are assumed to be operational 95% of the time, with the remaining 5% reflecting either maintenance or idle time.

Figure 6-7 present our estimated voyage costs based on these assumptions. For a return trip, we estimate a cost of \$43,049. For one-way, this translates into \$21,525, or \$10.76 per slot

²⁵ On exception is a small service to Alaska, as well as DP World barge to Nanaimo. The latter, for example, offers a weekly (sometimes bi-weekly) barge service with a 328 TEUs capacity. This represents less than 2 % of the capacity of a weekly 18,000 TEU service.

²⁶ See document titled "Short Sea Tug And Barge Container Operations - Alberni Canal to Vancouver and Puget Sound: An Analysis From A Navigator's Perspective", by Captain Al Flotre.

²⁷ See <http://www.canadiansailings.ca/?p=4108>. By comparison, the Alaska Titan, a tug used for the Seattle-Alaska trade built in 2008, is 36 metres long and has a 5,000 HP twin Z-drive. No price is available, but it can be safely assumed that it would cost more than the 25 metres tug ordered by Ocean. Of note, these tugs generally tow only one barge.

per way. These estimates, when benchmarked to estimates of existing tug and barge services in the region,²⁸ appear to fall in the right ballpark.

Figure 6-7: Estimated Voyage Costs for Feeder Service

Item	Unit	Value
Assumptions		
Tug Cost	\$ per Day	\$ 3,488
Barge Cost	\$ per Day	\$ 698
Fuel consumption	Ton per Day	12
MGO price	\$ per Ton	\$ 1,085
Labour Cost	\$ per Day	\$ 2,400
Days with tug (return)	Day	2
Days with barge (return)	Day	3.75
Costs		
Tug Capital Costs	Voyage	\$ 6,979
Barge Capital Costs (x2)	Voyage	\$ 5,232
Fuel Cost	Voyage	\$ 26,040
Labour Costs	Voyage	\$ 4,800
Profit Margin	%	0%
Total Cost of Service	\$ per Voyage	\$ 43,049
Cost per slot (two way)	\$ per slot	\$ 21.52
Cost per slot (one way)	\$ per slot	\$ 10.76

Source: CPCS

6.4.2 Terminal Handling Costs

For this phase, we focus on terminal handling fees at DeltaPort and Fraser Surrey Docks for comparative purposes. We assume lower handling fees at smaller inland barge terminals given the potential to use non-unionized labour and, potentially, automating operations as these terminals.

DeltaPort

Terminal handling fees include both fees going to stevedores and port-related charges, in particular wharfage. Published wharfage charges tend to be higher than negotiated charges.

²⁸ The model was benchmarked on estimates for DP World's service between Nanaimo and Centerm, and on a quotation for a lumber barge service between Port Alberni and Vancouver. The model was tested with adjusted capital and fuel consumption estimates to reflect these services, and the estimates produced were within 3% of the quotations received.

In Vancouver, published wharfage charges for an import container are \$37.61 per TEU. For an export container, they are \$26.82 per TEU. Yet, according to Ocean Shipping Consultant (OSC) estimates, actual charges for a mix of import and export cargo at Vancouver in 2012 were only 20.85 per TEU.²⁹

Stevedoring charges, as estimated by CPCS based on published tariff, were about \$223 per TEU for trucks and \$273 per TEU for rail at Deltaport. This included vessel discharge and container loading on truck or train, as well as gate charges, rail surcharges and fuel surcharge. OSC's estimate was \$255 per TEU. These estimates depend on assumptions about the proportion of 20-foot containers versus 40-foot containers, on the mix of empty and laden containers, and on the mix of import and export containers.

In summary, CPCS estimates terminal handling fees at Vancouver to be about \$261 per TEU for truck traffic and \$311 for rail traffic, compared to OSC's estimate of \$275. Given the preponderance of rail traffic in Vancouver, the CPCS estimate is slightly over OSC's estimate, but remains fairly close.

Barge Dock Unloading/Loading at PNW Coastal Ports and River Terminals

If any of the existing docks in Vancouver are used, throughput charges will apply and no saving will be realized. It would be possible to use some underused docks with significantly lower wharfage fees, but given that these fees generally represent only a small proportion of handling fees, the savings are not expected to be significant.

In order to generate savings on the throughput charge for barge unloading operations, two options are possible. Given that the fleet will be standardized, operations could be automated at newly built inland terminals, thus lowering handling costs significantly. Alternatively, for significant clients, purpose-built private docks could be built. In such a scenario, we can imagine operating costs being about half those observed in current terminals. This is our assumption for truck-bound traffic. Of note, the fact that barges are able to call many different terminals to serve truck-bound traffic would certainly increase competition, thus lowering the negotiated rate that can be obtained for truck-bound containers. One terminal operator at the Port of Vancouver confirms that handling rebates would be more significant than for rail.

Handling charges for truck-bound containers could be halved due to efficient processes and increased competition among terminals.

²⁹ See Table 5.2, p 126 of OCS's report "Port Metro Vancouver Container Forecasts" July 2013.

The main challenge is for cargo that needs to be loaded onto rail for shipment to Central and Eastern Canada and the US Mid-West, among other inland markets. Direct rail represents over half of all inbound cargo at the Port of Vancouver. Moreover, all existing docks with direct rail access have significant throughput charges. For example, rail throughput charge at Fraser Surrey Dock is \$495 per container, slightly higher than the average \$485 at Deltaport.³⁰ Wharfage fees are lower (\$ 18.85 per TEU compared to \$37.61 per TEU), however, so total costs are slightly lower. They remain, however, within a narrow range.

Moreover, developing efficient operations which could translate in significant savings is challenging. In particular, while direct barge-to-rail movements can be done, it is even done currently in rail-intensive terminals (in the Port of Montreal, for example), it requires strong coordination between barge and rail services. Railcars must be available to be loaded, but not too early because the terminal usually doesn't have the space to store them. The most efficient process would see export containers brought in by the railway shortly before the barge comes in, to be offloaded directly on empty barges already docked in the terminal. This frees railcars that are then loaded with import containers as soon as the barge arrives. On the other hand, coordination issues often end up forcing the terminal to offload containers on the ground before loading barges or railcars.

According to a terminal executive at FSD, it would be feasible to handle containers directly from barge to rail at one of FSD's existing berths, though that would require capital investment to increase the number and length of rail tracks. Additional rail tracks would need to be built to allow rail car movements and shunting. Additional handling equipment, such as a mobile crane, may also be required. From our observations, it would be difficult to set up a barge-to-rail operation at Deltaport in its current layout, due to the lack of berth-side rail tracks available for container handling, railcar movement and shunting.

