Competitiveness of Transpacific Routes through North American West Coast Gateway Ports

for: The Pacific Maritime Association

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Introduction

US West Coast (USWC) port authorities have seen their shares of North American container imports from Asia decline over the last several years, while the two West Coast Canadian container-handling ports (Vancouver and Prince Rupert) have experienced increased shares.

As a result, the Pacific Maritime Association (PMA) wanted to obtain an independent analysis of the factors – such as government subsidies, labor arrangements, infrastructure investments, etc. – that might provide competitive advantages for container ports in British Columbia (BC) vis-à-vis USWC ports.

Import shipments that are moved through USWC ports by rail to US interior markets in the marine containers in which they arrived into the US - generally referred to "Intact Intermodal" movements - comprise a market segment which can be considered discretionary and for which the BC ports compete aggressively. It is this segment that is the focus of Mercator's study.

The relative competitiveness of the USWC ports for Asian imports into the interior of the USA, vis-à-vis the two BC ports, depends on which inland market the containers are destined to.

The two British Columbia container ports – especially Prince Rupert – have route cost advantages of several hundred dollars per import FEU-load over both the San Pedro Bay (SPB) gateway and the Puget Sound gateway for Intact Intermodal imports from Asia to the inland metro markets that Canadian National Railway (CN) and/or Canadian Pacific Railway (CP) serve from those ports – in particular, the critical Chicago market, the Memphis market (CN only), Minneapolis (CP only), and Detroit, which collectively account for **nearly 45%** of all Intact Intermodal volume moving thru USWC ports.

Conversely, the San Pedro Bay gateway does not compete with the two BC ports for imports into Texas, as well as for imports to several secondary Midwest markets (Kansas City, St. Louis, Omaha) because neither the CN or CP main-line network directly or efficiently accesses those cities.

Higher terminal-to-rail costs and higher land transport costs for SPB and Puget Sound ports are the key factors underpinning the route cost advantages that the BC ports have vis-à-vis the USWC gateways for Chicago and the other interior markets previously noted.

The major route cost disadvantages of the USWC gateways are likely to lead to further capture of intact intermodal Asian import traffic flows by Prince Rupert and Vancouver, especially as planned terminal expansions/developments in those two ports are completed.

Even without the development of Port Metro Vancouver's Roberts Bank Terminal 2 later this decade, capacity ***expansion projects already underway in container terminals in Prince Rupert and Vancouver could provide those two ports with the physical ability by 2022 to divert approximately 15% of the Intact Intermodal import volumes now moving through San Pedro Bay and the Puget Sound.***

Government initiatives that increase costs for the USWC gateways and/or that fail to address Canadian advantages will further compound the USWC volume and share losses.

Key Risk for USWC Ports: Near-term Terminal Capacity Expansion in BC Ports

Both BC ports presently have projects underway that will add significant additional throughput capacity at two terminals.

Prince Rupert/Fairview Terminal – Phase IIB Expansion

- The Port Authority and DP World are presently undertaking a project that will increase the acreage of this terminal's container yard, the amount of on-dock rail trackage, and the number of gantry cranes.
- By or before 2023, the terminal is expected to have a throughput capacity of about 2.0 million TEUs, an increase of about 700,000 TEUs/year from its current level.

Vancouver/Centennial Terminal

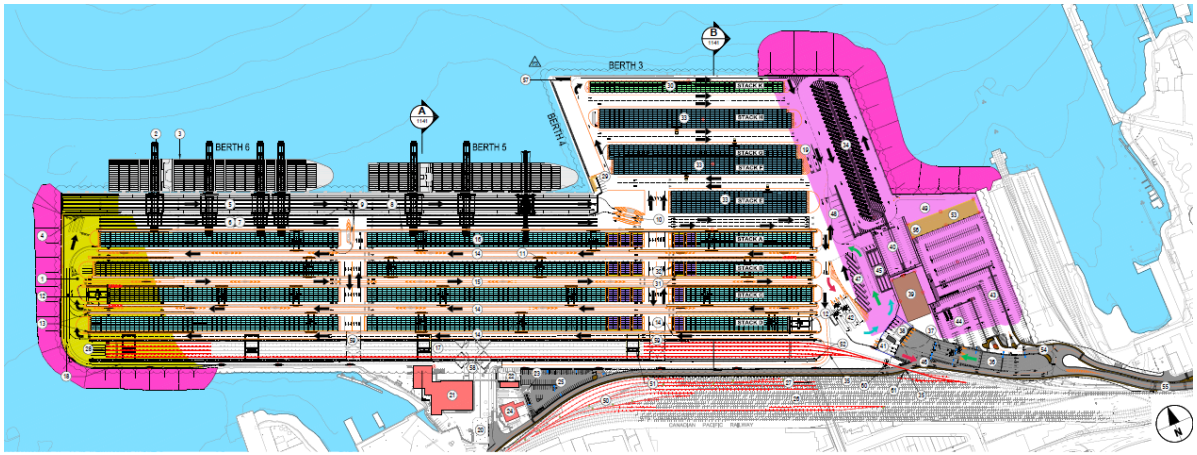
- Port Metro Vancouver and DP World are presently undertaking a project that lengths the main berth of this terminal, reconfigure/densify its container yard, and add rail tracks to its on-dock transfer facility.
- By or before 2023, the terminal is expected to add about 500,000 TEUs/year of throughput capacity.

New Capacity for USWC Diversions

- Of the roughly 1.2 million TEUs/year of new capacity being added to these two terminals by or before 2023, at least 630,000 TEUs should be available for import flows.
- Taking into account the capacity required to support organic growth of Canadian imports from Asia, Mercator estimates that ***at least 400,000 TEUs of the new capacity should be available to handle diverted Intact-Intermodal import flows from USWC ports.***

Aerial view of Fairview Terminal, Prince Rupert

Diagram showing the expansion and revised layout of Centennial Terminal, Vancouver



Competition Framework – Overview of USWC Container Port Traffic Base

In 2019, based on port authority statistics, the three port gateways of the US West Coast (USWC) - San Pedro Bay (SPB), San Francisco Bay, and the Puget Sound - received a total of 10.81M TEUs of loaded international imports, about 92% of which originated in East Asia (the countries between and including Japan and Myanmar).

Loaded international exports from these three port gateways to all offshore regions tallied only 47% of the loaded import volume, so clearly the international container traffic base of the USWC is driven by imports from Asia.

There are three segments of the Asian import container market thru the USWC ports:

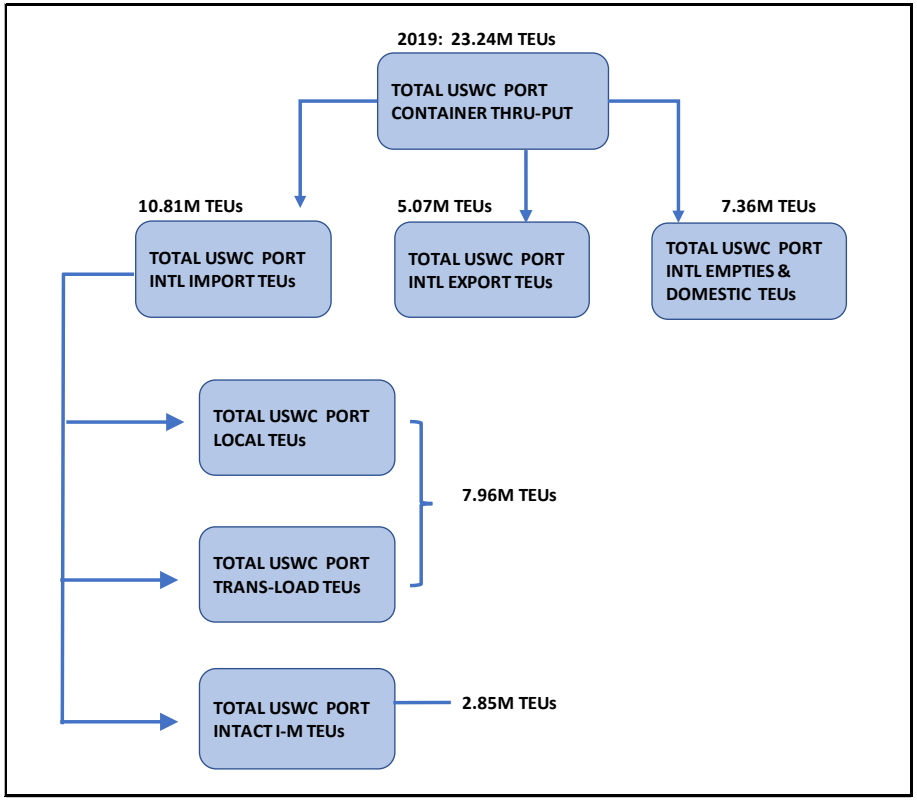
- "Local" – containers being trucked to consignees' facilities located in the three West Coast states, as well as in adjacent states (Idaho, Nevada, Arizona) or in Baja California Norte.
- "Transload" – containers being trucked to facilities in the three West Coast states, at which the import cargoes are unloaded and immediately transloaded into domestic containers and trailers for eastward movement by truck or rail.
- "Intact Intermodal" – containers moving directly by rail from the USWC ports to inland import receiving facilities in the Central and Eastern US.

The USWC ports have limited competition from the BC ports for the Local segment, due to inherent geographical advantages in inland trucking costs to consignees in the West Coast states.

The USWC ports also presently have limited competition from Vancouver and Prince Rupert for the Transload segment, because trans-loading US-destined import cargoes in either of the BC ports requires the importer to clear Canadian **and** US Customs.

However, the USWC ports confront intense competition from the two BC ports for the highly-discretionary Intact Intermodal segment, which comprises 26% of loaded USWC import TEUs, according to Datamyne and US Census import manifest data --- five years earlier, the Intact Intermodal segment accounted for over 32% of USWC import TEUs.

Segmentation of container volumes through US West Coast ports



Sources: USWC Port Authorities, Datamyne and US Census: Intact intermodal imports based on the declared destination for each container load recorded in the Datamyne data base for 2019; US Census import manifest data used as a cross-check.

Note -- although the Transload segment is significant in volume and generates tens of thousands of logistics-related jobs in the USWC gateways, the balance of this report focuses exclusively on the Intact Intermodal segment.

Competition Framework – Geographic Distribution of Intact Intermodal Imports

The Intact Intermodal segment of the USWC import container traffic base has a wide geographic distribution in terms of the destinations for those containers.

