TE MANATŪ WAKA
MINISTRY OF TRANSPORT

Domestic Transport Costs and Charges Study

Working Paper C14
Coastal Shipping

Prepared for Te Manatū Waka Ministry of Transport (NZ)
Rockpoint Corporate Finance, in association with Ian Wallis Associates Ltd
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Research, Economics and Evaluation

The Research, Economics and Evaluation team operates within the System Performance and Governance Group of Te Manatū Waka Ministry of Transport. The team supports the Ministry's policy teams by providing the evidence base at each stage of the policy development.

The team is responsible for:

- Providing sector direction on the establishment and use of the Transport Evidence Base (see below) – including the collection, use, and sharing of data, research and analytics across the transport sector and fostering the development of sector research capabilities and ideas.
- Leading and undertaking economic analyses, appraisals and assessment including providing economic input on business cases and funding requests.
- Performing the evaluation function for Te Manatū Waka, including designing monitoring and evaluation frameworks and approaches, developing performance metrics and indicators, and designing, conducting and procuring evaluations.

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The Transport Evidence Base Strategy creates an environment to ensure data, information, research and evaluation play a key role in shaping the policy landscape. Good, evidence-based decisions also enhance the delivery of services provided by both the public and private sectors to support the delivery of transport outcomes and improve wellbeing and liveability in New Zealand.

The Domestic Transport Costs and Charges study aims to fill some of the research gaps identified in the 2016 Transport Domain Plan (Recommendation R6.2), which forms part of the Transport Evidence Base.

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For more information

For more information about this project and associated report, please contact: info@transport.govt.nz.

Glossary of terms and abbreviations

Data Sources:

Te Manatū Waka	Ministry of Transport
NFDS	National Freight Demand Study
FIGS	Freight Information Gathering System
Waka Kotahi	NZ Transport Agency
Drewry	maritime consultancy – author of Drewry “Ship Operating Cost Review”, 2019
Alphaliner	maritime consultancy – database of shipping statistics
	Deloitte Port Report

Units

TEU	Twenty foot equivalent unit, a standard 20’ container
FEU	Forty foot equivalent unit, a standard 40’ container
MT	Empty container, of all/any size
mtpa	Million tonnes per annum
mt	Million tonnes
mTEU	Million TEU

Port Codes:

8 Principal Ports, all publishing Annual Reports, Price Tariffs and other documents

AKL	Ports of Auckland
TRG	Port of Tauranga
NPE	Port of Napier
WLG	Centreport
NSN	Port Nelson
LYT	Lyttelton Port
TIU	PrimePort Timaru
POE	Port Chalmers

Secondary Ports

MAP	Northport (Marsden Point)

GIS	Port Gisborne
NPL	Port Taranaki
MLB	Marlborough Port
BLU	SouthPort

Freight Terms

Break-Bulk Cargo	Goods loaded individually and shipped on pallets, in crates or barrels, or as project cargo, vehicles and equipment. Cargo is usually unable to be containerised due to size or weight restrictions.
Bulk Cargo	Goods of homogeneous characteristics which are transported unbound, such as dry materials (rock and ore, cement, fertiliser, logs and woodchip) or liquids (petroleum products, liquid chemicals).
Container	Standard steel "box" for shipping goods, being 20' by 8' by 8.5', termed Twenty Foot Equivalent Unit (TEU). Variants: FEU (40'), hi-cube (10.5' high), reefer (refrigerated).
Consignment	A general term to describe a "package" of goods for transport.
Devanning	A process of unpacking a container
Exports	Goods of domestic origin being sent to foreign destinations.
Freight	As for cargo, also referred to as shipment, consignment, goods.
Gross Weight	The full weight of a shipment, including goods and packaging.
Imports	Goods of foreign origin being brought to New Zealand.
Manifest	A full list of a ship's cargo from all bills of lading (individual consignments).
Marshalling	Receipt of cargo from road or rail transport and loading and assembling it on the wharf ready for export. In the case of imports, the removal of cargo from the wharves to prepare it for dispatch.
Neo Bulk	cars, trucks, machinery, lumber, paper, steel
PCTC	Pure Car and Truck Carrier
Reefer	temperature-controlled (refrigerated) container
ROPAX	Roll-On Roll-Off Passenger ferry, variation on RORO
Shipper	The party owning goods in transit. Typically an exporter.
Tare Weight	Weight of container/packaging without the weight of the goods.
Vanning	Process of packing and sealing a container for export/transport.
Unitised bulk	containers

Shipping Terms

Bareboat Charter	Or demise charter; the vessel is hired bare, with the charterer taking possession, full control, legal and financial responsibility, and liability for all operating expenses. Demise charters can be a form of hire-purchase.
Voyage charter	The charterer hires the vessel with its crew, for a specific voyage(s), paying an agreed sum. The ship owner pays the port, fuel costs and crew costs.
Time charter	The charterer hires a vessel for a specific period, perhaps several years. The owner manages the vessel and crew, while the charterer directs where the vessel goes and pays for fuel, port charges, commissions, and a daily hire. Foreign container ship operators typically adopt time charter.
DWT	Deadweight Tonnes
GT	Gross Tonnes
LOA	Length Over All

Executive summary

Scope

Coastal shipping is a niche provider in the NZ domestic freight (and passenger) market. This paper considers the costs and charges associated with providing shipping capacity to NZ's key coastal shipping freight markets: cement (dry bulk), petroleum (liquid bulk) and containers.