Such an efficient setup would certainly reduce the dwell time of the containers compared to the traditional handling process. Though FSD is not served by the railways currently (containers are drayed to the railyard due to insufficient volumes), the volume from a PATH transshipment operation could justify a direct service. According to a FSD executive, handling charges for barge-to-rail (or rail-to-barge) transfers might be lower than charges for traditional handling, simply due to the efficient process, but as is currently the case, rates would be negotiated based mostly on volume. Strong volumes help increase labour productivity and utilization rates, and capital investments are amortized over a larger number of unit moves. As such, volume remains therefore the main driver to reduce handling costs.

³⁰ The rail surcharge is different for containers loaded to or unloaded from a railcar. Hence, throughput charges at Deltaport, including gate and rail surcharges, are \$472 for import containers onto rail and \$499 for export container from rail. The average of the two is \$485 per container.

There are no other existing facilities which could handle high levels of container barge traffic to rail without very significant investments, and it is unclear whether such facilities could be built and operated cost competitively. Moreover, such facilities would require additional service by the railways, above and beyond current on-dock rail services. Even if the volume would justify the service, this could add complexity to their operations, particularly in BC's Lower Mainland.

Potential savings for rail-bound containers is more limited, and unlikely to represent a discount of more than 35% of published prices.

We consider that for rail traffic, the potential savings in terms of handling costs are more limited. Indeed, they would be more in the order of 25% to 35% when compared to Deltaport. Our discussion with FSD confirmed that in terms of pricing, discounts from published prices slightly beyond 25% could be considered with a direct barge-to-rail operation. These discounts would, however, rely significantly on volume commitments. For our analysis, we assume a discount in the higher (more optimistic) bracket of our estimate, at 35%. It is important to note that this rebate is on the published prices, and discounts would be more limited if compared to actual prices paid by shipping lines committing large volumes (which likely currently already see discounts on published prices at Vancouver terminals).

6.4.3 Drayage Costs

A significant portion of traffic unloaded at the Port of Vancouver is then drayed to final customers or to stuffing/destuffing facilities. With a barge feeder service, it is believed that a good portion of these costs will be eliminated since cargo will be delivered closer to final customers. For estimation purposes, we evaluate that about 30 % of import traffic is drayed. We also estimate drayage costs to be about \$250 per container, or \$140 per TEU (assuming 20% of traffic is 20-foot containers). With barge feeder operations, we assume that average drayage costs will be halved since significantly more cargo will be delivered directly to customers along the Fraser River, or as the results of shorter drayage routes.

6.5 PATH Single Port of Call versus Status Quo Scenario

Figure 6-8 presents the costs and price estimates of relevance for our analysis. It shows that to be competitive in serving customers receiving their shipment by truck from current terminals, the PATH Single Port of Call Scenario could have combined throughput and wharfage charges of \$205.23 per TEU. At any price below that, some customers would benefit. For rail customers, the maximum combined wharfage and throughput charges that can be imposed are \$113.58 per TEU. These customers currently represent the largest proportion of import container cargo at the Port of Vancouver. These results are shown graphically in Figure 6-9 and Figure 6-10.

Figure 6-8: Estimated Price for PATH to be Competitive with Current Supply Chain Costs

Cost Item	PATH	Status Quo Vancouver/Seattle
Deviation Cost (accrues to shipping line)*	\$ 3.69	\$ 20.38
Feeder Costs (assumes no markup)*	\$ 11.96	-
Handling Charge - Truck**	\$ 130.50	\$ 261.00
Average Charge - Truck***	\$ 70.00	\$ 140.00
Handling Charge - Rail**	\$ 202.15	\$ 311.00
Total – Truck	\$ 216.15	\$ 421.38
Max Price**** of PATH – Truck	\$ 205.23	
Total - Rail	\$ 217.80	\$ 331.38
Max Price**** of PATH - Rail	\$ 113.58	

Source: CPCS Analysis based on previously shown data.

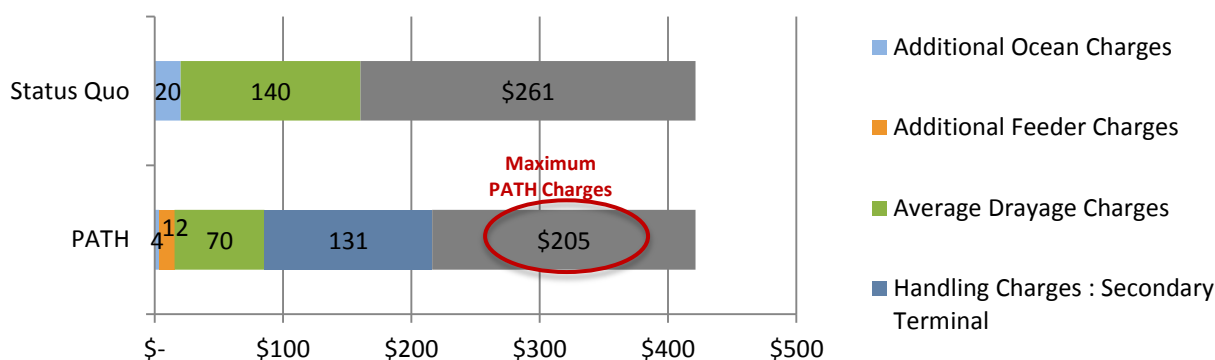
* Assumes 90% loading factors

** Assumes limited markup for SSS Vancouver handling operations

*** While some customers may benefit, others may not, depending on the location of the SSS terminals and relevant stuffing / destuffing facilities.

**** Wharfage & Throughput

Figure 6-9: Supply Chain Price Differential (from Deviation Point): Truck-Served Customers in Local Market



Source: CPCS estimates shown on Figure 6-8.

Figure 6-10: Supply Chain Price Differential (from Deviation Point): Rail-Served Customers in Inland Market



Source: CPCS estimates shown on Figure 6-8.

An obvious challenge is that the PATH Single Port of Call Scenario is unlikely to be able to differentiate between customers that are realizing significant savings and those that are not in terms of handling rates charged (see box below). For example, within trucking customers – destined to the BC Lower Mainland, for example, some may realize higher savings (if they receive containers at their facility), while others may have no drayage savings. For instance, a trucking customer might be located close to existing terminals and incur minimal drayage costs (often picking up their containers instead of paying the shipping line drayage rates). In such cases, PATH would offer very minimal drayage savings, or none at all.

Benefits to and PATH Pricing for Vancouver Island Shippers

Shippers located on Vancouver Island would benefit greatly from a service at PATH. Right now, they not only face the usual costs outlined here under the Status Quo Scenario, but also additional transshipment costs to reach the Island. For example, a shipper with large volumes would face an additional cost of \$425 per container between Centerm and Nanaimo (about \$236 per TEU assuming 80% of 40-foot containers). Hence, the difference between a PATH service and current services, including deviation savings, are slightly over \$500 per TEU. If PATH wished to capture these savings, it would need to price the handling of containers destined to or from Vancouver Island at a significant premium to those destined to Vancouver. This could be implemented through a gate charge of \$200 or \$300 per TEU, over and above the terminal fee that will be estimated through the financial model.