About 9% of the 2.85M TEUs of Intact Intermodal loaded imports through the USWC ports in 2019 was destined to cities in the **Mountain States** (Denver, Salt Lake City, El Paso, etc.). For these traffic flows, the USWC ports face minimal competition.

The balance of the Intact Intermodal containers terminated in seven regions east of the Rockies, demarcated in the map to the right.

The highest-volume flow was to the **"core" Midwest** zone of Illinois and Missouri (primarily Greater Chicago, Kansas City, and St. Louis), according to US Census data, with **about 30%** of total Intact Intermodal volume to Greater Chicago, and **10%** to KC/St. Louis).

The next largest flow was to the **South Central** zone, with **about 20%.**

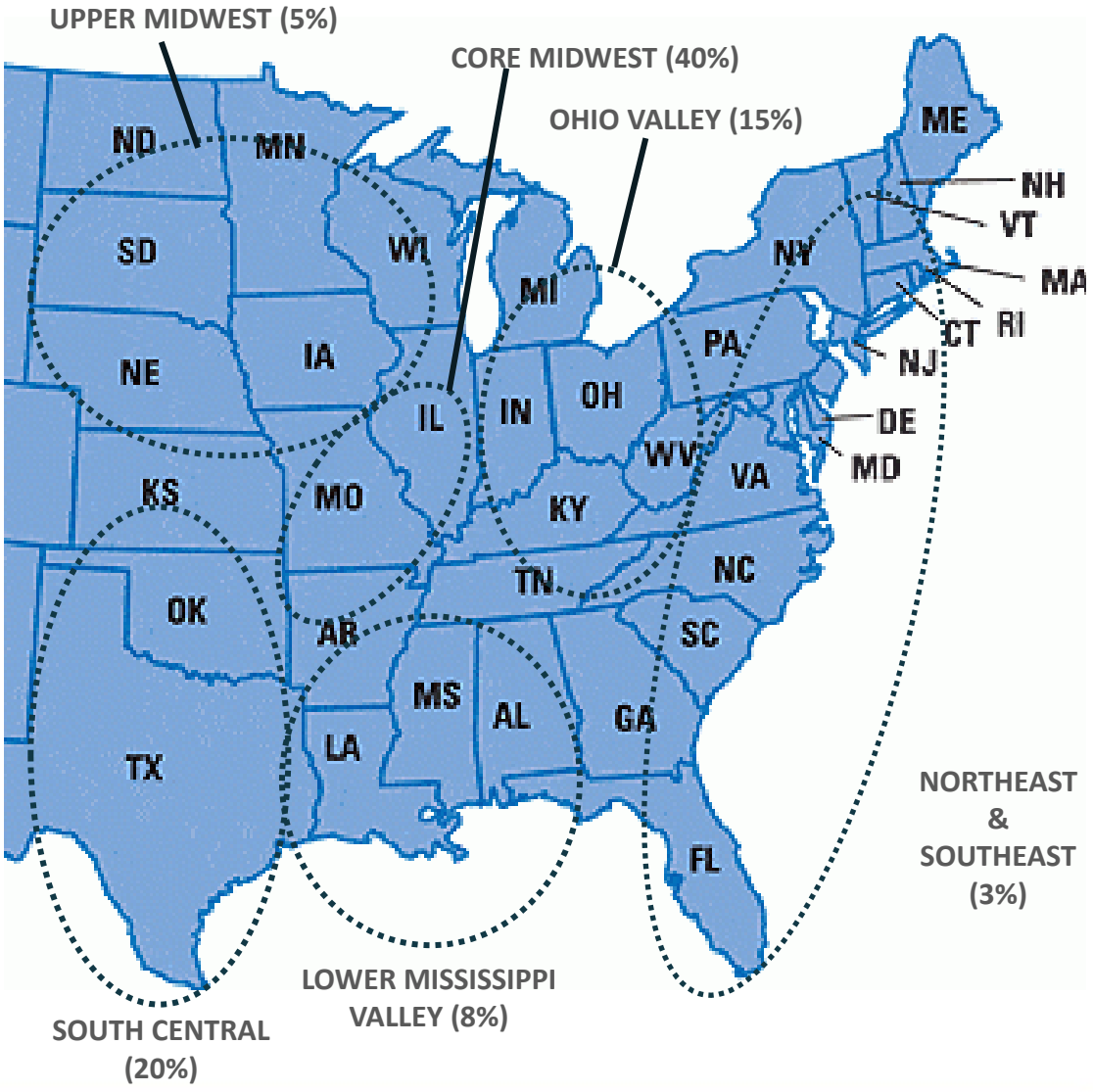
The **Ohio Valley** zone accounted for **about 15%** and the **Lower Mississippi Valley** zone (including western Tennessee) received **about 8%** of Intact Intermodal containers moving through USWC ports.

The **Upper Midwest** zone was the destination for about **5%** of the USWC intermodal imports.

The **Northeast** and **Southeast** zones collectively accounted for only **3%,** because nearly all Asia imports to those zones are already moving via all-water services.

The competitive position of the USWC ports vs. the BC ports varies significantly across these seven destination zones, as will be discussed further on the next few pages.

Regions receiving Intact Intermodal imports



Competition Framework – USWC versus BC port gateways to Core Midwest Zone

The Core Midwest zone, as the largest market by far with 40% of the Intact Intermodal imports, attracts the most competing gateways and rail routes, seeking to divert containers away from USWC ports. Illinois and Missouri make up this zone.

There are two groups of primary competitors for Los Angeles/Long Beach and Seattle/Tacoma for the **Chicago** market (30% of the intact intermodal volume):

- The two British Columbia (BC) ports – **Vancouver** and **Prince Rupert -** linked by CP (Vancouver only) and CN (both ports).
- The two main Northeast ports – New York/New Jersey (NY/NJ) and Norfolk/Portsmouth – linked by CSXT and Norfolk Southern (NS).

Among these two groups of competitors, ***the BC ports represent the far-greater threat to the SPB and Puget Sound ports, having not only significant cost advantages, but also transit time savings as well.***

Key intermodal rail service corridors thru BC gateways – Core Midwest Zone

Compared to Chicago, the competitive landscape is different for the two secondary markets of the Core Midwest zone – Kansas City and St. Louis (10%).

- St. Louis is not accessed directly by the CP rail network, and CN's access is via a branch line, and thus, it does not include this metro area in its intermodal service network.
- CN does not have main-line access to Kansas City, and CP's intermodal network for Kansas City is via Chicago, and hence circuitous and non-competitive from BC.

Hence, the USWC ports have minimal competition from the BC ports for these two secondary markets.

Competition Framework – USWC versus BC port gateways to South Central Zone

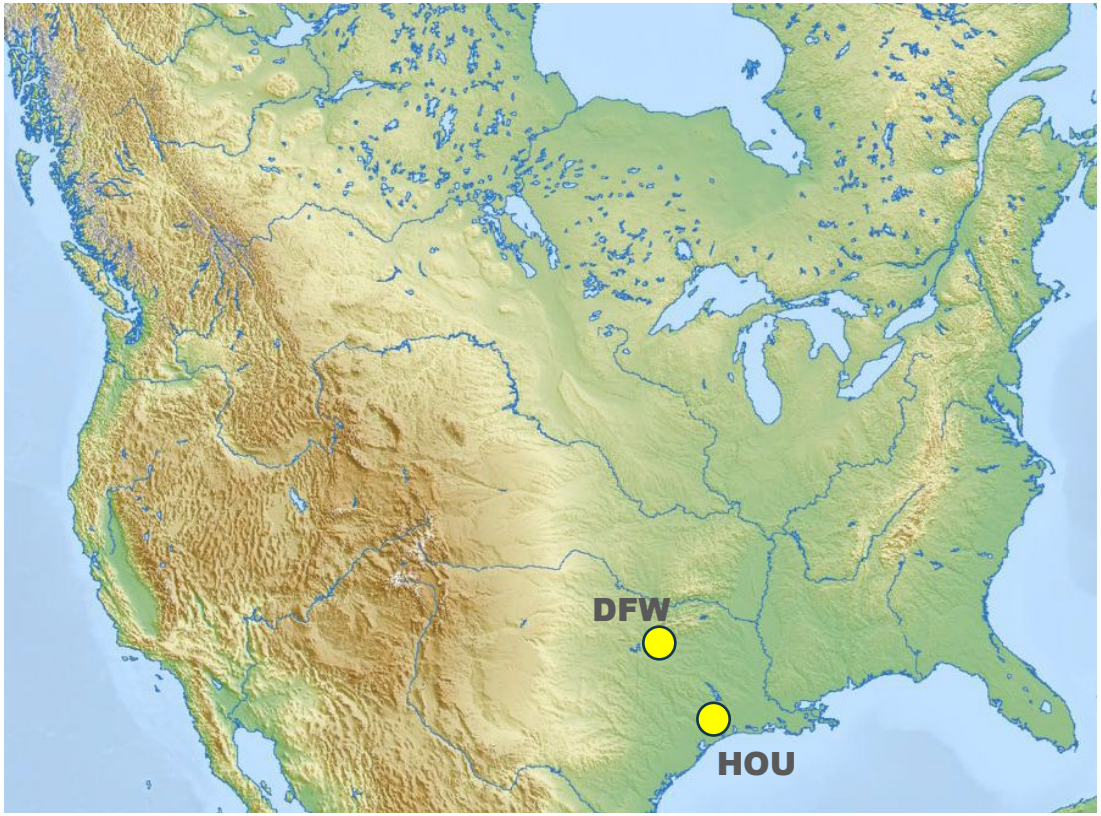
The South Central zone, comprised of Texas, Oklahoma and central Kansas, is the second largest market for Intact Intermodal imports from Asia thru USWC ports, accounting for 20% of those imports.

Almost 80% of the Asia-origin/Intact Intermodal volume destined to this zone is destined to the Dallas /Forth Worth area while most of the balance flows to Houston.

The vast majority of the Intact Intermodal imports to this South Central zone via USWC ports move thru San Pedro Bay – neither BNSF nor UP have competitive routes and intermodal services for containers that might be routed from the Puget Sound to either Dallas or Houston.