Coastal and international trade is focussed on 8 key commercial ports. The largest, Tauranga, serves 25% of all cargo ship visits, 31% of NZ's trade, and 43% of the container trade. The coastal shipping sector operates on a fully commercial basis. Shipping capacity is provided by competing private domestic and foreign operators, while ports are commercial enterprises run by local authorities.

NZ's domestic cargo carrying capability is provided by 7 domestic ships and numerous foreign ships, which nominally compete against road and rail.

The Cook Strait ferry freight and passenger services are covered in a separate working paper.

Overview

Coastal shipping carried an estimated 5.2 million tonnes ("mt") of cargo in 2018/19, representing less than 2% of the domestic freight task. Its market share in terms of tonne kms is much greater, at 13.2%, reflecting its relatively long average trip length (890 km)[1].

The 5.2 mt domestic coastal shipping freight task is made up of 2.5 mt petroleum products (liquid bulk), 1.1 mt cement (dry bulk), 0.25mt of various other bulk cargos (break, dry and liquid) and an estimated 1.1 mt of domestic cargo in containers.

Container ships carried 270,000 TEU domestic containers along our coast in 2019, in addition to 169,000 TEU of transhipments[2]. 129,000 TEU of those domestic containers (48%) were loaded , with an estimated cargo weight of 1.1 million tonnes (assuming 8.9t/TEU as derived from imported containers). Transhipment containers, 95% being full, accounted for an estimated 1.56 mt. The coastal shipping of containers (domestic and transhipment) competes directly with long-haul road and rail transport. The sole domestic container ship (the *Moana Chief*) directly contests the coastal container trade with foreign ships – and has achieved a 25% market share of this trade.

NZ ports served over 7000 ship visits in 2018/19, with the 8 key ports handling 83% of the 5500 cargo ship visits. Container ships accounted for 55% of those visits, bulk ships almost 30%, while tankers and vehicle ships shared the balance. This ship traffic is primarily serving international trade, with coastal cargo accounting for less than 10% of the total handled by NZ ports. The 410,000 TEU domestic containers moved along the coast, each being handled by both a loading and a discharge port, represent 25% of port throughput.

Coastal shipping competes most effectively in the long-haul freight market, with its average haul distance of 890km being materially higher than rail at 230km and road at 90km (NFDS). The national distribution of just two commodities, petroleum and cement, accounts for 75% of the coastal shipping task, with each forming part of vertically integrated (uncontested) supply

[1] Based on National Freight Demand Study 2017/18 ("NFDS"), adjusted for 2018/19 data
[2] Derived from Freight Information Gathering System ("FIGS") database

chains. Coastal Oil Logistics (COLL) operates two dedicated ships distributing 2.5 million tonnes of petroleum from Marsden Point to all NZ ports[3]. Similarly, two competing cement suppliers (Golden Bay Cement and Holcim) collectively distribute 1.4 million tonnes of cement[4] from Whangarei and Timaru respectively on their own ships. All other bulk cargo amounts to less than 5% of the coastal shipping freight task, while containers make up the remaining 20%.

A changing market environment has seen the decline of domestic shipping over many years. Step changes have arisen from key events. Key were the establishment of the Cook Strait Roll-on-Roll-Off (RORO) ferries in 1962 which absorbed most inter-island traffic, while the Maritime Transport Act 1994 allowed foreign ships to carry domestic cargo (cabotage), which quickly captured the rapidly growing container trade.

Domestic ships operate at some disadvantage to global players. First, the small coastal freight market denies domestic operators the scale economies able to be achieved by global shipping operators, which are also able to utilise available ship capacity to carry domestic cargo at minimal marginal cost. Second, bunkers (ship fuel) cost 30% more in NZ than in global markets[5], a material disadvantage to domestic ships given bunkers account for about 40% of total ship operating costs[6]. Further, domestic ships must pay the NZ Emissions Trading Scheme (ETS) levies on bunkers (adding a 15% premium) whereas foreign ships are exempt[7]. Third, most components of ship operating costs are higher in NZ. Crewing costs are up to triple the level of global seafarers (higher salaries, more shore leave), consumables and maintenance are double, while in the absence of suitable facilities in NZ domestic ships must travel far for dry-dock inspections.

Total cost assessment

Our analysis has been based primarily on comprehensive official datasets, notably Te Manatū Waka's National Freight Demands Study 2019 ("NFDS") and its Freight Information Gathering System ("FIGS") database. Publications and datasets from Statistics NZ and key industry stakeholders such as NZ ports added considerable detail. Shipping is a competitive and volatile sector, with limited formal information on costs and prices: accordingly, we have relied on respected international studies, notably Drewry's Ship Operating Cost Review 2018/19 and ASX Marine's Alphaliner database. With the kind input from key NZ stakeholders, these global insights and local knowledge have been adjusted to better reflect the domestic shipping sector, allowing for both the smaller ship sizes and the higher domestic cost structures.

The two key domestic coastal bulk trades, petroleum and cement, are part of uncontested integrated supply chains, with little insight available into the breakdown of cost components (raw materials, manufacturing, distribution etc) of the final product. Containers in contrast represent the key contestable coastal trade, with shipping costs a more discrete, identifiable component. Accordingly, containers are the focus of our financial modelling, which has then been extended to the bulk trades.