Given that price differentiation would be extremely difficult, it is more likely that PATH will have uniform wharfage and throughput charges. In some cases, it may be able to price-differentiate between rail and truck cargo. In order to attract rail-bound cargo, the rate should not be over \$114 per TEU. At that price, the supply chain costs of the PATH Single Port of Call Scenario and the Status Quo Scenario would be equal for rail customers. That would likely

allow PATH to gain market share among clients accepting truck deliveries in the region, while retaining rail customers. If revenues must be higher, PATH may wish to provide differentiated prices to shipping lines, increasing the truck prices towards the \$205 per TEU limit. Assuming a 50/50 split, PATH's average price would be \$159.

To be competitive, PATH's combined pilotage, wharfage and throughput charges should not exceed \$113 per TEU for rail customers and \$205 per TEU for truck customers.

By comparison, Deltaport's combined wharfage and throughput charges are currently \$311 per TEU for rail customers and \$261 per TEU for truck customers.

Price Differentiation and Service Viability

One needs to be careful when estimating supply chain costs. There is a significant difference between cost and prices. In general, because the beneficial cargo owner is deciding on the routing of its cargo, price is ultimately what matters in terms of routing decision.

Unfortunately, if price is what matters and prices are different for different customers, it may mean that the proposed supply chain, while beneficial on average, is not sustainable in the marketplace. Indeed, if some customers face lower prices than before and some higher prices than before, even if on average they face lower prices, it is unlikely that those facing higher prices will decide to adopt the new service. Unless the entire service is offered by one entity and unless that entity is able to price differentiate (charge more to customers realizing bigger savings, and vice-versa) and cross-subsidize (across customers), the service will likely be unable to retain all its customers.

7

Expected Economic Impacts and Other Benefits

7.1 Overview of Economic Impact Measures

The purpose of this chapter is to quantify the economic impact of the PATH project. Simulation analysis using an input-output model (a model that replicates the inter-industry relationships in the economy) is the method used to estimate the economic impact. Simulation is carried out by deliberately altering or “shocking” the level of a particular variable (or variables) in the model in order to change it (them) from its (their) status quo, and then observing the effects on the remaining variables in the model. “Economic impact” is measured here in terms of the impacts on the key indicators of GDP, employment and government tax revenue.

The key drivers of these economic impact measures are the project’s capital and operating costs as provided to CPCS.

7.2 PATH Project Capital Costs

The engineering analysis has identified three location options for construction of the PATH project: Sarita Bay North, Sarita Bay South Option A and Sarita Bay South Option B. These are all located close together so effectively they are three options at the ‘same’ location. The vast majority of the work involved is standard across all of three options and it is really only the earthworks and dredging that differ. Given this, we have chosen to carry out the economic impact analysis on the least expensive option. This is Sarita Bay South Option A the option with the least amount of earthworks.

The total capital cost (including contingency) of the PATH project, located at Sarita Bay South (Option A) is \$1.63 billion.³¹

In comparison, Sarita Bay North entails a total for construction of \$1.963 billion, while Sarita Bay South Option B entails a total for construction of \$2.055 billion.

³¹ Capital costs were provided by Hatch consulting engineers, who are advising the Port Alberni Port Authority on the engineering components of the PATH project.

7.3 Sarita Bay South Option A Construction Cost

Figure 7-1 presents a summary of the construction cost for the Sarita Bay South Option A. Because the PATH project is being planned as a fully automated terminal, of which there are very few in the world, the single largest cost item is the container handling equipment at \$515 million, representing almost one third of the \$1.630 billion total for construction. Other major cost items include terminal site excavation and fill at \$304 million, wharf structural costs at \$171 million, and civil and miscellaneous structural terminal infrastructure at \$95 million.

Figure 7-1: Sarita Bay South Option A Total for Construction

Item	Description	Cost \$	Contingency \$
1	Mobilization/Demobilization	61,033,000	9,155,000
2	Dredging and Land Reclamation	46,792,800	11,698,200
3	Removals and Site Preparation	2,888,750	433,300
4	Excavation and Fill – Terminal Site	304,215,000	45,632,250
5	Wharf Structural	171,257,540	25,224,800
6	Civil & Misc. Structural Terminal Infrastructure	94,684,900	11,457,100
7	Offsite Improvements	4,116,500	617,500
8	Gate Complex	3,407,500	511,100
9	Buildings	26,573,000	2,657,300
10	Electrical Terminal Infrastructure	51,684,000	12,921,000
11	Container Handling Equipment for Fully Automated Terminal	515,045,000	51,504,500
Total for Capital Cost Construction		1,281,697,990	171,812,050
Total for Capital Cost Construction, Incl. Contingency		1,453,510,040	
12	Permitting, Engineering, Contract Administration	147,400,000	29,479,100
Total for Project		1,429,100,000	201,300,000
Total for Construction, Incl. Contingency		1,630,400,000	

Source: Capital cost estimates provided by Hatch

7.4 Economic Impact Methodology

The approach taken to estimate the economic impact of the PATH project has been to make use of Statistics Canada's Interprovincial Input-Output (I-O) model.³² Through its representation of the inter-industry relationships in the economy, the model allows for the estimation of the direct, indirect and induced impacts of a project and their aggregation. In carrying out this exercise we have worked closely with Statistics Canada's Industry Accounts Division which maintains the model and makes available the service of running the model, and

³² See Statistics Canada product main page at <http://www.statcan.gc.ca/bsolc/olc-cel/olc-cel?catno=15F0009XDB&lang=eng>.

advising on the use of the model. Use of Statistics Canada's I-O model for estimating the economic impact of projects is common practice by project proponents in Canada.

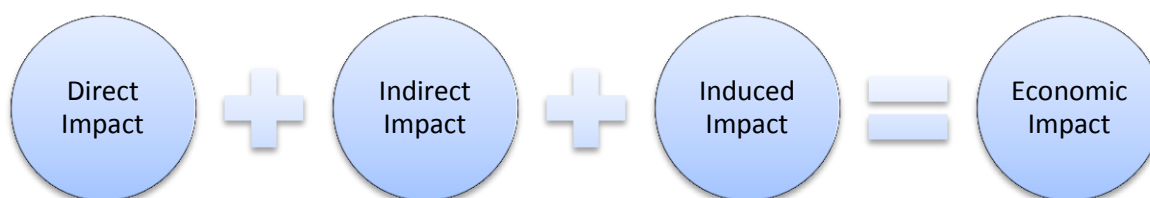
7.4.1 The Input-Output Model

Industry inputs and outputs in the I-O model cover every industry in the economy and must, of course, be expressed in a common unit of measure. They are therefore in value, and not volume, terms. The current Statistics Canada I-O model is based on 2006 values for industry inputs and outputs. This means that the impacts estimated using the model will reflect the 2006 relative prices and inter-industry relationships in the economy.