Moreover, the main-line networks of CN and CP do not extend to Texas/Oklahoma, so ***neither Prince Rupert nor Vancouver are viable port gateways for Asian imports to this zone.***

Key intermodal rail service corridors thru BC gateways – South Central zone



Competition Framework – USWC versus BC port gateways to Ohio Valley Zone

The Ohio Valley zone consists of Ohio, Indiana, Kentucky, eastern Tennessee, West Virginia, and Michigan. It receives about 15% of Intact Intermodal imports moving thru the USWC ports.

60% of the containers destined to this region move to Columbus, Cleveland and Cincinnati. Detroit and Louisville account for another 25%.

The two BC ports compete for Asia-origin intermodal imports to this zone but ***are constrained by the network limitations of the CN and CP.***

- Because CN's network includes a line linking Chicago and Toronto via Detroit, CN can connect Asia/Detroit-destined containers from its BC/Chicago trains to its Chicago/Toronto trains.
- However, CN does not have direct links to the other main markets within this region.
- CP uses trackage rights to transport Asia/Detroit boxes via train-to-train relays in Chicago, but like CN, lacks direct links to the other main markets of the Ohio Valley zone.

Key intermodal rail service corridors thru BC gateways to Ohio Valley zone

Competition Framework – USWC versus BC port gateways to Lower Mississippi Valley zone

The Lower Mississippi Valley zone comprises western Tennessee, Arkansas, Louisiana, Mississippi, and Alabama.

This zone receives about 8% of the Intact Intermodal containers imported via USWC ports from Asia. *Over 90% of these containers coming to the zone are destined to Memphis.*

Because of the CN main line between Chicago and New Orleans thru Memphis, ***Prince Rupert has become a highly competitive gateway for this zone,*** with blocks of Asia/Memphis-destined stack-cars combined with East Canada-Europe to Memphis stack cars in Chicago.

Although CN can also move Asia – Memphis traffic through the Port of Vancouver, it prefers that its ocean carrier-customers route these containers through Prince Rupert, in order to have larger blocks of such traffic on its trains.

Key intermodal rail service corridors thru BC ports to Lower Mississippi Valley zone

Competition Framework – USWC versus BC port gateways to Upper Midwest zone

The Upper Midwest zone is comprised of Minnesota, Wisconsin, Iowa, Nebraska, and the Dakotas.

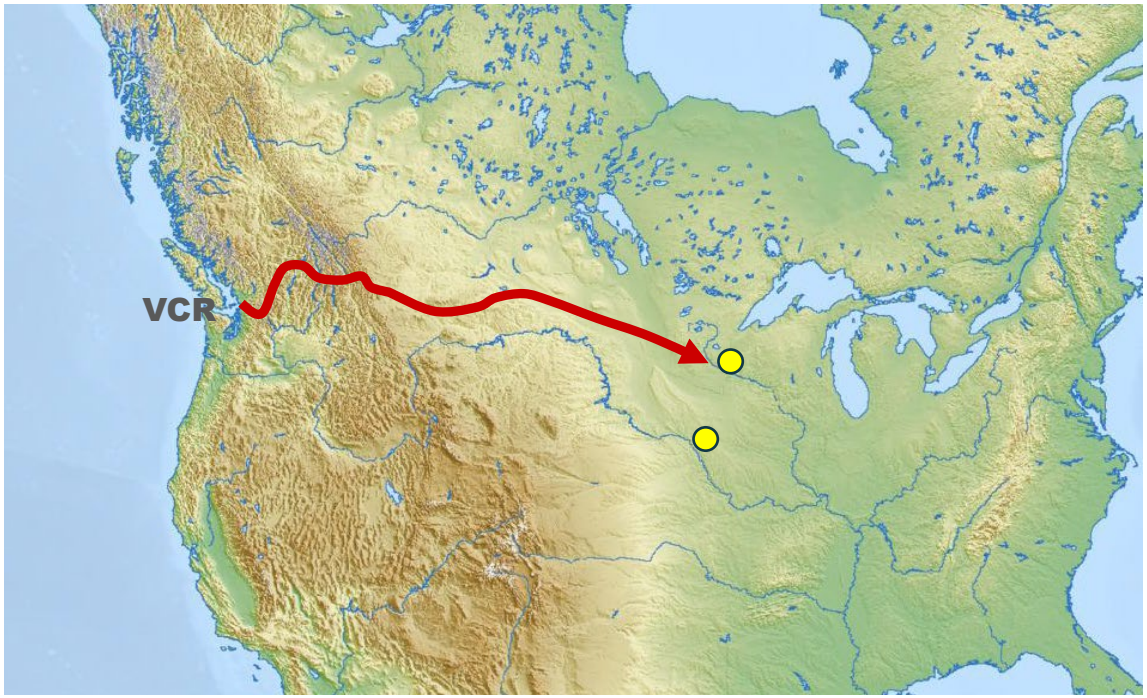
About 5% of USWC Intact Intermodal imports from Asia are destined to this zone, with about 90% of the flow terminating in Minneapolis or Omaha.

Competition from the BC port gateways vis-à-vis the USWC ports (and in particular, versus the Puget Sound ports) is limited for several reasons:

- The CN has a branch line between Duluth and Minneapolis, but does not offer intermodal train service to/from that market.
- Neither the CN nor the CP networks access Omaha.

Thus, ***the only notable source of competition for this zone's Asia import traffic is the Port of Vancouver,*** because CP's main line between the latter port and Chicago runs right thru Minneapolis.

Key Intermodal Rail Service Corridors thru BC ports to Upper Midwest zone



Competition Framework – USWC versus BC port gateways to Northeast and Southeast zones

The Northeast zone consists of the Mid-Atlantic states of Virginia, Maryland, Delaware, Pennsylvania, New Jersey, and New York, together with the New England states, while the Southeast zone consists of the Carolinas, Georgia, Florida, and eastern Tennessee.

All-water liner services have continuously diminished the volume of Asia imports routed thru USWC ports to both zones over the past 15 years, such that collectively, only about 3% of USWC intact intermodal import volume moves to these two Eastern zones, the majority of which goes to Atlanta.

Neither the CN nor CP have main lines into the Southeast (or Northeast) from British Columbia, and therefore are not competitive with the USWC ports for Asia imports to these zones.

The cost competitiveness of a gateway port is determined by not just the costs incurred within the port complex, but rather by the sum of all the costs incurred along the container shipping routes which pass through the gateway.

The respective cost competitiveness of the two USWC port complexes handling significant Asia import volumes (i.e., San Pedro Bay and Puget Sound) was therefore assessed by comparing the "**intermodal route cost chains"** from three representative origin ports in Asia through those two gateways with the complete "route cost chains" that pass through the principal alternate (BC) gateway ports.

The intermodal route cost chains for ocean carriers delivering intact intermodal Asia-origin containers to inland markets were divided into three parts for analysis:

A. **Ocean shipping costs** from the three origin ports to the North American gateway port, with the inbound load being charged for the return voyage of the vessel service back to Asia.

B. Costs at the gateway port ("**gateway ship/rail transfer costs**") which include discharging the ship, transferring the container to an intermodal rail facility (normally, but not always, an "on dock" rail terminal at the port) and loading the container onto a railcar (unless the container is typically trucked to the inland market).

   i. Note that the capital spending that North American port authorities and terminal operators have incurred to date to comply with local, state/provincial, and/or federal environmental regulations are assumed by Mercator to be incorporated into the rates that ocean carriers are paying to their terminal operators/port authorities.

   ii. Key surcharges paid by beneficial cargo owners are included in the derivation of gateway transfer costs.

C. **Cost for inland transportation** from the gateway port to the inland market --- normally effected by double-stack train, but via truck for certain markets located close to the gateway port (such as the Dallas/Forth Worth market via the Port of Houston).

The derivation of each of these three cost components is described on the next pages, commencing with the ocean shipping costs.

Ocean Shipping Costs (Cost Per FEU-Slot) – Analytical Approach

Mercator's ocean shipping service cost model was used to calculate the underlying unit costs for carriers to operate services that connect the selected offshore origin points with each of the selected North American gateway ports.

The service cost model is built upon pro forma voyage plans for each fixed-day-weekly service, which are used to calculate days at port and at sea, speed, and fuel consumption.

- The analysis considers two ship sizes: 8000 TEU ships, which are the "workhorse" mid-sized ships presently operating in the transpacific trade, and ships of 14000 TEU size.
  - Cost per day for these ships was based on our estimated cost to carriers of owning and operating or long-term chartering the ships.
  - To reduce the impact on the results of variations in costs among carriers and among similar ships within a carrier's fleet, we applied the same daily costs for the standard ships used for each route.
  - Voyage itineraries were based on actual services operating in each trade to ensure the service models reflect current practice for port calls made, number of ships deployed on a route, and corresponding speed.
  - Fuel costs were computed for two categories of ships:
    a) ***Ships with exhaust gas scrubbers,*** *which allow the continued use at sea of high sulfur fuel oil (HSFO). For these ships that are able to consume lower priced, higher-sulfur fuel, a daily cost increment was added to account for the cost of installing the scrubber systems.*
    b) ***Ships without scrubbers,*** *which must now consume very low sulfur fuel oil (VLSFO) as per the IMO 2020 guidelines for ship fuels.*
  - Fuel costs also accounted for the impact of consuming ultra low sulfur fuel when operating within Emissions Control Areas.
  - Costs per port call were estimated based upon size of ship and historical cost data for each port.
  - These costs are summarized for the two different ship sizes and two categories of ships (with and without scrubbers) for each relevant route for each of the three representative origin ports in the table on the following page.

Mercator used its ocean shipping operating cost model to assess the cost to operate a Transpacific vessel service from each of three regions of Asia (Northeast, Southeast, and Southwest) to each of two coastal zones on the West Coast of North America – the PNW/BC zone (encompassing the Puget Sound, Vancouver, and Prince Rupert), versus the California zone (encompassing Los Angeles/Long Beach and Oakland).

In doing so, we were simulating common Transpacific vessel deployment designs, in which the ships in a given deployment shuttle between a group of ports in Asia and just one of those two West Coast zones.

We chose representative actual services wherever possible to ensure that the analysis reflected current service design practices.

We selected Ningbo (PRC) as the representative loading port for the Northeast Asia region, Kalang (also known as Port Kelang, in Malaysia) as the representative loading port for the Southeast Asia region, and Chennai (India) as the representative loading port for the Southwest Asia region.

As the table to the right demonstrates, the unit cost differentials between Asia – PNW/BC services and Asia – California services range between 4-8%, depending on the Asia region and the assumed size-class of ships in the service.