Ship-related costs comprise capital costs (the ship itself), ship operating costs (including labour, to ensure the ship is available to operate) and bunker costs (fuel for the journey). Port charges

[3] FIGS data
[4] Derived principally from Golden Bay Cement and Holcim announcements
[5] Bunkerworld and pers comments Z-Energy
[6] Drewry Ship Operating Costs Annual Review and Forecast 2019/20 (Drewry")
[7] United Nations Kyoto Protocol 2005 and International Maritime Organization MARPOL Convention

are divided between ‘wet’ charges (levied on the ship) and ‘dry’ charges (levied on any cargo loaded or discharged). Drewry assessed ship costs across a range of ship types and sizes (most often larger than those operating in NZ), with scale economies apparent for larger ships. Similarly, port wet charges reflected scale economies on ship size, although dry charges were fixed according to cargo type (for containers: TEU or FEU, full or empty, dry or reefer). Informed assumptions were made to allocate the known cargo mix to the various ships and routes, so allowing for ship costs to be unitised as $/tonne or $/TEU. Domestic ships must recover their costs solely over the coastal cargo they carry, whereas foreign cargo ships (principally container ships) can spread the costs of core import and export cargoes by choosing to carry coastal cargo.

The total costs (including normal profit margins) associated with the 2018/19 coastal shipping domestic transport task (5.2 million tonnes, 4.7 billion ntkm, as above) were some $225 million pa. This equates to an average of approximately $45/tonne (or 4.1c/ntkm) for containerised freight, $40/tonne (or 6.4c/ntkm) for dry bulk freight (such as cement) and $45/tonne (or 4.5c/ntkm) for liquid bulk freight (such as petroleum).

Marginal cost assessment

For an industry where capacity can only be added in relatively large increments, it is difficult to provide a single measure of marginal cost that is useful for policymakers. Both ship owners and ports operate with a degree of slack to provide flexibility to meet varying customer requirements and to have the ability to absorb delays due to weather and unexpected events. Thus in the very short run, there is generally some spare ship, infrastructure and port worker capacity on the New Zealand coast. As a consequence, the marginal cost in the strictest sense is often close to zero. This is also likely to be the case for other modes of transport. However, for the policy maker, if we simply report that there is spare capacity at the margin in ships and trains so the marginal cost in each case is close to zero, this may be interesting but is unhelpful. Perhaps of greater interest is an assessment of what increment in demand may necessitate investment to add capacity, and so add marginal cost.

When considering issues relating to cabotage, we could consider the carriage of domestic containers the marginal activity. In this case we could make the assumption that the foreign ship itinerary is fixed by the need to service its international cargo. The cost of handling domestic containers comprises the direct port costs and the in-port costs of ships transferring cargo. The latter increase per container with ship size. The marginal cost is estimated to be $120 per TEU per port, or $240 for each coastal journey, whether for domestic or international ships. Around $220 is port handling costs and $20 is ship costs.

However foreign shipping has (in theory at least) the option of making a single NZ port call and aggregating/ dispersing cargo by land transport, in which case the entire coastal operation becomes a marginal activity. Viewed in this light, the appropriate cost to use would include the steaming cost for foreign ships on the NZ coast. This increases the marginal cost by 3.5 cents/TEU-km and 0.9 cents/TEU-km for domestic and international ships respectively. This is an additional $50 for the Moana Chief or $25 for a 4000 TEU international vessel between Auckland and Lyttelton. If we calculate the costs on this basis, this will be more helpful to Te Manatū Waka and other parties making policy decisions such as “should we invest in port facilities to handle international cargo at Napier”.

The ports also appear to have spare capacity, but this is not so significant when we compare the utilisation with the industry norm of 60% utilisation, above which risks of ship delays put pressure on ports to increase capacity. This is because there is a marginal externality cost associated with port calls since one ship taking longer to load/unload due to the marginal container potentially delays the subsequent port user. This cost depends on the utilisation of the current infrastructure and is estimated to be as high as $5 per TEU for Auckland and as low as $1.50 per TEU for Wellington.

The long run marginal port cost will include the capital costs of additional cranes, berths and other infrastructure. Based on expected capital costs and likely utilisation, this is estimated to be $4 per TEU for new berths and $4.50 per TEU for additional cranes. Port capacity should be expanded if this cost is less than the externality cost calculated above. We estimate that this will be the case if either crane utilisation exceeds 50% or berth utilisation exceeds 45%. These percentages are consistent with the accepted port industry norm of expanding capacity at 60% utilisation.

Chapter 1 Introduction

1.1. Study Scope and Overview

The Domestic Transport Costs and Charges (DTCC) study aims to identify all the costs associated with the domestic transport system on the wider New Zealand economy including costs (financial and non-financial) and charges borne by the transport user.

The Study is an important input to achieving a quality transport system for New Zealand that improves wellbeing and liveability. Its outputs will improve our understanding of the economic, environmental and social costs imposed by different transport modes - including road, rail and coastal shipping - and the extent to which those costs are currently offset by charges paid by transport users.

The DTCC is intended to support the wider policy framework of Te Manatū Waka, especially the Transport Outcomes Framework (TOF). The TOF seeks to make clear what government wants to achieve through the transport system under five outcome areas:

- Inclusive access,
- Economic prosperity,
- Healthy and safe people,
- Environmental sustainability, and
- Resilience and security.

Underpinning outcomes in these areas is the guiding principle of mode neutrality. In general, outputs of the DTCC study will contribute to the TOF by providing consistent methods for (1) estimating and reporting economic costs and financial charges and (2) understanding how these costs and charges vary across dimensions that are relevant to policy, such as location, mode and trip type.

Robust information on transport costs and charges is critical to establishing a sound transport policy framework. The Study itself does not address future transport policy options; but the study outputs will help inform important policy development including areas such as charging and revenue management, internalising externalities, and travel demand management.