Modeling inter-industry relationships requires a system for classifying industries and commodities. As described by Statistics Canada,³³ the industry classification in the I-O model is based on the Canadian "Standard Industrial Classification Manual," designed to accommodate establishment-based data, the building blocks of the input-output system. The commodity classification used was specifically designed for the input-output system. It was intended to provide concordance between a variety of commodity classification systems employed throughout the Canadian statistical system. Consistent classification of commodities is crucial in the construction and balancing of input-output tables. For example, a commodity must be coded consistently whether it be as part of a manufacturer's output, as an item being transported, as an export or import, or as a purchase by a final consumer.

7.4.2 Standard Economic Impact Assessment

Our analysis adopts the standard approach of estimating impacts in three categories: direct, indirect, and induced. Also in keeping with standard practice, we refer to the sum of these as the economic impact of the PATH project.



Direct impact, in general, measures the initial requirements for an extra dollar's worth of output of a given industry. In the present case, the industry is the one that supplies marine terminals. The initial requirements for the PATH project are summarized in Figure 7-1 above and include, for example, the material handling equipment. There will then be a direct impact on the output of the material handling equipment industry. This direct impact is the one dollar

³³ Statistics Canada, *A User Guide to the Canadian System of National Accounts, Chapter 3, Input-Output* at <http://www.statcan.gc.ca/nea-cen/pub/guide/chap3-eng.htm>.

change in material handling equipment output to meet the change of one dollar in final demand. Associated with this, there will be direct impacts on GDP, jobs and imports.

Indirect impact measures the changes due to inter-industry purchases as they respond to the new demands of the directly affected industries. For example, the new material handling equipment will require steel used in the manufacture of the equipment. Indirect impact, in general, includes all the chain reaction of output up the production stream since each of the products purchased will require, in turn, the production of various inputs.

Finally, induced impact measures the changes in the production of goods and services in response to the consumer expenditures induced by households' incomes (i.e. wages) generated by the production of the direct and indirect requirements. To estimate the induced impacts, the model is re-run a second time. In this second iteration, the level of wages and salaries is "shocked" by an amount equal to the additional income generated in the first iteration from the direct and indirect effects, and the impact that this shock to wages and salaries has on the economy is then determined.

In the results discussed below, impacts are presented for British Columbia, the province in which the project is occurring, for the four western provinces as a whole (Manitoba, Saskatchewan, Alberta and BC), and for all of Canada. Also, impacts are calculated and reported in terms of additional GDP, full-time equivalent (FTE) jobs – the same as person-years of employment – and tax revenues. Regarding tax impacts, these are taxes on products or production; the model does not include income taxes.

7.4.3 Interpreting the Results

Every project has a life cycle including both a construction phase and an operations phase. In the case of the PATH project, we have carried out I-O model simulations to estimate the economic impacts of both phases, i.e. construction and operations. However, it is important to recognize that the results of the two phases cannot simply be added together to arrive at the total impact over the project life cycle.

When the model is shocked by an amount representative of the construction or expansion of a facility, the model estimates the economic impact. In reality, however, construction activity occurs over several years and what the model estimates is, in effect, the cumulative impact of the construction phase. In contrast, when the model is shocked by an amount representative of the annual operating costs due to the project, the result given by the model corresponds to the economic impact for a single year. To arrive at the cumulative impact of the annual operating costs, the results given by the model would have to be multiplied by the number of

years the facility would be in operation, in the present case 50 years.³⁴ In the section 7.5.2, we summarize the impacts of the operating costs on both an annual and cumulative basis.

7.5 Economic Impact of Sarita Bay South Option A

In this section, we summarize the economic impact of the PATH project's Sarita Bay South Option A. Results are indicated first for the construction and operations phases of the project. Following this, we provide an indication of the impact on a cumulative basis, combining the results for the construction and operations phases.

7.5.1 Sarita Bay South Option A Construction Phase Impact

As noted above, the industry classification used in the Statistics Canada I-O model is based on the Canadian "Standard Industrial Classification Manual." This is not the same categorization as used in the engineering analysis to determine the construction cost for the PATH project. It has therefore been necessary to reclassify the engineering construction cost information according to the I-O model requirements. Figure 7-2 summarizes this re-classification.

Figure 7-2: Sarita Bay South Option A Construction Cost Classified for Economic Impact Analysis

Input-Output Commodity Classification		\$ Thousands		
Code	Title	Cost	Contingency	Total
MPG23B001	Industrial buildings	26,573	2,657	29,230
MPG23C101	Highway, roads, streets, bridges and overpasses	2,881	432	3,313
MPG23C109	Other transportation construction	84,740	9,965	94,705
MPG23C300	Electric power engineering construction	51,684	12,921	64,605
MPG23C501	Marine engineering construction	318,658	54,704	373,361
MPG23C502	Waterworks engineering construction	5,068	760	5,828
MPG23C503	Sewage engineering construction	6,113	917	7,030
MPG23C509	Other engineering construction	418,337	67,430	485,767
MPG333902	Material handling equipment	513,625	51,363	564,988
MPG336112	Light-duty trucks, vans and SUVs	900	90	990
MPG336120	Medium and heavy duty trucks and chassis	520	52	572
Total		1,429,098	201,291	1,630,389

Source: CPCS, based on capital cost estimates provided by Hatch

³⁴ We recognize, of course, that calculating the cumulative impact in this manner does not take into account the "time value of money," as would be the case in a financial or economic cost-benefit evaluation where future cash flows are discounted to their present values.

Using the above costs to “shock” the I-O model, Figure 7-3 summarizes the economic impact results for the construction phase. It is not surprising that the bulk of the impact occurs in British Columbia.

Figure 7-3: Economic Impact of Sarita Bay South Option A Construction Costs

Effect	GDP (\$ millions)			FTE Jobs Created (number)		
	Canada	BC	Western Canada	Canada	BC	Western Canada
Direct	446	402	410	4,983	4,561	4,619
Indirect	495	327	394	5,130	3,581	4,047
Induced	341	221	259	3,116	1,996	2,311
Total	1,282	950	1,063	13,229	10,138	10,977

Source: Statistics Canada Interprovincial Input-Output Model simulation

In total (adding the direct, indirect and induced impacts together), the construction of the PATH project’s Sarita Bay South Option A would lead to an increase in GDP of approximately \$1.3 billion in Canada as a whole, of which \$950 million occurs in BC and \$1.0 billion occurs in Western Canada (Manitoba, Saskatchewan, Alberta and BC). The resulting additional full-time equivalent (FTE) jobs would be 13,229 in Canada, including 10,138 in BC and 10,977 in Western Canada.

Not shown in Figure 7-3 are the tax implications. In total, the construction of the PATH project’s Sarita Bay South Option A would lead to an increase in governments’ tax revenue of approximately \$134 million in Canada as a whole, of which \$106 million would occur in BC and \$113 million would occur in Western Canada.