Slot Costs For Selected Routes and Common Ship Sizes

	Carrier Cost per Round-Trip FEU		Diff. Vs Calif. Route (Same size each route)	
Ship Size	14000	8000	14000	8000
Fuel Type	HSFO	HSFO	HSFO	HSFO
Origin-Coast/Route	w. scrub.	w. scrub.	w. scrub.	w. scrub.
Ningbo-PNW/BC	670	800	-	-
Ningbo-California	670	800	-	-
Ship Size	14000	8000	14000	8000
Fuel Type	HSFO	HSFO	HSFO	HSFO
Origin-Coast/Route	w. scrub.	w. scrub.	w. scrub.	w. scrub.
Kalang-PNW/BC	810	980	(70)	(70)
Kalang-California	880	1,050	-	-
Ship Size	14000	8000	14000	8000
Fuel Type	HSFO	HSFO	HSFO	HSFO
Origin-Coast/Route	w. scrub.	w. scrub.	w. scrub.	w. scrub.
Chennai-PNW/BC	1,460	1,620	(60)	(80)
Chennai - California	1,520	1,700	-	-

Ocean Transportation Cost Comparison – Sensitivity to Fuel Type / Scrubber Installation

On this page, we examine the impact of IMO 2020 VLSFO fuel use requirements for ships with no scrubbers on the differential in ocean costs for routes to California versus routes to the PNW/British Columbia.

As can be seen in the table below, the unit cost differential between the PNW/BC route and the California route is fairly similar or equal across the two ship size-classes, as well between ships with or without scrubbers.

Slot costs for selected routes and common ship sizes

	Carrier Cost per Round-Trip FEU				Difference Vs PSW Route Same size each route.			
Ship Size	14000	14000	8000	8000	14000	14000	8000	8000
Fuel Type	HSFO	VLSFO	HSFO	VLSFO	HSFO	VLSFO	HSFO	VLSFO
Origin-Coast/Route	w. scrub.	no scrub.	w. scrub.	no scrub.	w. scrub.	no scrub.	w. scrub.	no scrub.
Ningbo-PNW/BC	670	710	800	850	-	-	-	-
Ningbo - California	670	710	800	850	-	-	-	-
Fuel Type	HSFO	VLSFO	HSFO	VLSFO	HSFO	VLSFO	HSFO	VLSFO
Origin-Coast/Route	w. scrub.	no scrub.	w. scrub.	no scrub.	w. scrub.	no scrub.	w. scrub.	no scrub.
Kalang-PNW/BC	810	890	980	1,070	(70)	(60)	(70)	(70)
Kalang - California	880	950	1,050	1,140	-	-	-	-
Fuel Type	HSFO	VLSFO	HSFO	VLSFO	HSFO	VLSFO	HSFO	VLSFO
Origin-Coast/Route	w. scrub.	no scrub.	w. scrub.	no scrub.	w. scrub.	no scrub.	w. scrub.	no scrub.
Chennai-PNW/BC	1,460	1,570	1,620	1,750	(60)	(60)	(80)	(70)
Chennai - California	1,520	1,630	1,700	1,820	-	-	-	-

- Note – the costs shown here for the ships with scrubbers are the same as shown on the prior page, and are included as a reference, to compare with the cost for using ships with no scrubbers and burning VLSFO.

Terminal Cost Comparisons for USWC ports versus BC ports

Mercator collected and analyzed inputs from a variety of industry sources to estimate the approximate charges paid by ocean carriers to discharge an inbound container and have it loaded aboard an intermodal train at the gateway ports being reviewed in this report.

Cost to move an inbound container from aboard ship to departing on a train (per FEU)

Average Charges by Region	Ship-Train Handling	Surcharges	Total Cost Ship-to-Train
San Pedro Bay	$520	$140	$660
Other USWC	$510	$90	$600
BC	$400	$1	$401

- Actual terminal charges are governed by confidential agreements between carriers and terminal operators. Figures above reflect our best estimates based on our participation in the sector and available market information.
  - *Ship-to-train handling includes discharge from the ship, handling in the terminal, and delivery to the rail terminal and loading aboard a train.*
  - *In addition to the charges paid to terminal operators, the ship-train handling costs include assessments paid by ocean carriers to port worker pension and benefit funds and employer associations.*
  - *Wharfage charges are normally included within the handling rates paid to the terminal operator but, in any case, are included in the ship-to-train costs.*
- It is evident from this analysis that ***before surcharges***, ***USWC ports have substantially higher costs for ship-to-train handling. SPB costs are about $120 higher than in BC.***
- Surcharges include the Harbor Maintenance Fee in the US (0.125% of cargo value, which we estimate to be about $90/container) and the Alameda Corridor Fee in San Pedro Bay ($26.33 per TEU, or nearly $50 per container).
- While all US ports have the same Harbor Maintenance Fee (estimated to be $90/container), ***BC port users pay only an inconsequentially small infrastructure fee***. SPB traffic also pays the Alameda Corridor Fee of nearly $50/container.
- In addition to offering lower direct charges for container handling services, BC ports are able to operate economically during all three shifts because the overnight "hoot shift" at BC ports provides 6.5 hours of productive working time for 8 hours of pay (as compared to the 5 hours working for 8 hours pay in US ports). This shortens the required vessel port stay and lowers carriers' service costs.
- Other local West Coast fees (like the Pier Pass traffic mitigation or clean truck fees) do not generally apply to intermodal traffic, which is primarily loaded to trains at on-dock terminals.

North American Inland Transport Costs

Mercator collected and analyzed inputs from shippers / carriers / industry participants to estimate the approximate inland transportation costs paid by ocean carriers for intermodal train service to key inland markets across North America. The results are summarized in the table below.

Cost per inbound container for movement from main gateway ports to key inland markets

Gateway	Zone	Inland Costs For relevant Gateway/Inland Combinations						
		Chicago	Kansas City	Dallas	Memphis	Atlanta	Columbus	Detroit
San Pedro Bay	California	1710	1630	1580	1630	1850	2170	1900
Seattle/Tacoma	PNW/BC	1700	1970		1800		2160	1890
Vancouver/Rupert	PNW/BC	1330			1570			1540

- Actual rail transportation charges are governed by confidential agreements between ocean carriers and railroads. Figures above reflect our best estimates based on our participation in the sector and available market information.
- As the table above indicates, ***the two Class I Canadian railroads (CN and CP) are assessed by Mercator to be charging considerably less for rail transportation service to the critical Chicago metro market than the UP and BNSF are viewed to be charging their ocean carrier customers.***
- CN and CP are also charging much less to the smaller Detroit metro market, having the ability to offer single-line service (whereas UP and BNSF have to interchange with NS or CSXT to access Detroit).
- CN and CP are both exploring options for interchanging containers with short-line railroads to serve additional metro markets in the Ohio Valley zone (such as the CN's agreement with the Indiana Railroad that provides cost-effective access to the Indianapolis market).
  - *If CN and/or CP can implement similar agreements with other short-lines to such markets as Columbus and/or Cincinnati, the BC ports will likely be able to divert additional Asia – Ohio Valley imports away from the two USWC gateways.*
- UP/BNSF rates from SPB to Memphis are more competitive with CN charges to Memphis (versus to Chicago).

North American Route Costs – Using 8,000 TEU Ships

Combining the ocean transportation costs, gateway port handling costs and surcharges, and inland transportation costs, we computed the carrier's total route cost from origin (Ningbo, in this example) to key inland markets across North America. The results are summarized in the table below.

Cost per inbound container, origin to inland destination by gateway (upper); difference in cost versus SPB gateway (lower)

Gateway	Route	Ocean-Gateway-Inland: Route Costs (8000 HSFO)						
		Chicago	Kansas City	Dallas	Memphis	Atlanta	Columbus	Detroit
San Pedro Bay	California	3170	3090	3040	3090	3310	3630	3360
Seattle/Tacoma	PNW/BC	3060	3330		3160		3520	3250
Vancouver/Rupert	PNW/BC	2520			2750			2720
Gateway	**Route**	**Diff in Ocean-Gateway-Inland Route Costs Vs Calif Route**						
		Chicago	Kansas City	Dallas	Memphis	Atlanta	Columbus	Detroit
San Pedro Bay	California	-	-	-	-	-	-	-
Seattle/Tacoma	PNW/BC	(110)	240		70		(110)	(110)
Vancouver/Rupert	PNW/BC	(630)			(310)			(610)

- Routes through the SPB gateway have much higher costs than the BC ports for the key markets of Chicago, Memphis, and Detroit.
- Routes through the Puget Sound gateway are also much higher than the BC ports for the same key markets.
- ***The cost differences between either the SPB gateway or the Puget Sound gateway with the BC ports are so significant that further share erosion is likely.***

North American Route Costs – Using 14,000 TEU Ships

This table repeats the figures from the prior table, except is based on slot costs using 14,000 TEU ships in each lane.