The Study has been undertaken for Te Manatū Waka by a consultant consortium headed by Ian Wallis Associates. The Study has been divided into a number of topic areas, some of which relate to different transport modes (including road, rail, urban public transport and coastal shipping), and others to impacts or externalities (including accidents, congestion, public health, emissions, noise, biodiversity and biosecurity).

Working papers are being prepared for each of the topic areas. The topic areas and specialist authors are listed in Appendix 2.

1.2. Costing Practices

The focus of DTCC is on NZ transport operations, economic costs, financial costs and charges for the year ending 30 June 2019 (FY 2018/19). Consistent with this focus, all economic and financial cost figures are given in NZ$2018/19 (average for the 12-month period) unless otherwise specified.

All financial costs include any taxes and charges (but exclude GST); while economic costs exclude all taxes and charges.

The DTCC economic and financial analyses comprise essentially single-year assessments of transport sector costs and charges for FY 2018/19. Capital charges have been included in these assessments, with annualised costs based on typical market depreciation rates plus an annualised charge (derived as 4% p.a., in real terms, of the optimised replacement costs of the assets involved).

1.3. Paper Overview

This Working Paper deals with Coastal Shipping

- Main topic areas (or sub-topics) covered in this paper are the costs of operating ships in NZ waters. The review spans the different types and sizes of ship active in NZ, and the port infrastructure provided to serve them. There are few domestic cargo ships, they mostly focussed on specialist cargo (petroleum products, cement), with a single domestic container ship. We provide a background of coastal cargo trade flows in the appendices.
- The presence of foreign ships introduces unique complexity to coastal shipping. First, foreign ships operate on different (materially lower) cost structures than domestic ships. Second, given their key focus is import-export trade, carriage of coastal cargo is opportunistic marginally costs are (very) low, yet price is set by full-cost domestic operators.
- Cargo tasks are almost invariably multi-modal. This paper limits its scope to the costs and prices of shipping, being the delivery from port yard to port yard, to distinguish the shipping task from road and rail covered fully in other papers. For similar reasons, the scope of this paper excludes externalities, many of which are covered in other papers in this study.
- Our modelling of coastal shipping reflects this complexity, domestic and foreign ships, ship and port costs, constrained within the known freight task. Within our assumptions, we allocate the task and costs to provide fixed, variable and marginal cost and prices across different trades.

Within the Transport Outcomes Framework (TOF), four elements of coastal shipping stand out. First, shipping plays a narrow role in NZ's freight task. Second, ships currently serving in NZ waters, and the ports, offer capacity to absorb significant growth, with low unit costs associated with expanding that capacity. Third, while limited by frequency and available routes, shipping can undertake long-haul tasks at materially lower costs than competing modes, and also offer resilience to factors which may affect other modes. And finally, the externalities considered associated with coastal shipping, including health, safety and congestion, and emissions are materially lower than for road and rail.

Chapter 2 Overview of Coastal Shipping in NZ

2.1 Background and Methodology

This introductory chapter provides a brief overview of coastal trade, and context to properly evaluate the costs and prices associated with the provision coastal shipping services in New Zealand. Readers are referred to a more complete review in Appendices A-E. Abbreviations and definitions used in this report are presented in the Glossary (Appendix G).

Coastal shipping in NZ covers the movement of cargo (goods or passengers) by ship or vessel from one NZ port to another, comprising both domestic cargo and the transhipment of import and export goods. Coastal cargo can be carried by either a NZ (domestic) ship or a foreign ship. In NZ, the principal coastal cargo moved are petroleum products, cement, and containerised goods, forming the basis of our modelling.

This review of coastal shipping has relied primarily on key Te Manatū Waka reports such as National Freight Demand Study ("NFDS"), Freight Information Gathering System ("FIGS"), and other datasets, government agencies including Waka Kotahi NZ Transport Agency, Statistics NZ ("StatsNZ") and Maritime NZ ("MNZ"). Extensive use was made of public resources, such as annual reports and publications from port companies and other industry stakeholders. Further, Te Manatū Waka subscribed to Drewry's Ship Operating Cost Annual Review and Forecast 2019/20 ("Drewry") and kindly provided a copy to form the basis of this study's ship cost analysis. We note that, following input from industry stakeholders, Drewry's global ship operating costs have been adjusted in our modelling to reflect NZ conditions (Sec 6, 7, 8).

We engaged with numerous industry stakeholders, spanning shippers (the cargo owners), shipping lines (owners and operators of the ships), ports (providers of infrastructure to enable the transfer of cargo to/from ships), and government agencies. Many have provided valuable data, insights and opinions, although given commercial sensitivities, much information was provided informally. As a rule, official and public data takes precedence over other sources. We highlight where official data may differ from or be supplemented by other reputable or verifiable sources. All data reflects the year to 30 June 2019.

2.2 Historic Context

By virtue of its long coastline, and distance from its markets, New Zealand has always been a seafaring nation. Most cities grew around natural harbours or river ports, or where harbours could be etched out of hostile coasts. Each year, NZ ports receive over 7,000 foreign cargo ships bringing goods from overseas or delivering local products to distant markets. Foreign ships may opt to move domestic cargo between NZ ports in competition with domestic ships – although there are now few of these.

From its early pre-eminence, coastal shipping has evolved and declined as road and rail networks expanded, and cargo demands changed, whittling down the early multitude of "ports" to just 13 key commercial ports today. This shipping evolution has been both gradual, and also periodically interrupted by step-changes:

- Legislation. The Port Companies Act 1988 corporatised the port sector. The Maritime Transport Act 1994 created Maritime New Zealand and its regulatory framework, adopted international maritime standards and crucially allowed foreign ships to carry domestic cargo – termed cabotage.