7.5.2 Sarita Bay South Option A Operations Phase Impact

As of this writing (May 2014) PATH's proponents are working on developing the financial model for the project, and a complete accounting of the expected operating expenses is not yet available. We have therefore based the economic impact analysis of the PATH's operations on the information provided by the proponents shown in Figure 7-4, which is partial and preliminary.

As may be seen, the annual labour expense during operations is estimated at approximately \$237 million. The annual other operating expenses are estimated at approximately \$34 million.

The annual total operating expenses are therefore estimated at approximately \$271 million, with the labour expense accounting for the great majority of the total (87%).³⁵

These estimates are based on an annual container throughput of 1.5 million TEUs.

Figure 7-4: Estimated Annual Operating Expenses for Sarita Bay South Option A

Operating Expense	Cost per TEU	Total Cost at Throughput of 1.5 Million TEUs
Wages and benefits	\$157.90	\$236,850,000
Other operating expenses	\$22.98	\$34,470,000
Total operating expenses	\$180.88	\$271,320,000

In Figure 7-5, we show the estimated economic impacts resulting from the operations, based on the above annual operating expenses. In total, there would be an impact on annual GDP of \$401 million for Canada as a whole, including an impact of \$362 million in BC and an impact of \$376 million in Western Canada.

Of the total annual GDP impact, \$237 million, or 59% for Canada and 65% for BC, is the direct impact. The large size of the direct impact is not surprising since it is the direct result of the labour expense. The induced impact, \$140 million for Canada and \$109 million for BC, is also relatively large since it results from spending the disposable income portion of the wages and salaries. The indirect impact is relatively small since it results from the other operating expenses.

³⁵ Operating cost cost detail obtained from the Port Alberni Port Authority.

On a cumulative basis, the GDP impact of PATH operations over the 50-year life of the project would amount to approximately \$20 billion for Canada as a whole, including \$18 billion in BC and \$19 billion in Western Canada.

Figure 7-5: Economic Impact of Sarita Bay South Option A Operating Costs

Effect	GDP (\$ millions)			FTE Jobs Created (number)		
	Canada	BC	West- ern Canada	Canada	BC	West- ern Canada
Direct	237	237	237	3,945	3,945	3,945
Indirect	24	16	20	276	201	229
Induced	140	109	120	1,276	977	1,072
Total	401	362	376	5,497	5,123	5,246
Total over 50 years	20,050	18,100	18,800	274,850	256,150	262,300

Source: Statistics Canada Interprovincial Input-Output Model simulation

Also as shown in Figure 7-5, the number of FTE jobs, i.e. person years of employment, resulting from the PATH's operations would be 5,497 for Canada, including 5,123 in BC and 5,246 in Western Canada per year.

The cumulative impact of PATH operations over the 50-year life of the project would amount to approximately 275,000 for Canada, including 256,000 in BC and 262,000 in Western Canada.

Although not shown in Figure 7-5, the PATH's operations would also result in increased tax revenues for governments in Canada. In total, government could expect increased tax revenue of \$30.1 million per year, including \$7.7 million at the federal level, \$16.3 million at the provincial level and \$6.1 million at the municipal level. With the assumed 50 year life, the cumulative tax impact for government would amount to \$1.51 billion.

7.5.3 Summary of Sarita Bay South Option A Economic Impact

Figure 7-6 presents a summary of the Sarita Bay South Option A economic impact. Focusing on the cumulative impacts, the results indicate that the PATH project's Sarita Bay South Option A would over its lifetime add approximately \$21 billion to Canada's GDP (2006 dollars). The resulting additional full time equivalent jobs, or person years of employment, would be approximately 288 thousand. The project would also add approximately \$1.6 billion to governments' revenue (2006 dollars).

Figure 7-6: Summary of Sarita Bay South Option A Economic Impact ⁽¹⁾

Construction Phase Impact (2)	
Total cost of construction (including contingency)	\$1.63 billion
GDP impact	\$1,282 million
Jobs impact	13,229
Tax impact	\$134 million
Operations Phase Impacts (3)	
Annual operating expense	\$271 million
Annual GDP impact	\$401 million
Annual Jobs impact	5,497
Annual Tax impact	\$30.1 million
Cumulative Impacts (4)	
GDP impact	\$21,332 million
Jobs impact	288,079
Tax impact	\$1,639 million
⁽⁵⁾ Impacts shown are for Canada as a whole, and are the total of direct, indirect and induced effects. Jobs impacts are full-time equivalent, full year jobs and thus equal to person-years of employment. Tax impacts include taxes on production and on products but not on incomes. Dollar figures are 2006 values reflecting the current version of Statistics Canada's Interprovincial Input-Output (I-O) Model.	
⁽⁶⁾ Construction costs and impacts are totals relating to the entire construction period.	
⁽⁷⁾ Operating expense and impacts relate to a single year in the operating life of the project.	
⁽⁸⁾ Cumulative impacts are the sum of the impacts for the construction period and the entire 50 year operating life of the project.	

7.6 Other Benefits Resulting from the PATH Project

In addition to benefits directly related to spending on the construction and operations of the facility, it is also important to note the impacts that PATH would have on the regional transportation system. In this Chapter, we provide a high-level assessment of these benefits.

7.6.1 Quantifiable Benefits

Context

In the proposed PATH operating concept, the feeder barge operations serving PATH could spread regional container handling capacity over a large number of coastal and inland terminals along the Fraser River and reduce hinterland congestion, particularly by avoiding, reducing and spreading truck transportation (drayage) in the BC Lower Mainland.

The benefits of spreading truck traffic are two-fold.

- First, it reduces congestion on some of the major congested transportations axis, providing benefits to passenger vehicles and trucks using these corridors.
- Second, by unloading containers closer to their final destination, drayage costs and transit time are reduced for these customers.

In both cases, there are beneficial impacts on fuel emissions as transit times and/or distance travelled is reduced. The first impact also minimizes the need for new investment at critical locations, and the second reduces total distance travelled and associated road wear and tear.

Valuing such benefits with a high level of accuracy would require a detailed assessment of where the PATH mainland terminals would be located along the Fraser River. It also involves mapping with significant accuracy the destinations of containers transiting via PATH. Given that this information is not available, we focus on providing a high-level assessment of these benefits.

Current and Forecasted Traffic

In September 2012, the Port of Vancouver published a report on the road impacts of its container capacity improvement program, including the potential impacts of T2 capacity improvements.³⁶ The following findings are most notable:

- The T2 project, which will add 2.4 million TEU of capacity to Deltaport, would generate 3,692 truck trips per day on average, of which 886 would be at peak hour (8AM to 9AM) (Table 2, page 8).

³⁶ Port Metro Vancouver et al. (2012), "Container Capacity Improvement Program: Road Traffic Distribution Report", September 27, 2012.