Cost per inbound container, origin to inland destination by gateway (upper); difference in cost versus SPB gateway (lower)

Gateway	Route	Ocean-Gateway-Inland: Route Costs (14000 TEU, HSFO)						
		Chicago	Kansas City	Dallas	Memphis	Atlanta	Columbus	Detroit
San Pedro Bay	California	3040	2960	2910	2960	3180	3500	3230
Seattle/Tacoma	PNW/BC	2930	3200		3030		3390	3120
Vancouver/Rupert	PNW/BC	2400			2635			2605

Gateway	Route	Diff in Ocean-Gateway-Inland Route Costs Vs California Route						
		Chicago	Kansas City	Dallas	Memphis	Atlanta	Columbus	Detroit
San Pedro Bay	California	-	-	-	-	-	-	-
Seattle/Tacoma	PNW/BC	(110)	240		70		(110)	(110)
Vancouver/Rupert	PNW/BC	(640)			(325)			(625)

- As with the 8000 TEU size class, routes through the SPB gateway are have much higher costs than the BC ports for the key markets of Chicago, Memphis, and Detroit.
- Routes through the Puget Sound gateway are also much higher than the BC ports for the same key markets.
- ***Once again, the cost differentials between the USWC gateways and the BC gateways in key markets are large enough to lead to continued diversions of volumes thru the Canadian ports.***

Additional Cost Disadvantage for San Pedro Bay Ports
Compliance with California Clean Air Regulations

- California is well known for being in the vanguard of environmental protection regulations generally, and specifically with respect to regulations that affect ports and shipping.
- Laws and regulations already in place have had a significant impact on the cost of shipping cargo to/from/through California ports.
- Starcrest Consulting LLC, working on behalf of the Pacific Merchant Shipping Association (PMSA), has undertaken analysis of port-related transport operations and has estimated that compliance costs **already incurred** by the shipping sector in California **have amounted to nearly $6.5 billion dollars.**
  - ***Mercator assumes that these compliance costs are already contributing to the differentials enumerated in earlier in this report.***
- However, going forward, additional regulation of California shipping, port and trucking operations is planned and will add to the existing cost differentials.
- Analyzing the results produced by Starcrest, Mercator estimates that the additional costs for compliance with proposed clean air regulations will cost the **SPB container sector about $9.5 billion over the next 10 years,** as summarized in the table below:

Cost of Compliying with Proposed Requirements	Total $ Est Cost	Container Sector % of Tot	Container Sector $ millions
Heavy Duty Trucks: Advanced Clean Truck Regulation	7,259	95%	6,896
Other (non-truck) Regulations			
Ocean going Vessels CARB At-Berth Amendments	178	100%	178
Ocean going Vessels VSR -thru 2030	50	53%	27
Ocean going Vessels Fuel Switch - thru 2030	220	44%	97
Cargo Handling Equipment CARB CHE Amendments	2,229	100%	2,229
Commercial Harbor Craft CARB HC Amendments	179	53%	95
Proposed Requirements (other than local trucks)			2,625
Proposed Requirements Total			$ 9,521

Additional Cost Disadvantage for San Pedro Bay Ports
Compliance with California Clean Air Regulations – Incremental Cost Per Container

Further analysis allows the Starcrest results to be expressed on a cost per container basis:

Drayage Truck Compliance Costs

- The $6.9 billion cost to replace the drayage truck will raise the cost of container drayage in SPB, and be paid by local, transload, and off-dock intermodal volumes.
- Based on 2020 estimated volume splits and expected growth, we estimate that over the next 10 years the volume of such import drayage containers will total about 71 million TEUs (about 40 million containers).
- Dividing the expected compliance cost for drayage trucks ($6.9 billion) by the estimated headhaul (import) drayage volume (about 40 million containers) yields a **cost per import drayage container of about $170 per unit.**
  - This cost would not impact most San Pedro Bay intermodal traffic (which mostly moves via on-dock intermodal facilities and so avoids the increased drayage costs), but would severely impact those intermodal containers that for a wide variety of reasons cannot be handled on-dock and which must be drayed to a near-dock intermodal terminal.
  - This extra cost differential would make the use of off-dock intermodal terminals much less competitive and make it significantly more difficult to serve smaller intermodal markets that cannot be effectively served via on-dock loading.

Other Compliance Costs

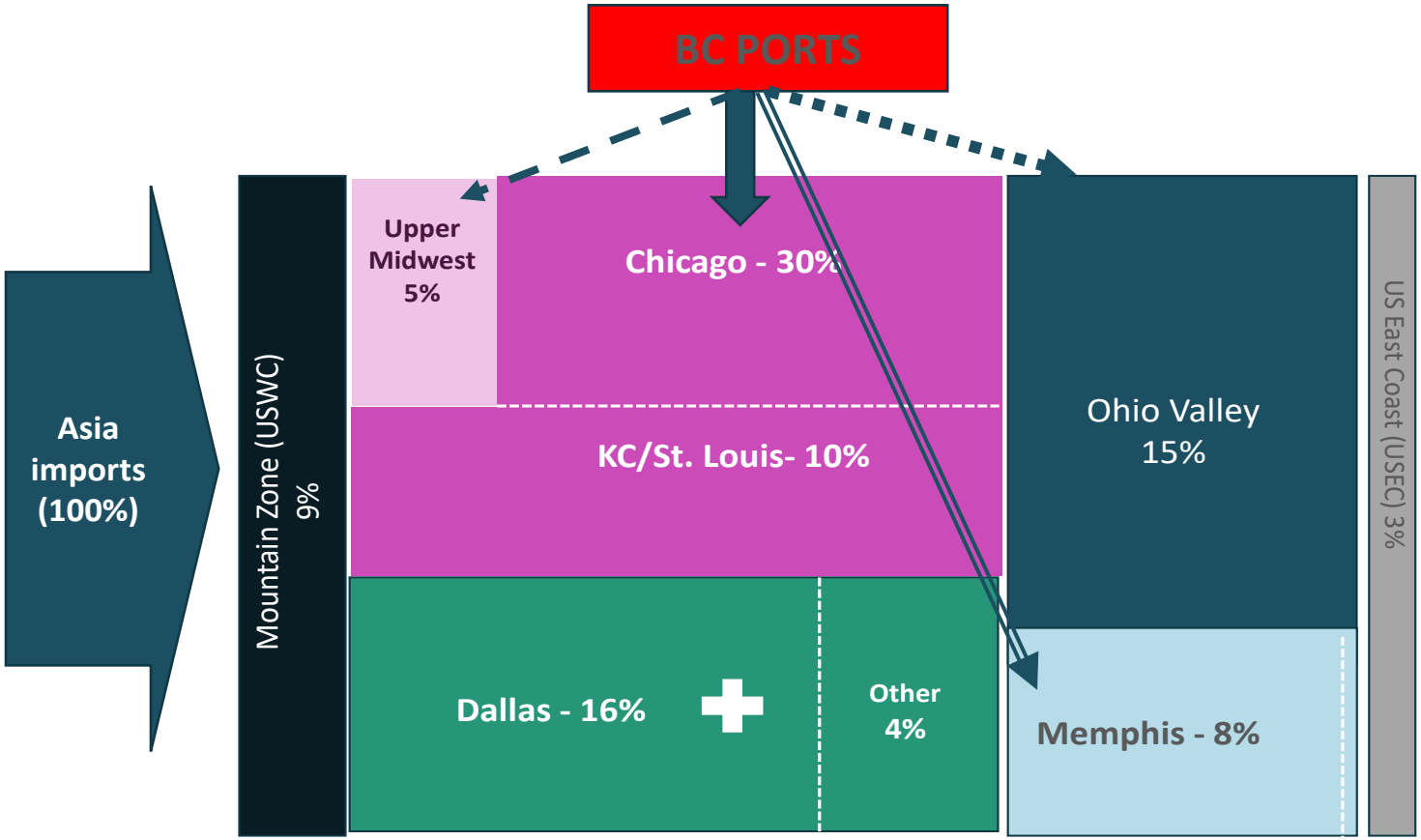
- The other compliance costs total about $2.6 billion and would be incurred by containership ocean carriers, port service providers (tugs and pilots), and by terminal operators.
- These costs would be applicable to all headhaul volumes, and as such Intermodal containers would have to pay a full pro-rata share.
- Considering total import volume of about 89 million TEUs (about 49 million containers) over 10 years, the $2.62 billion in estimated new clean air regulation compliance costs would increase the cost per import container by **a little more than $50 per import container.**
- ***This additional $50 per container would further increase the competitive cost disadvantage of the SPB gateway for intermodal import cargo as compared to Canadian, or non-California gateways, and would undoubtedly stimulate further diversion of discretionary import traffic to other North American gateways.***

The two main US West Coast port gateways (specifically, for Asian-origin container imports into the interior of the United States have significant cost disadvantages versus Canadian port gateways.

- The two British Columbia container ports – especially Prince Rupert – have competitive transit times and have route cost advantages of up to $500-600 per import FEU for Northeast Asia loads destined to the major markets of Chicago and Detroit, and (for CN only) about $300-400 to Memphis. These route cost advantages of Vancouver -- and especially Prince Rupert-- over SPB and Puget Sound are underpinned by:
  - Lower costs for locomotive fuel, ownership/leasing, and maintenance/repair for CP and especially CN trains.
  - Lower unit costs for marine terminal labor and lower terminal lease rates.
  - Avoidance of payment of the Harbor Maintenance Tax and (for SPB only) of the Alameda Corridor Transportation Authority transit fee.
- The distribution within the USA of the intact intermodal imports from Asia that move thru container terminals in San Pedro Bay, the Puget Sound, and San Francisco Bay is highly concentrated among a handful of inland major metropolitan areas, and several of these major interior markets are accessed by the main-line networks of the CN and CP from the two British Columbia container ports.
- The combination of the route cost advantages that the Vancouver – and especially Prince Rupert – have, and will continue to have to various inland markets, coupled with the concentration of intermodal volumes to those inland markets, heightens the risks of further losses of intermodal volumes away from the USWC ports.
- The imposition of additional costs on terminal operators and ocean carriers during this decade for compliance with CARB regulations will further raise the risk of additional diversions of intermodal boxes to the BC ports.
- Even without the development of Port Metro Vancouver's Roberts Bank Terminal 2 later this decade, capacity ***expansion projects already underway in container terminals in Prince Rupert and Vancouver could provide those two ports with the physical ability by 2022 to divert approximately 15% of the Intact Intermodal import volumes now moving through San Pedro Bay and the Puget Sound.***

Ramifications of Major Route Cost Disadvantages for USWC Gateway Ports

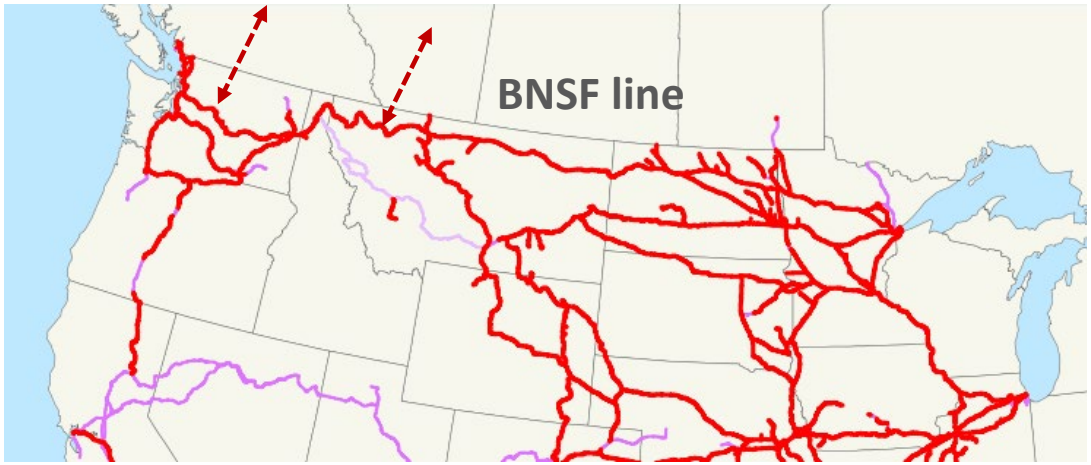
Given the route cost disadvantages outlined in this report and summarized on the prior page, a major portion of the existing intact-intermodal Asia import traffic base is highly vulnerable to further diversion to other gateway ports –



Over 45% of the USWC's current intact-intermodal import traffic is at risk of diversion to BC ports over the balance of this decade, due to continuing route cost disadvantages, and considering planned long-term infrastructure improvements in those two ports.