- Cook Strait Ferries. The establishment of inter-island RORO rail ferry service in 1962 provided a vital “land bridge” to complete a national road and rail network, and in doing so reduced the demand for coastal shipping.
- Trade Agreements. Trade and shipping patterns changed materially following NZ’s key trading partner, United Kingdom, joining the European Union in 1973, and again when NZ and Australia signed the Closer Economic Relations Agreement, CER. While primarily affecting import-export trade, both also drove reconfiguration of coastal shipping.
- Containerisation. Standardising the unit of cargo has transformed the transport industry through secure efficient movement of goods across all modes and between all markets.

Cargo ships are configured for the goods they typically carry - dry bulk, liquid bulk, break bulk, cars and containers. Goods are increasingly being transported in containers, with container ships accounting for 45% of NZ port calls 2019 (up from nil in 1970), while bulk ships account for 30% and tankers 12%.

The Maritime Transport Act 1994 permits cabotage, so allowing foreign ships on scheduled services to New Zealand to carry domestic freight. Foreign bulk ships typically do not carry domestic cargo – different bulk cargos cannot be co-mingled and it may simply be too hard to amass sufficient domestic volumes. Foreign container ships however have captured 80% of the coastal market given domestic containers are physically undifferentiated from imports and exports, and so readily integrated into their logistics streams. Car carriers appear to be an untapped coastal opportunity.

Growth and the changing nature of cargo have required ports to either invest, or wither. The great multitude of “ports” from last century have been whittled back to 13 key commercial ports today. Other established historic ports are variously maintained to serve non-cargo activities such as fishing and aquaculture.

2.3 Coastal Freight Task

The 2017/18 NFDS assessed the annual national freight task at 279 million tonnes (“mt”) and 30.6 billion tonne-km (“btkm”), of which 4.6 mt and 4.0 btkm respectively were classified as being carried by coastal ships. Coastal shipping accounted for <2% by volume (mt) and 13% by task (btkm). The implied average sea voyage is 890km, against 230km for rail and 90km for road. Coastal shipping in NZ is a niche player, competing only in the long-haul sub-segment of the freight market. Notably, it dominates national distribution of petroleum and cement and has achieved a 20% share of the inter-island freight task (ntkm). The NFDS does not consider transhipments, which form a coastal leg of an import or export journey, nor inter-island ferry traffic (covered in a separate report).

Table 2. 1

National Freight Task - 2017/18

Mode	million tonnes		oil cement	intra-regional	intra-island	inter-island	billion tonne-km		km Avg Trip
Sea / Ship	**4.6**	**1.6%**	3.4	0.1	0.1	0.9	**4.0**	**13.2%**	**890**
Rail / Train	15.6	5.6%		5.3	10.0	0.2	3.5	11.6%	230
Road / Truck	258.5	92.8%		211.0	43.8	3.3	23.1	75.3%	90
	278.7						30.6		

Source: National Freight Demand Study - Sep 2019, modified

In this study, we assess 2018/2019 coastal volumes (excluding inter-island ferries) to be 5.2 mtpa (against NFDS at 4.6 mtpa in 2018). The principal coastal cargos are:

- Petroleum – 2.5 mtpa. Three dedicated coastal ships (tankers) deliver petroleum products from Refining NZ at Marsden Point, Northland, to 13 domestic ports. Two are operated by Coastal Oil Logistics Ltd ("COLL), owned by the shareholders of Refining NZ, while Ports of Auckland owns, and Z-Energy operates, a barge serving Auckland. Collectively these ships undertake some 50 voyages and 200 port calls annually, and face no competition and have no backhaul opportunities. (Petroleum products are imported directly into various ports)
- Cement – 1.4 mtpa. The NZ cement market is dominated by two companies, Golden Bay Cement (part of Fletcher Building) and global building materials company, Holcim. The former manufactures cement at Portland (Whangarei) and distributes approximately 0.9 mtpa using its 3 dedicated ships[8]. Holcim imports around 0.5 mtpa directly into Auckland and Timaru, and uses its own ship to deliver nationally ex-Timaru[9]. These ships face no competition for their respective coastal trades and have no backhaul opportunities.
- Other Bulk – 0.2 mtpa. Coastal Bulk Shipping[10] carries some 0.05 mtpa of various cargos, serving a wide variety of cargo through almost all NZ port son its small bulk carrier, *Anatoki*. Chatham Islands Shipping[11] operates its small general cargo ship, *Southern Tiare*. Various foreign bulk ships may opportunistically carry domestic cargo (estimated at 0.2 mtpa), as on occasion do foreign car carriers. While a theoretical growth opportunity exists for coastal bulk cargo, that is not apparent from market evidence.
- Containers – 0.27 mTEU, or 1.1 mtpa (excluding transhipments). FIGS data recorded 3.2 mTEU cross-wharf container moves in 2019 which, when adjusting for double-counting, saw 2.7 mTEU unique containers moved by coastal ship in 2019. Of these, 0.27 mTEU are domestic coastal containers, with 48% of those being full, weighing an estimated 1.1 mtpa. Transhipment movements, being the coastal movement of import and export containers, total 0.14 mTEU and 1.6 mtpa. Coastal flows follow predictable

[8] Golden Bay Cement website ; https://www.goldenbay.co.nz/about-us/our-profile/
[9] Holcim cement website, review of import and coastal ship movements
[10] Coastal Bulk Shipping website http://www.coastalbulkshipping.co.nz/ and pers comments
[11] Chatham Islands Shipping website https://www.chathamislandsshipping.co.nz/

patterns of movement (see Appendix C.4), the key routes being full domestic containers moving from AKL to LYT, full export transhipments from various southern ports to TRG, and a flow of empty containers from import ports (AKL, LYT) to the key export ports (TRG, NPE, NSN, POE).