- Employees and visitors would also generate a significant increase in passenger vehicle trips, of 2,034 vehicle trips per day, of which 785 at peak hour (7AM to 8AM) (Table 2, page 8).
- This additional traffic would mean that unless mitigating measures are taken, port-related traffic will represent 11% of southbound traffic in the peak AM hour, compared to 5.9% before T2. Northbound, in the evening peak-hour, port-related traffic would represent 8.7%, up from 5% before T2 (Table 8-9, page 31-32).
- The study did not provide a detailed assessment of the additional traffic on delays. It did note, however, that based on modelling the truck traffic in the George Massey Tunnel at peak hour in the base year (140 trucks) increased the average bridge crossing time by over 2 minutes, from under 15 minutes to over 17 minutes (about 15% increase). T2 is expected to increase the number of trucks by 220 in that peak-hour period (Table 10, page 33).
- Truck traffic to/from the port will operate on increasingly congested causeways. On the George Massey Tunnel alone, AM peak traffic, excluding port truck traffic, is expected to increase 38%, from 5,715 to 7,895 (Table 10, page 33).

As shown on Figure 7-7, most of the traffic from Roberts Bank is destined to areas accessible from existing or future containers docks on the Fraser River (e.g. Richmond, Tilbury), which would minimize the needs for truck drayage through congested areas (e.g. George Massey Tunnel, Alex Fraser Bridge, sections of the South Fraser Perimeter Road). This distribution is assumed to also reflect future T2 traffic.

Figure 7-7: Roberts Bank Estimated Truck Traffic Distribution



Source: Exhibit 2, Port Metro Vancouver et al. (2012), "Container Capacity Improvement Program: Road Traffic Distribution Report", September 27, 2012.

7.6.2 Potential Benefits of PATH

There is no doubt that without mitigation, increased container traffic at Roberts Bank will create increased congestion on major corridors in Vancouver. Moreover, as it expands, Robert Bank will concentrate more and more traffic in one location, forcing this traffic to navigate congested roads. Many mitigating measures have been put forward. Most these measures can be put in place, and are justified, even if T2 does not go ahead.

PATH provides a long-term solution to some of these issues. Indeed, by removing truck traffic from these corridors, and shortening the drayage for many customers, it reduces congestion faced by commuters and the costs faced by shippers.

Time Saved by Commuters

Trucks represent a fairly small proportion of traffic at peak hour. Indeed, truck drivers purposefully choose to concentrate their activity on the shoulder periods to avoid, as much as possible, commuter traffic. As such, the benefits of reduced truck traffic on congestion are not very significant.

If we focus on peak AM time only, we can safely assume based on the estimate provided in the Port Metro Vancouver report (2012) that removing trucks related to T2 expansion would diminish average crossing time for the George Massey Tunnel by about three minutes. Given that 7,895 passenger vehicles are estimated to cross each morning in 2031, this represents savings of 395 hours of travel time each business day. Assuming 250 business days per year, this represents savings of 98,750 hours for commuters each year.

In British Columbia, the average hourly wage in March 2014 was \$24.51. Using that value as a proxy of the value of time, we estimate that the congestion caused by T2 in the peak AM on the George Massey Tunnel alone could cost approximately \$2.4 million per year to commuters.

Assuming a similar pattern for PM traffic, this value could easily be doubled. If we were to value the impact for other routes, the value could also increase significantly.

To be conservative, we estimate the value of time loss for passenger cars at \$6 million per year.

Fuel Consumption and Emissions by Commuters

Based on the aforementioned time savings, which is assumed to represent idling, it is possible to measure the associated reduction in emissions. Based on research on idle fuel consumption and emission rates for a small light duty vehicle such as a Ford Fusion,³⁷ we can estimate that reduced idling would lead to a reduction in fuel consumption and emissions as follows:

- 99,184 litres of gasoline
- 265 tonnes of CO₂;
- 95 kilograms of total hydrocarbons;
- 38 kilograms of carbon monoxide; and
- 3.5 kilograms of nitrogen oxides.

In terms of fuel consumption, based on the average price in Vancouver in late April (about \$1.49),³⁸ the annual loss for commuters is \$148,000 per year.

The social cost of associated emissions is a fraction of that value. For example, CO₂ emissions, which are by far the highest social value emissions in a litre of gasoline,³⁹ are valued at about \$55 dollars by the EPA in 2030 using a 3% discount rate.⁴⁰ This means that passenger cars idling at peak AM in the George Massey Tunnel represent about \$15,000 in social CO₂ costs.

It is reasonable to think that even if we were to value the impacts of other emissions, the total value of fuel and emissions avoided due to reduced idling passenger cars in the AM peak in the George Massey Tunnel would be of the order of \$175,000 per year.

Using the same ratio as for time saved (2.5) to capture the impacts on other hours of the day and other routes we estimate that savings in fuel consumption and emissions would represent \$435,000 per year, of which \$370,000 is associated with fuel savings and \$65,000 to the social cost of emissions.

³⁷ US Department of Energy, "Which Is Greener: Idle, or Stop and Restart?: Comparing Fuel Use and Emissions for Short Passenger-Car Stops", from http://www.afdc.energy.gov/uploads/publication/which_is_greener.pdf, accessed on April 24, 2014.

³⁸ Based on <http://www.cbc.ca/bc/gasprices/>, which reports data from www.gasbuddy.com.

³⁹ Carbon dioxide emissions are valued highly in large part because their impacts are global (i.e. climate change), rather than local (i.e. local air pollution). As such, they impact a much larger population.

⁴⁰ See <http://www.epa.gov/climatechange/EPAactivities/economics/scc.html>.

Reduction in Truck-Km Traveled

The reduction in drayage distance and time is by far the most significant benefit of PATH. By reducing inefficiencies, it lowers supply chain costs and limits associated emissions. Establishing with certainty the impact of PATH on that metric is near impossible at this stage. It is, however, possible to get a sense of the magnitude of these benefits.

Based on Figure 7-7, it is possible to see that most of the containers trucked from Robert Bank could be barge to terminals much close to their destinations under the PATH operational concept. In many cases, drayage distances could be drastically reduced and would occur on largely uncongested roadways. In some cases, drayage could be completely eliminated (docks at stuffing/de-stuffing facilities, for example).

Moreover, a significant amount of cargo which is currently carried between Vancouver Island and the City of Vancouver to be containerized could be loaded/unloaded directly at PATH, generating significant savings. In this context, it seems reasonable to think that drayage km-traveled could be reduced by nearly half for containers using PATH and destined to be distributed by trucks once on the island.

According to the traffic study mentioned earlier,⁴¹ T2 would generate 959,177 truck trips annually. With about half of trips destined to Tilbury and Richmond (between 20 and 25 km), and the other half to destinations further away, it is reasonable to think that the average drayage distance would be about 30 km.