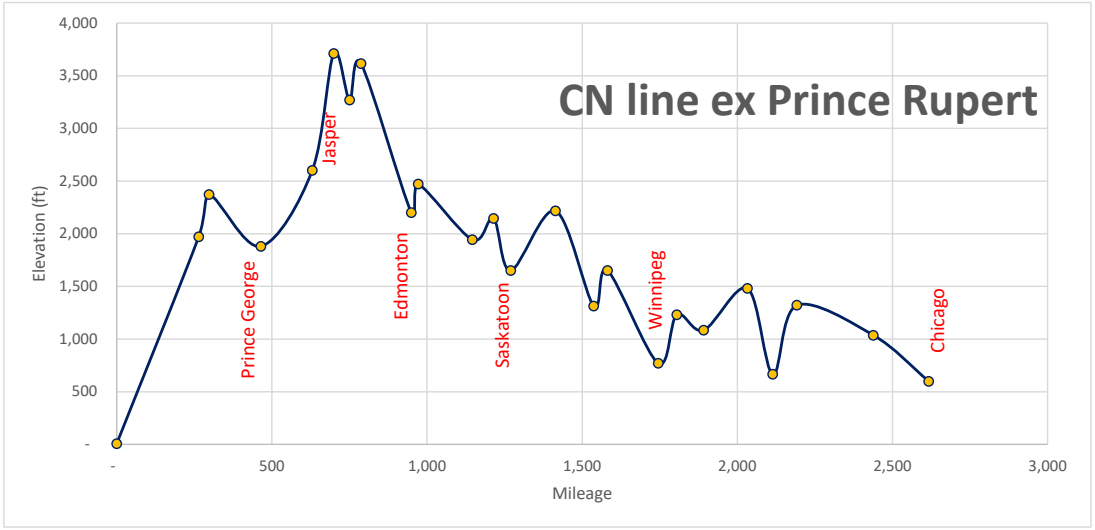
Fuel Cost Advantage for Canadian National (via Prince Rupert) versus BSNF (via Seattle/Tacoma)

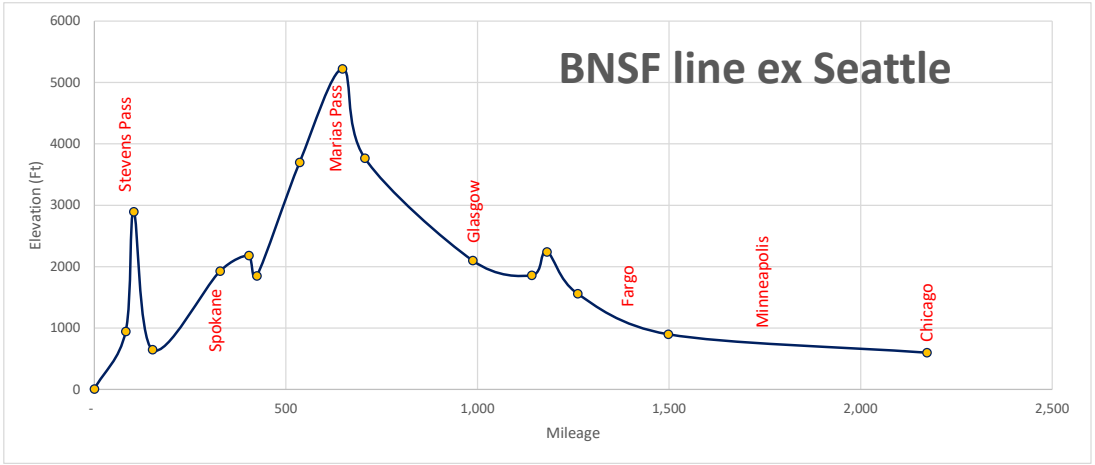
- The CN main line from Prince Rupert to Prince George to Edmonton to Chicago is the best rail route from the Pacific Coast to the US Midwest, in terms of major ascents/descents and elevation changes.
- This line has only two major ascents – the first is over the Coast Mountain range, between Prince Rupert and Prince George, and the second is over the Continental Divide (i.e. the Rockies).
- The summit over the Coast range is at only 2375' elevation, which is reached nearly after a train travels on a very gradual ascent 300 miles inland from Prince Rupert.
- By comparison, the BNSF main line from Seattle to Chicago climbs over the Cascade Range (which is the US counterpart to the BC Coast Range) with a summit of 2900', reached only 100 miles inland from Seattle (with 1900' of climb in the last the 20 miles).
- The summit over the Continental Divide for CN is at only 3700' elevation and is reached after a train climbs about 1800' over 230 miles from Prince George, again with a gradual ascent.
- By comparison, the BNSF main line's summit over the Continental Divide is over 5200' elevation, and is reached after a train climbs about 1950' over 45 miles from the west side of Glacier Park.
- In addition, the BNSF main has a third major ascent – over the Bitterroot Range in far western Montana.
- As a result, CN needs fewer locomotives to haul the same intermodal train from Prince Rupert to Chicago, than BNSF needs on its route.



Fuel Cost Advantage for Canadian National (via Prince Rupert) vs. BNSF (via Seattle/Tacoma)

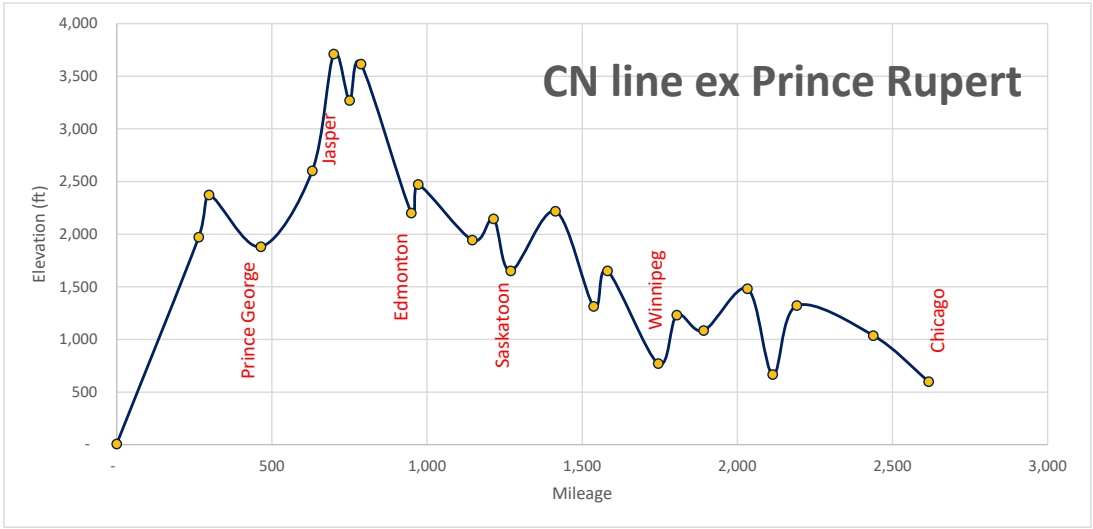
- Former operations executives of CN advise that CN requires only two high-horsepower engines to haul an intermodal train with 30-32 five-platform double-stack cars from Prince Rupert to Chicago and back.
- Using inputs from these same executives, Mercator has estimated the throttle positions of those two engines, along with estimating the average running speed of this representative train, and utilized a table published by GATX's Locomotive Division to derive the approximate diesel fuel consumption of the train on a round-trip on this line.
- A similar approach was utilized to derive the approximate fuel consumption of a similarly-sized intermodal train running from Seattle to Chicago and back, using inputs from former railroad operations executives – including guidance that BNSF would typically utilize 4 locomotives to move an international container train on this route.
- Mercator estimated the fuel consumption for the eastbound CN train at approximately 19,250 gallons, versus approximately 35,500 gallons for the eastbound BNSF train.
- Using a price for locomotive diesel fuel of USD $2.15 per gallon (the average price for 2019), the BNSF train costs nearly $35,000 more in fuel than the CN train, just on the eastbound leg.
- After assigning ***all*** of the estimated fuel consumption for the westbound train to the head-haul traffic (similar to our approach for ocean transport costing), Mercator concludes that ***the fuel cost advantage of the CN route versus the BNSF route from the Puget Sound is in the range of $195-210 per import 40' load.***

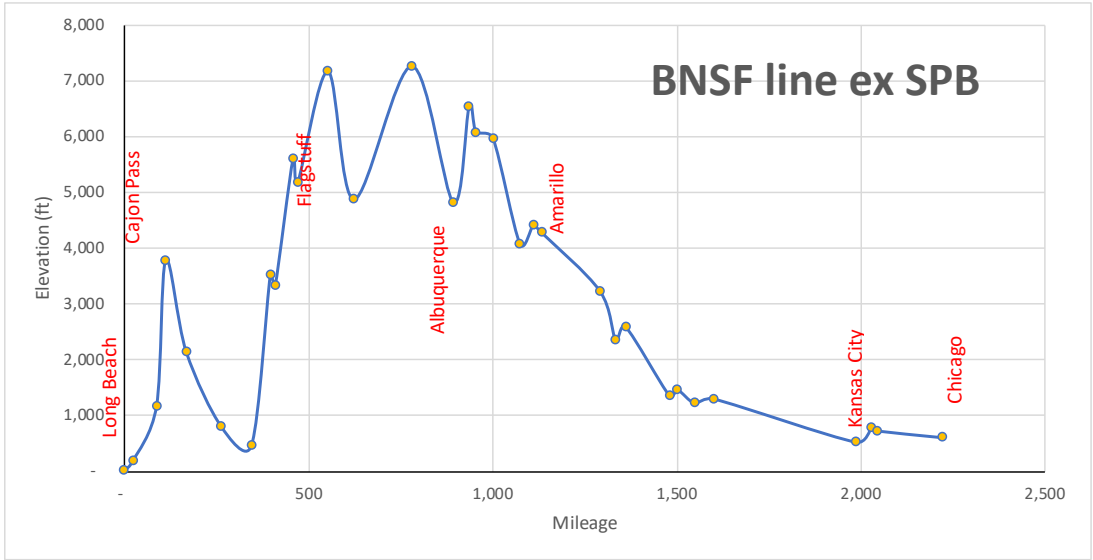




Fuel Cost Advantage for Canadian National (via Prince Rupert) vs. BNSF (via SPB)