2.4 Coastal Container Services

Containers represent the key coastal shipping activity after bulk petroleum and cement. NZ's single domestic container ship, Pacifica's *Moana Chief*, competes with several foreign container ships for the coastal trade, and directly with road and rail transport modes for long-haul domestic containers. We note that almost all coastal movements require inter-modal (road or rail) services for "last mile" delivery. The container freight task does not differentiate import, export or domestic containers – all use the same port infrastructure.

The 5 largest global container ship lines are amongst the foreign operators providing 14 scheduled services on the NZ coast, schedules which nominally require 68 container ships. These services use ungeared ships (without on-board cranes) which exceed 2500TEU, so exclusively using port container terminals. The exceptions are those few smaller geared ships, principally serving Pacific/Tasman routes.

Pacifica Shipping is the only domestic provider of container ship services. Its *Moana Chief* (1700TEU, ungeared) follows a weekly service calling on 4 ports, making 200 annual port calls. In addition, Chatham Island Shipping provides a 30-day service linking NPE and TIU to Chatham and Pitt Islands, using its small multipurpose *Southern Tiare*.

The 14 foreign container ship schedules, almost all weekly, collectively make 2400 NZ port calls annually. These foreign container ships provide a matrix of port-port connections, of which 34 per week are direct, as presented in the following figure (left). Indirect connections (right) are less attractive to domestic shippers given each intermediate port call will extend transit times by a day or so. In addition, domestic operator Pacifica provides an additional weekly service (AKL-LYT-NSN-TRG-AKL), as shown by superimposed red circles.

Figure 2. 1 Foreign container ship schedules

Direct - weekly port connections

	MAP	AKL	TRG	NPE	WLG	NSN	LYT	TIU	POE	BLU
MAP							0.5			
AKL	0.5		0.5			1	4	0.5		
TRG	0.5	2		1						
NPE			4				1			
WLG			2	3						
NSN					2					
LYT			0.5	2	2			1	1	
TIU			0.5				1		1	
POE							1			
BLU									1	

Indirect - 1 intermediate port

	MAP	AKL	TRG	NPE	WLG	NSN	LYT	TIU	POE	BLU
MAP			0.5							
AKL			0.5	1	3	1	0.5			
TRG							1			
NPE			1					1		
WLG		1	2							
NSN			2							
LYT			2	2	1					
TIU	0.5			1					1	
POE		1		1						
BLU							1			

FIGS 2019 data shows domestic container flows comprise 129,000 TEU full and 141,000 TEU empty (sometimes referred to as "MT")[12]. Transhipments (of which 95% are full) add 102,000 TEU export and 37,000 TEU import moves, thus resulting in the total annual coastal task of

[12] FIGS

409,000 TEU. Domestic ships (that is, Pacifica) carry 18% (75,000TEU) of the total annual coastal task, or 34% of all containers moved on its weekly schedule.

Domestic ships compete for coastal containers at some disadvantage. Part is inextricably the nature of global shipping, where large global competitors employ larger ships which offer significant economies of scale. Other issues such as tax differences and flags of convenience cannot be readily addressed without NZ risking breaching its international agreements, or the imperative of establishing transport policies which are neutral between modes and sectors. Domestic ship operators face materially higher operating costs than for foreign ships, notably crewing and bunkers (ship fuel) which together more than double the annual cost of operating NZ-registered ships relative to foreign equivalents. These issues are clearly identified by the New Zealand Shipping Federation in its publication "Full Steam Ahead"[13].

[13] NZ Shipping Federation – Full Steam Ahead http://nzsf.org.nz/

Chapter 3 Regulation and Competition

3.1 Regulation

Coastal shipping operates in competition with other transport modes, and directly with foreign operators. NZ is signatory to many international conventions, including for shipping, yet its legislation and regulatory settings are unique.

Maritime New Zealand ("MNZ") is a Crown entity created by the Maritime Transport Act 1994 covering safety, security and environmental protection of marine activities and has three key roles: regulation and compliance; maritime safety and incident response. MNZ also has responsibilities under other legislation, namely Maritime Security Act, Ship Registration Act, Health and Safety at Work Act, Hazardous Substances and New Organisms Act: and Civil Aviation Act. Under Section 198 of the Maritime Transport Act 1994, which permits cabotage, foreign ships "passing through New Zealand waters while on a continuous journey from a foreign port to another foreign port, and [is] stopping in New Zealand to load or unload international cargo" are permitted to carry coastal cargo – a right termed cabotage.