Assuming that this average distance is halved, to 15 km, it is quite reasonable especially given the much larger than average savings associated with traffic to/from Vancouver Island.

In total, thus, we can estimate that if PATH were to handle the same amount of traffic as T2, savings per year would be about 14.4 million truck-kilometres.

Estimating the value saved is difficult. Indeed, one of the main drivers of drayage cost reduction is the time drivers would save by draying from less congested terminal, reducing their wait time. Indeed, trucker wait times represent nearly 40% of the cost of drayage.⁴² For ease of estimation, we assume that drivers also reduce, on average, half the wait time due to lessened congestion.

⁴¹ Port Metro Vancouver et al. (2012), "Container Capacity Improvement Program: Road Traffic Distribution Report", September 27, 2012.

⁴² BC Trucking Association and Asia-Pacific Gateway Skills Table (2013), "Drayage Trucking in Metro Vancouver: Owner-Operator Business Toolkit", accessed from <http://toolkit.bctrucking.com/>, April 24, 2014.

An estimate of the average trip cost, before and after, was obtained using the financial model posted as part of the Owner-Operator Business Toolkit for Vancouver.⁴³ The average initial trip was assumed to be a total of 30 km, with 2.5 hours of wait time (queuing, pickup terminal and delivery terminal). For PATH traffic, the average trip was assumed to be 15 km, with an average wait time of 1.25 hours. The difference in cost was \$70 (from \$140 to \$70) per trip. Of that, about \$8 to \$9 per trip is related to fuel.

Based on this, we estimate that potential commercial savings related to reduced miles-travelled for traffic levels equivalent to T2 are of the order of \$67.1 million per year. Fuel savings alone represent \$8.6 million. Using a similar ratio of fuel value to social cost as for commuters, we can estimate the social cost of emissions at roughly \$1.1 million per year.

Summary of Benefits

The value of these quantifiable benefits is not insignificant. Indeed, on an annual basis, savings related to changes in congestion and traffic patterns would be of the order of \$74.6 million per year, or over \$30 per TEU.

Figure 7-8: Estimated Value of Traffic-Related Benefits

Description of benefits	Value per Year (\$)	Value per TEU (\$)
Time Saved by Commuters	6,000,000	2.50
Fuel Saved by Commuters	370,000	0.15
Social Cost of Emissions by Commuters	65,000	0.03
Commercial Savings for Drayage	67,100,00	27.96
Social Cost of Drayage Emissions	1,100,000	0.46
Total	74,635,000	31.1

Source: CPCS estimates. Based on traffic generated by T2, with container volumes estimated at 2.4M TEU per year.

⁴³ Ibid, see <http://toolkit.bctrucking.com/3-0-my-business/3-5-financial-tools/>.

7.6.3 Qualitative Benefits

In addition to these quantifiable savings, other benefits are worth outlining. First, the proposed PATH facility is considerably cheaper than the proposed T2 expansion. Indeed, with PATH is estimated at slightly under \$1.7 billion, the cost of T2 was estimated as being *more than \$2 billion* in 2011. Since then, costs are believed to have escalated significantly.

This suggests that significant infrastructure savings are possible by developing PATH, savings which could be transferred to shippers or other supply chain stakeholders. Moreover, since PATH would be an automated terminal, operational savings are also expected. The potential for more efficient operations in Vancouver, with the direct loading of trains from barges, for example, would also provide real benefits.

PATH would also allow a better utilization of existing assets in Vancouver. Indeed, with container growth leading to larger vessel calls, significant terminal capacity on the Fraser River cannot be unlocked. With PATH, that capacity and these assets could be better used and developed. This would also lead to increase competition in the marine terminal sector without requiring massive investments at all three PNW ports.

Similarly, PATH provides clear potential for further economic development, both on Vancouver Island and along the Fraser River. The benefits of these developments are not fully understood, but it is clear that such a seismic change in the way of distributing containers would provide new and innovative opportunities for producers, shippers and carriers. These development opportunities would not be unlocked in the same ways by other capacity improvement projects.

Finally, PATH is a relatively environmentally friendly way to improve capacity on the West Coast. It does not require as much environmentally damageable construction methods as other projects and it reduces trucking emissions. Overall, it is a greener way to handle future container capacity constraints in Vancouver and the Pacific North West.

8 Conclusions

8.1 Conclusions

The PATH concept is bold and could significantly alter container flows to and from PNW ports and terminals. It also has the potential to generate significant economic and other benefits.

The market potential of the PATH project would likely be tied to a push by a major shipping line or shipping line alliance for a market share grab – by deploying larger ships and offering lower container slot costs for PNW trades. Our consultations have suggested that this could be feasible, and shipping lines are not closed to this possibility, though this scenario is largely contingent on the ability of the PATH concept to deliver handling cost savings, relative to competing PNW ports which translate into lower overall transportation costs for shippers.

Based on an analysis of the logistics costs of the PATH Single Port of Call Scenario vs. the Status Quo Scenario, PATH's handling charges would need to be below \$110 per TEU for rail customers and \$202 per TEU for truck customers. By comparison, Deltaport's combined wharfage and throughput charges are currently \$311 per TEU for rail customers and \$261 per TEU for truck customers. This provides some room for offering a discount (but this would be contingent on overall lower operating costs at PATH, including appropriate coverage for capital costs).

At any rate, to be viable, the PATH concept would need to secure long term traffic and investment commitments from one or more shipping lines.

Appendix A: Major Shipping Lines Rotation in the Pacific Northwest

Shipping Line	Alliance	Service Code	North American Ports	Foreign Countries Served	Foreign Ports	Notes
APL	New World Alliance, G6	PNW	Vancouver, Seattle, Tacoma	South Korea, Taiwan, China	Busan, Shanghai, Kaohsiung, Yantian, Hong kong	
APL	New World Alliance, G6	PSX	Vancouver, Seattle, Oakland, San Pedro	Japan, China, Vietnam, Thailand	Tokyo, Yantian, Hong Kong, Cai Mep, Laem Chabang	
MOL	New World Alliance, G6	PN1	Vancouver, Tacoma	Japan, South Korea, Taiwan, China	Tokyo, Nagoya, Kobe, Shanghai, Kaohsiung, Yantian, Hong Kong, Xiamen	
MOL	New World Alliance, G6	PNW	Vancouver, Seattle, Tacoma	South Korea, Taiwan, China	Busan, Shanghai, Kaohsiung, Yantian, Hong kong	
MOL	New World Alliance, G6	PSX	Vancouver, Seattle, Oakland, San Pedro	Japan, China, Vietnam, Thailand	Tokyo, Yantian, Hong Kong, Cai Mep, Laem Chabang	
OOCL	New World Alliance, G6	NWX	Vancouver, Tacoma	Japan, South Korea, China	Tokyo, Nagoya, Kobe, Busan, Ningbo, Shanghai, Qingdao	Weekly
OOCL	New World Alliance, G6	PAX	Tacoma Oakland, Los Angeles	Asia and East Coast US		Weekly, Pendulum service
OOCL	New World Alliance, G6	PNX	Vancouver, Tacoma	South Korea, Taiwan, China, Singapore, Thailand	Busan, Kaohsiung, Hong Kong, Da Chan Bay, Singapore, Leam Chabang	Weekly
Hapag-Lloyd	Grand Alliance, G6	NWX	Vancouver, Tacoma	Japan, South Korea, China	Tokyo, Nagoya, Kobe, Busan, Ningbo, Shanghai, Qingdao	
Hapag-Lloyd	Grand Alliance, G6	PNX	Vancouver, Tacoma	South Korea, Taiwan, China, Singapore, Thailand	Busan, Kaohsiung, Hong Kong, Da Chan Bay, Singapore, Leam Chabang	