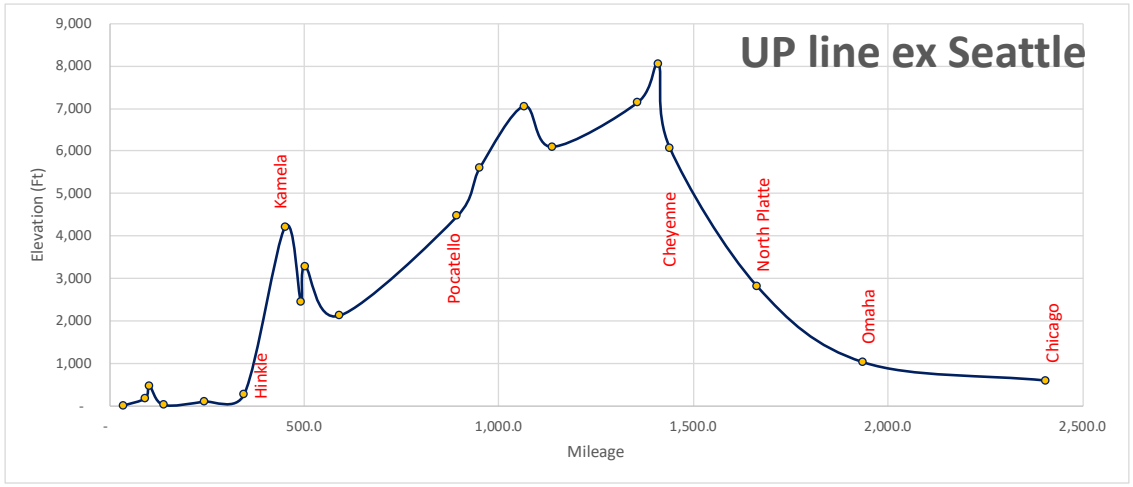
- As the diagram below right indicates, the BNSF main line from San Pedro Bay to Chicago has four major ascents and descents, the lowest of which has a similar elevation to the CN's summit across the Continental Divide, while two of the other three have summit elevations above 7000'.
- Mercator was advised by former rail operations executives that BNSF typically assigns 4 high-horsepower engines for intermodal trains on this route.
- Using the same approach, with estimates of engine throttle positions and average running speeds, we estimate that the fuel consumption for the BNSF on this route in the head-haul, eastbound direction is in the range of 37,100 gallons.
- With the same allocation methodology on the fuel consumption on the westbound leg (i..e. allocating all of the fuel cost to the eastbound traffic), Mercator estimated that the eastbound containers on the BNSF train require about 27,000 more gallons on a round-trip basis than if the same train was moving on the CN route.
- Thus, Mercator concludes that ***the fuel cost advantage of the CN route versus the BNSF route from San Pedro Bay is in the range of $200-210 per import 40' load.***

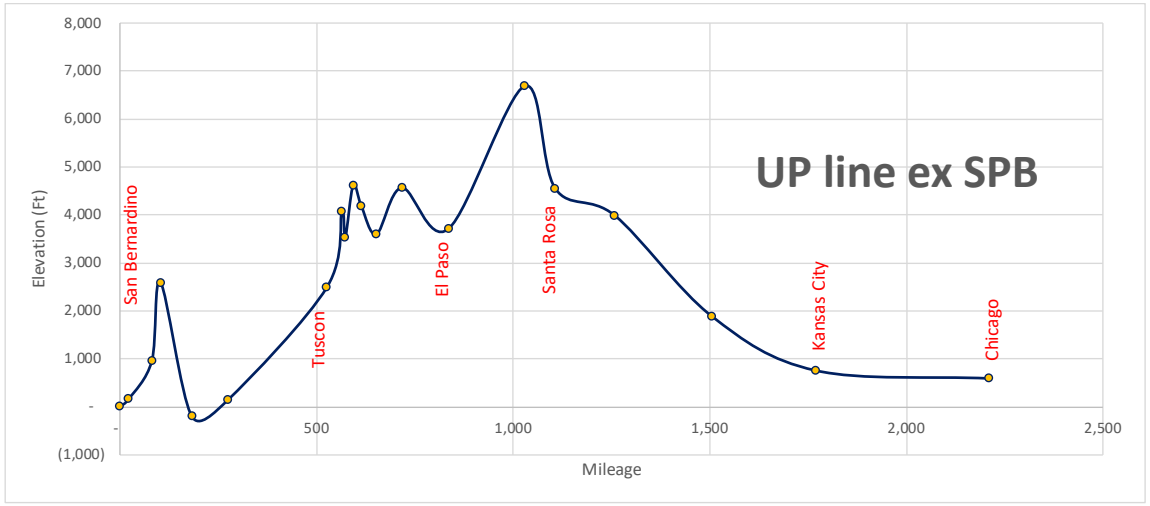




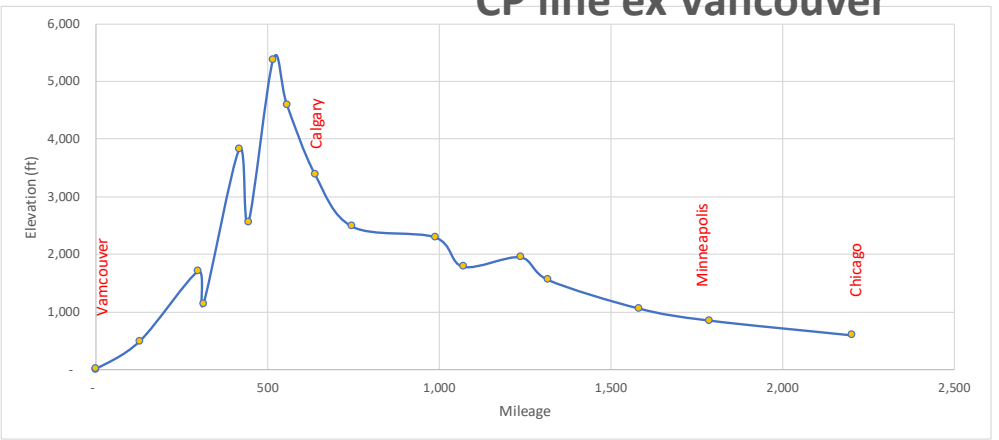
Fuel Cost Advantages for Canadian National (via Prince Rupert) vs. UP routes

- As the diagram to the right indicates, the UP main line from the Puget Sound to Chicago has three major ascents and descents, the lowest of which (over the Blue Mountains in eastern Oregon) is a relatively steep climb to an elevation of about 4200'.
- This route also traverses the highest main-line pass among the four western Class I railroads – at about 8000' elevation – near Laramie, WY.
- Mercator was advised by former rail operations executives that UP typically assigns 4 high-horsepower engines for intermodal trains on this route.
- UP's route from San Pedro Bay via Yuma/El Paso to Chicago (as diagramed below left) has four major ascents/descents, the lowest of which climbs over 1600' in about 20 miles to traverse Beaumont Pass (east of San Bernardino).
  - This route also traverses three summits in Arizona and New Mexico, the highest of which is about 6700' elevation.
- Mercator was advised that UP typically assigns 4 high-horsepower engines for intermodal trains on this route.
- Using the same fuel consumption model and allocation methodology, Mercator estimated that the UP trains on either of these routes are requiring at least 22,000-24,000 more gallons of fuel than CN requires.
- Thus, Mercator concludes that ***the fuel cost advantage of the CN route versus the UP routes is in the range of about $160-180 on a round-trip basis.***





- Given the alignment and topography of the CP's route across British Columbia, this railroad does not have comparable fuel cost advantages over BNSF and UP between the Pacific Coast and Chicago, as CN has via Prince Rupert.
- The CP's route ex Vancouver features a gradual ascent up the Fraser River valley and canyon to a 1700' summit just east of Kamloops, but then has a steep ascent over the Selkirk Mountains, followed by an even steeper ascent across the Continental Divide (on the BC/Alberta border), at an elevation of nearly 5400'.
- It is Mercator's understanding that CP runs its intermodal trains, consequently, with 4 high-horsepower engines between Vancouver and Calgary, but then uses 2 such engines between Calgary and Chicago, as that portion of the route has very gradual elevation changes.
- As a result of requiring/using an additional two engines between Vancouver and Calgary (than CN uses between Prince Rupert and Edmonton), Mercator estimates that the locomotive fuel savings that CP has versus either BNSF or UP for West Coast – Chicago trains are approximately $65-70 less per import FEU than CN's savings.
- Thus, we estimate that CP's fuel cost advantage over the BNSF or the UP is in the range of $100-140 per eastbound load, depending on which route of which US Class I railroad is being compared against.
- These fuel savings derive from being able to use fewer locomotives over a longer section of "prairie terrain", relative to BNSF or UP.