Table 3.1

Maritime NZ Revenues - $m

FY 2018/19	Division/Group
Crown	9.459
Fuel Excise Duty	6.361
H&S	6.299
Crown	**22.119**
Oil Pollution Levy	7.774
Maritime Levy	15.044
Maritime Levy	**22.818**
Seafarers	1.031
Ship Registration	0.283
Maritime Operators	1.131
NZ Oil Pollution	0.690
Services to MoT	1.000
Services to Pacific	2.446
Other	0.939
Other	**7.520**
Interest	**0.309**
Total	**52.766**

Source: Maritime NZ 2019 Annual Report

Table 3.2

Maritime Levies

FY 2020/21 Vessel Category	Payment Frequency	Factor Rates GT or LOA	PAX Cap Rate	DWT Rate	
NZ non-SOLAS <24 m	Annual	$13.89	$16.05		
NZ non-SOLAS >24 m	Annual	$7.52	$16.05		
New Zealand SOLAS	Annual	$7.13	$42.75	$0.42	
Foreign Non-Passenger	Per Port	$0.11		$0.0087	
Foreign Passenger	Per Port	$0.08	$1.68	$0.0075	
Levy Calculations					
Domestic Cargo Ships					implied
	LOA	GT	DWT	$m	$/tonne
Matuku - petroleum	183	50,143	29,735	0.37	0.30
Kokako - petroleum	183	49,218	29,470	0.36	0.29
Moana Chief - containers	175	18,358	23,305	0.14	0.31
Buffalo - cement	130	9,092	6,311	0.07	0.17
Aotearoa Chief - cement	125	8,024	8,745	0.06	0.07
Awanuia - petroleum	80	3,900	2,747	0.03	
Anatoki - general bulk	51	561	820	0.00	
Foreign Cargo Ships - collective revenues					
	port calls	GT	DWT	$m	-
Container (av 4,000TEU)	2,380	43,300	50,800	12.16	0.64
Dry Bulk	1,679	20,000	30,000	4.06	0.09
Liquid Bulk	677	35,000	52,500	2.86	0.57

Source: Maritime NZ website, Rockpoint calculations

Foreign bulk ships typically do not carry domestic cargo – different bulk cargos cannot readily be co-mingled and it is simply too hard to amass sufficient volumes for coastal legs. Foreign ships however have captured 80% of the coastal container market given domestic containers are indistinguishable from import-export containers, and so are readily integrated into their logistics streams.

MNZ receives income from the Crown, and from various fees and levies it imposes or collects. Levies on the broader maritime industry (circled, table above right) total $32m. Maritime NZ applies levies on all commercial ships. Domestic ships pay annual fees while foreign ships pay by port visit. These levies are summarised in the table, below right.

From these, we calculate indicative maritime levies for key domestic cargo ships, and collectively for foreign ships. This suggests domestic ships pay $1m p.a., while foreign ships paid $19m over the 2019 year. These levies broadly translate to 20-30c/tonne for domestic cargo ships and approx. 60c/tonne for foreign cargo ships.

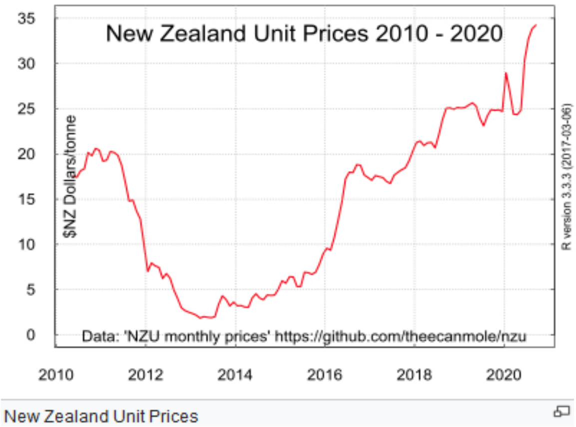


Figure 3. 1 New Zealand Unit Price

The government collects revenues from the wider transport industry through Fuel Taxes, Road User Charges and Vehicle Registration. The domestic maritime sector pays “carbon” levies through the Emission Trading Scheme (ETS), where carbon emitters can buy carbon offsets. The ETS operates a market which sets the price of a New Zealand Unit (NZU), equivalent to 1 tonne CO_2. On the basis that ship bunkers emit 2.9-3.2 tonnes of CO_2 for every tonne combusted, the NZU market rate is applied at source to the wholesale bunker price. In 2019, the average price was $25/NZU, so ETS levies equated to $70/tonne bunkers. With a wholesale bunker price of $480/tonne through 2019, the ETS levy boosts bunker prices by 15% to $550/tonne.

Few foreign ships bunker in NZ and accordingly they do not pay ETS levies.

Ports are administered under the Port Companies Act 1988, which transferred ownership from Harbour Boards into companies. While Section 14 of the Act facilitated private ownership, all ports remain under majority control of regional councils.

3.2 Foreign Ships

Maritime Transport Act 1994, Sec 198, permits qualifying foreign ships to carry domestic cargo. Foreign ships account for 90% of all port calls, and being optimised for import-export journeys, they are typically larger than domestic ships (for container ships, averaging 4500 TEU vs 1700 TEU for Pacifica’s *Moana Chief*). Domestic ships therefore compete directly with both foreign ships, and with road and rail operators.

In addition to economies of scale in ship size and operating fleet, and lower global operating costs (including crewing), the advantages enjoyed by foreign ships include:

- Low marginal cost: Foreign ships' key trade is import-export cargo. In addition to scale economies of their larger ships, they utilise capacity which would otherwise be unoccupied to carry domestic cargo (notably containers), and so incur no incremental ship costs (but do incur port dry charges and some arguably extra port time – wet charges).
- Berthing Priority: By virtue of activity, foreign ships are often given preferential port rates and priority berthing, even if off schedule.
- Tax: As foreign entities, they are not subject to NZ tax or employment law and are zero-rated for GST and ETS.
- Flags of Convenience: Half the world's commercial fleet are registered in a country differing from ownership (such as the Open Registries offered by Panama, Liberia and Bahamas), so benefitting from lower fees, and arguably weaker rules, regulations and crew employment laws. Domestic ships are registered in NZ and subject to NZ regulations, taxes and employment regime.
- Fuel: Bunkers account for 40% of ship operating expenses. Larger foreign ships typically carry sufficient bunkers to travel over 40,000 Nautical Miles or NM (4 return journeys Auckland to Singapore), and so will re-bunker wherever fuel prices are lowest. Domestic ships are compelled to bunker in NZ, paying a substantial price premium including ETS levies.