Shipping Line	Alliance	Service Code	North American Ports	Foreign Countries Served	Foreign Ports	Notes
Hyundai (HMM)	Grand Alliance, G6	PN1	Vancouver, Tacoma	Japan, South Korea, Taiwan, China	Tokyo, Nagoya, Kobe, Shanghai, Kaohsiung, Yantian, Hong Kong, Xiamen	
Hyundai (HMM)	Grand Alliance, G6	PNW	Vancouver, Seattle, Tacoma	South Korea, Taiwan, China	Busan, Shanghai, Kaohsiung, Yantian, Hong Kong	Add Kwangyang westbound
Hyundai (HMM)	Grand Alliance, G6	PS1	Vancouver, Seattle	Japan, South Korea, Taiwan, China	Yokohama, Kaohsiung, Chiwan, Hong Kong, Yantian, Xiamen, Busan	
NYK	Grand Alliance, G6	PNX	Vancouver, Tacoma	South Korea, Taiwan, China, Singapore, Thailand	Busan, Kaohsiung, Hong Kong, Da Chan Bay, Singapore, Leam Chabang	Weekly
NYK	Grand Alliance, G6	CKX	Seattle, Oakland, Long Beach	South Korea, China	Busan, Kwangyang, Shanghai	Weekly
NYK	Grand Alliance, G6	NWX	Vancouver, Tacoma	Japan, South Korea, China	Tokyo, Nagoya, Kobe, Busan, Ningbo, Shanghai, Qingdao	Weekly
NYK	Grand Alliance, G6	PAX	Tacoma, Oakland, Los Angeles	Asia and East Coast US		Weekly
ZIM	Aligned with G6	NWX	Vancouver, Tacoma	Japan, South Korea, China	Tokyo, Nagoya, Kobe, Busan, Ningbo, Shanghai, Qingdao	Weekly
ZIM	Aligned with G6	PNX	Vancouver, Tacoma	South Korea, Taiwan, China, Singapore, Thailand	Busan, Kaohsiung, Hong Kong, Da Chan Bay, Singapore, Leam Chabang	
"K" Line	CKYH	NOWCO-2	Prince Rupert, Vancouver, Seattle	China	Shanghai, Ningbo, Yantian, Hong Kong	
"K" Line	CKYH	NOWCO-3	Vancouver, Tacoma	South Korea, China	Busan, Shanghai, Ningbo	
"K" Line	CKYH	NOWCO-A	Vancouver, Tacoma	Japan, Taiwan, China	Tokyo, Nagoya, Kobe, Kaohsiung, Xiamen, Yantian, Hong Kong	
"K" Line	CKYH	CALCO-Q	Prince Rupert, Oakland, Long Beach	China	Qingdao, Xingang, Dalian	
CMA-CGM	P3	COLUMBUS / TP9	Vancouver, Seattle	South Korea, China, Malaysia	Busan, Shanghai, Yantian, Hong Kong, Tanjung Pelepas	Pendulum service with Asia/Europe. 17 x 8,500 TEU
MAERSK	P3	COLUMBUS / TP9	Vancouver, Seattle	South Korea, China, Malaysia	Busan, Shanghai, Yantian, Hong Kong, Tanjung Pelepas	Pendulum service with Asia/Europe 17 x 8,500 TEU

Shipping Line	Alliance	Service Code	North American Ports	Foreign Countries Served	Foreign Ports	Notes
<i>MSC</i>	<i>P3</i>	-	<i>Vancouver, Seattle, Oakland, Long Beach</i>	<i>Europe</i>	<i>Bremerhaven, Rotterdam, Antwerp, Balboa</i>	
COSCO	N/A	CPNW	Prince Rupert, Vancouver, Seattle	Japan, China	Yokohama, Shanghai, Ningbo, Yantian, Hong Kong	Capacity: 6 x 7,500 TEU
<i>COSCO</i>	<i>N/A</i>	<i>HPNW</i>	<i>Prince Rupert, Vancouver, Seattle, Portland</i>	<i>South Korea, China</i>	<i>Busan, Shanghai, Ningbo, Qingdao, Kwangyang</i>	<i>Capacity: 6 x 5,500 TEU</i>
COSCO	N/A	KPNW	Vancouver, Tacoma	Japan, Taiwan, China	Tokyo, Nagoya, Kobe, Kaehsiung, Xiamen, Yantian, Hong Kong	Capacity: 6 x 5,500 TEU
COSCO	N/A	YPNW	Vancouver, Tacoma	South Korea, China	Busan, Shanghai, Ningbo	Capacity: 5 x 5,500 TEU
CSCL	N/A	ANW1	Vancouver, Seattle	South Korea, China	Nansha, Hong Kong, Yantian, Shanghai, Ningbo, Busan	
<i>Hamburg Sud</i>	<i>N/A</i>	-	<i>Tacoma, Vancouver, Portland, Oakland, Los Angeles</i>	<i>Mexico, Panama, Venezuela, Europe</i>	<i>Hamburg, Rotterdam, Antwerp, Tilbury, Le Havre, Catagena, Panama, Manzanillo</i>	<i>Weekly</i>
<i>Hamburg Sud</i>	<i>N/A</i>	-	<i>Vancouver, Seattle, Oakland, Long Beach</i>	<i>Mexico, Chile, Guatemala, Peru</i>	<i>Lazaro Cardenas, Callao, Puerto Quetzal, Valparaiso, Puerto Angamos, Lirquen, Iquique</i>	<i>Weekly, 1,700 to 4,600 TEU</i>
Hamburg Sud	N/A	-	Seattle	South Korea, Taiwan, China	Busan, Shanghai, Kaohsiung, Yantian, Hong kong	Weekly, 8,900 TEU

Source: CPCS, from carrier's websites.

Note: Lines are in bold if the service represents a shared agreement with other carriers and is presented earlier. Lines are in italics if the service serves ports beyond the direct catchment area of Vancouver, Seattle and Taco