Locomotive Leasing/Repair Cost Advantages for CN versus BNSF and UP

- Because the CN can operate intermodal trains between Prince Rupert and Chicago with two fewer engines than either BNSF or UP, it requires a smaller fleet of locomotives to transport the same traffic flow volume – even though its train consist cycle time is a bit longer.
- As the tables to the right indicate, using common assumptions regarding the number of working days per year and a 10% allowance for spare engines, CN should require 18 fewer engines over a year to operate one daily intermodal train from Prince Rupert to Chicago (and back) than BNSF.
- Based on an estimated cost for leasing a modern, high-horsepower locomotive of $23,500/month (or $282,000 per year), and assuming that all of the engines are long-term leased (just as we assume that all of the ships are long-term chartered) and that per-unit leasing cost is essentially common across the Class I railroads, the smaller locomotive fleet saves CN nearly $5.1 million per annum.
- Assuming that each train is transporting 275 laden FEU and is operating 350 days per year, the head-haul volume across each of the three routes is constant, at 96,250 FEU.
- Thus, ***the CN's locomotive fleet leasing cost savings equates to more than $50 per FEU versus the BNSF.***
- Because we estimate that the UP is also deploying 4 locomotives per train, and that each locomotive consist has a 9-day round-trip turn time, we conclude that CN has a comparable savings vis-à-vis the UP for locomotive ownership costs (as expressed in leasing costs).
- Furthermore, based on Surface Transportation Board data, we estimate that the average annual M&R cost for a high-HP locomotive is approximately $135,000 per year.
- This suggests that ***CN derives an additional savings of about $25/import FEU vs, BNSF/UP in locomotive M&R.***

Prince Rupert - Chicago via CN		
Shuttle train operations	**Units**	**Input**
Working days / year	days	350
Roundtrip days / train	days / train	10
Roundtrips / train / year	**RT / train / yr**	**35**
Assumed consists per year	trains / yr	350
Locomotive requirements	**Units**	**Input**
Unit trains operating simultaneously (1 departure / day)	trains	**10**
Locomotives / train	units	2
Spare locomotives	units	2
Total locomotive requirements per year	**units / yr**	**22**

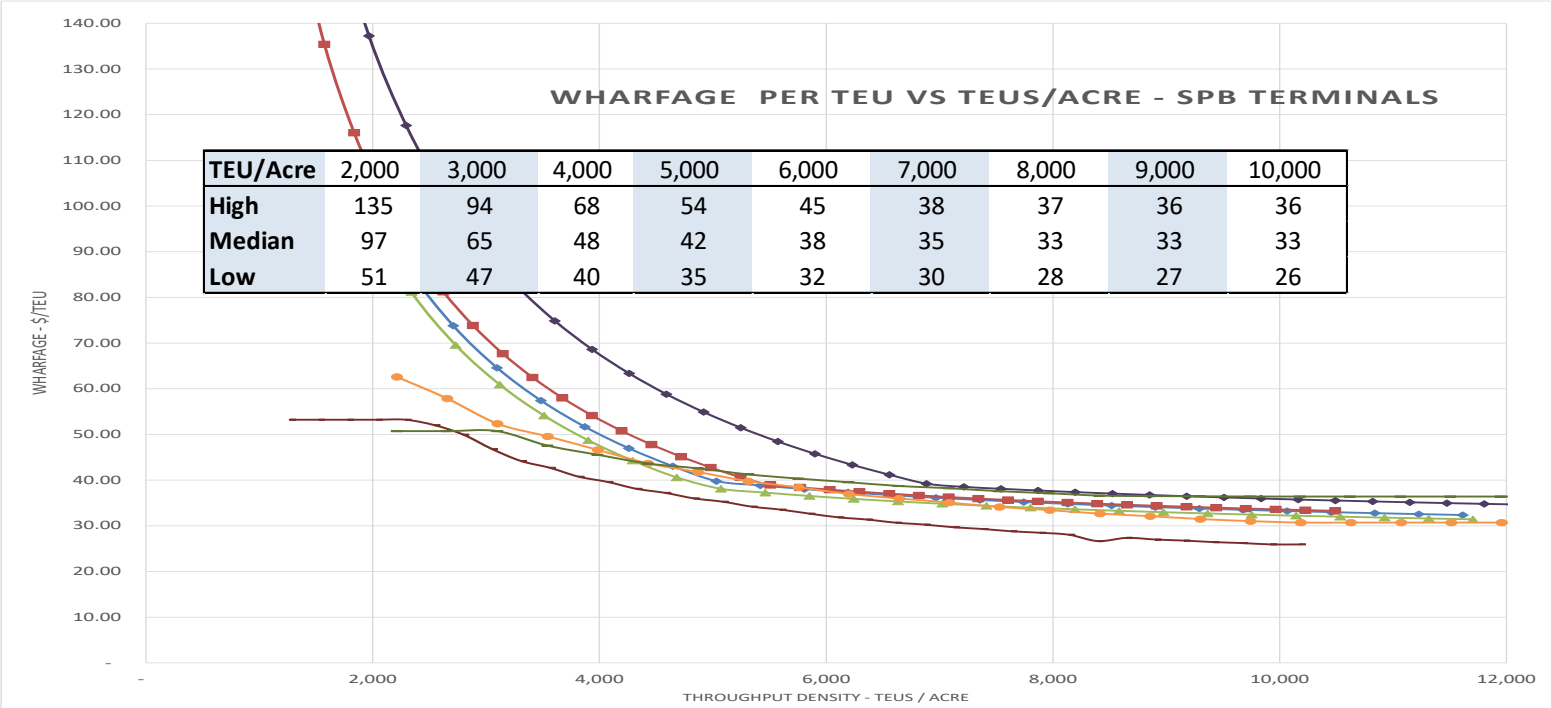
Seattle - Chicago via BNSF		
Working days / year	days	350
Days / Roundtrip / train	days / train	9
Roundtrips / train / year	**RT / train / yr**	**38**
Assumed consists per year	trains / yr	350
Locomotive requirements	**Units**	**Input**
Unit trains operating simultaneously (1 departure / day)	trains	**9**
Locomotives / train	units	4
Spare locomotives	units	4
Total locomotive requirements per year	**units / yr**	**40**

Los Angeles - Chicago via BNSF		
Working days / year	days	350
Days / Roundtrip / train	days / train	9
Roundtrips / train / year	**RT / train / yr**	**38**
Assumed consists per year	trains / yr	350
Locomotive requirements	**Units**	**Input**
Unit trains operating simultaneously (1 departure / day)	trains	**9**
Locomotives / train	units	4
Spare locomotives	units	4
Total locomotive requirements per year	**units / yr**	**40**

Key Terminal Cost Components
San Pedro Bay Terminal Lease Costs

San Pedro Terminal Lease costs per TEU

Costs per TEU fall as throughput density (expressed in TEUs / acre / year) increases



TEU/Acre	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000
High	135	94	68	54	45	38	37	36	36
Median	97	65	48	42	38	35	33	33	33
Low	51	47	40	35	32	30	28	27	26

- As illustrated above, the typical terminal agreement in San Pedro Bay features declining costs per unit as volume rises.
  - *There is normally a Minimal Annual Guaranteed rental payment that could vary between 200,000 and 400,000 per acre, depending on when the agreement was signed.*
  - *Above a certain threshold volume as specified in each lease, wharfage per unit is typically 50% of the rate paid for the initial volume. Other agreements have a pre-defined "sliding scale" with continuously declining unit rates as volume grows, which achieve the same result of a declining unit cost as volumes rise.*
  - *Agreements are subject to market re-setting at 5 year intervals, but the process is difficult and uneven because the characteristics of terminals are quite different, and non-container port uses are unhelpful in setting a value of the facilities.*

Key Terminal Cost Components
West Coast Terminal Facility Costs

On this page, we compare terminal facility costs in the main North American West Coast port zones – Southern California, Puget Sound, and British Columbia

Approximate Costs for Terminal Facilities - $/Container Basis

Port Complex	Effect. "Lease Rate" Per Container @4000 TEU/Acre Low	@4000 TEU/Acre High	@6000 TEU/Acre Low	@6000 TEU/Acre High	Leasehold / Property Tax Per Container	Crane Investment Paid By	Civil Works Investment Paid By
San Pedro Bay	$72	$122	$58	$81	abt. $10	Tenant	By Port
Puget Sound		$62		$41	abt. $4-5	Tenant	By Port
British Columbia	$35	$52	$23	$35	abt. $4-5	Tenant	By Port

- **Southern California:** In addition to "lease payments" of perhaps $60-80/container (which reflects costs at the 6000 TEU/acre throughput level), terminal operators in Los Angeles and Long Beach are subject to significant Leasehold and property taxes, which roughly amount to another $10/container. Infrastructure improvements are made by the port; ship-to-shore gantry cranes and operating equipment and systems are provided by the tenant.
- **Puget Sound:** terminal arrangements in Seattle and Tacoma reflect a more conventional property rental model with an annual charge per acre. A recent lease in Seattle was concluded at a rate of $137,000 per acre per year, which works out to $60/box at 4000 TEUs/acre, or $40/box at 6000 TEUs/acre. Some terminal operators use port-owned cranes and pay additional charges for that, which would typically add about $20 per box. Leasehold Excise (Property) taxes are about 13%.
- **British Columbia:** Terminal leases in BC are relatively less expensive than in WA and CA, but the terminal operators are generally responsible for a greater level of investment in the facility improvements. Property tax payments are about the same as what is paid in WA, but less than the levels paid in CA. Terminal operators often retain for themselves a portion of the standard PA wharfage charges that are paid by carriers.
- Taken together, we estimate that variable facility costs are roughly $40-45/container lower in British Columbia than in the main US gateway of San Pedro Bay.
  - *However, this reduced variable cost is offset by the requirement for higher capital investment in the terminals. The BC terminal operator's investment amounts are not known, making it difficult to bring these investment costs to a "$/box" level, but an imputed cost of $15-20/box would not be unreasonable.*
  - *Considering these additional factors we estimate that BC costs are roughly $20-30/container lower than in SPB and roughly comparable to the costs estimated for Puget Sound.*

Using a variety of labor productivity measures and hourly wage and benefit costs, Mercator has estimated the labor cost per intact-intermodal container moved through each of the major port gateways.

Estimated Terminal Labor Costs For Rail Intermodal Containers
Vessel Stevedoring, Terminal Handling, Rail Loading, Per Intermodal Container

Port Complex	Average Wages Paid - $/Hr	Benefits Cost $/Hr	Total Cost $/Hr	Total Vsl+ Term+ Rail Labor Hrs/Move	**Labor Cost per Inland Move**	**Advantage versus SPB**
SPB	$58	$64	$122	2.30	$281	
Puget Sound	$58	$64	$122	2.20	$269	($12)
BC (in USD $)	$51	$22	$73	2.40	$175	($105)

- Productivity (labor hours required per move) varies by terminal, and detailed data on hourly costs is not available across all ports, so some assumptions and estimates are required, making precise comparative analysis not possible. However, the above estimates illustrate the directionality and approximate magnitude of the cost differences.
- Compared to the SPB ports, Mercator estimates the Canadian gateways enjoy a labor cost advantage on the order of $100 per container.
- BC ports are able to operate economically on the overnight hoot shift, which shortens ports stays and saves service costs for ocean carriers.

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