As the New Zealand Shipping Federation states in "Full Steam Ahead":

"These legislated advantages undermine New Zealand's environmental policies, labour-force polices and tax policies. In addition to the benefits given to international ship operators by the New Zealand government, it is likely that international operators are getting significant fiscal and other incentives in their home country such as tax concessions (e.g., favourable depreciation rates, nil tax on corporate profits, concessionary tax regimes for seafarers, rebates of taxes to employers or total exemptions from personal tax), exclusive rights to carry local cargoes and operating subsidies."

That said, the NZ government cannot easily "level the playing field". Some of the disadvantages simply reflect NZ's small market where scale economies are more elusive, or where it seeks to uphold higher employment and health and safety standards than other jurisdictions. Further, NZ cannot unilaterally change policy relating to international shipping activities given doing so may breach of its trade agreements or international conventions. NZ, as a committed adherent to free markets, may resist intervening to favour or subsidise elements of economic activity.

Chapter 4 Shipping Costs

Shipping cost data is primarily derived from a UK maritime consultancy Drewry, whose publication "Ship Operating Costs Annual Review and Forecast Annual Report 2019/20" ("Drewry") provides a respected and comprehensive analysis of global ship operating costs. In addition, Rockpoint subscribed to the Alphaliner database and publications of global maritime research house, ASXMarine. While ship capital costs apply globally, ship operating and bunker cost for NZ domestic ships are materially higher than global averages.

Footnote re scope of analysis: Many domestic coastal freight tasks are priced on a door-to-door basis. In order to avoid the complexity of a widely variable overland component, our coastal shipping analysis is limited to the port-to-port element of the freight task.

Shipping services comprises 3 principal cost elements: the cost of providing the shipping capacity (buying, operating and fuelling the ships), the costs of transferring cargo from ship to land and vice versa (costs charged by the ports) and external costs (such as regulation and levies). This chapter considers the ship costs.

Delivering ship capacity falls into three cost categories.

- Capital Costs: covers purchasing, financing and registering (that is, owning) a ship, with ship prices variously set in the new-build market, the second-hand market and by proxy through charter rates.
- Operating Costs: covers expenses for running and maintaining a ship, including crewing.
- Voyage costs: expenses associated with a particular journey, restricted to fuel (or bunkers) in this report, but elsewhere could include route levies (such as Panama or Suez canals). Port costs are covered in Chapter 6.

The overall costs are optimised by minimising these three cost categories while maximising the utilisation of existing and future capacity.

4.1 Ship Capital Costs

Ships are the largest capital cost for shipping lines. Price can be established in three markets: new builds, the second-hand ship market and, by proxy, through charter rates. While new-build prices will broadly reflect fundamental construction costs (and hence be relatively stable), market price and charter rates have proven remarkably volatile, driven by wide swings in the global supply-demand balances over time.

New Build: Shipping lines have built new ships to expand their fleets to meet market growth, benefit from the latest technologies and efficiencies, and to capture the scale economies of ever-larger ships. We summarise build costs extracted from Alphaliner's container ship orderbook[14], comprising 2700 new builds since 2003 (in US$ nominal). This new build price data reflects wide variabilities such as time of construction (market conditions, inflation), ship specifications and many other unknown factors. Yet it is apparent that the dominant correlation for new build price is ship size. The stability of new-build ship price reflects competition in global shipbuilding, where contract

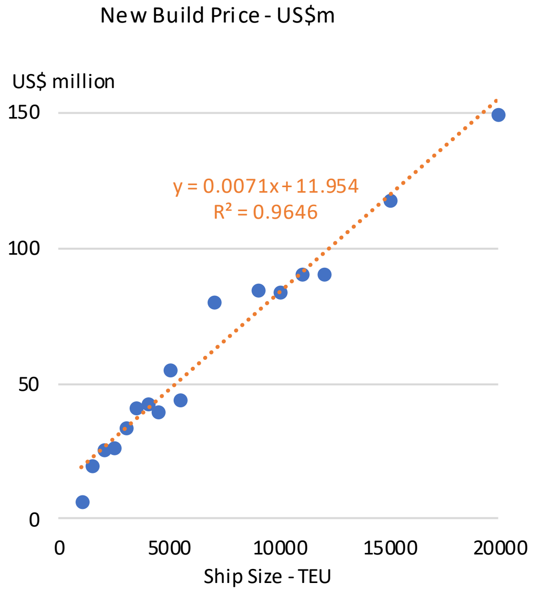
[14] ASXMArine subsidiary Alphaliner operates a global maritime database

prices are more closely linked to input costs (steel and labour) than wider economic market conditions.

Figure 4. 1

Containership New Build - US$ million (nominal)

Size TEU	Avg Price US$m	Number
<1000	6.5	2
1000-1500	19.6	48
1500-2000	26.0	58
2000-2500	26.3	14
2500-3000	33.9	31
3000-3500	41.5	8
3500-4000	43.0	3
4000-4500	40.0	4
4500-5000	55.0	1
5000-5500	43.9	13
5500-6000		
6000-7000	80.5	8
7000-8000		
8000-9000	85.0	28
9000-10000	83.5	76
10000-11000	90.8	29
11000-12000	90.6	39
12000-15000	117.4	86
>15000	149.5	126



Source: Alphaline (data period 2003-2019)

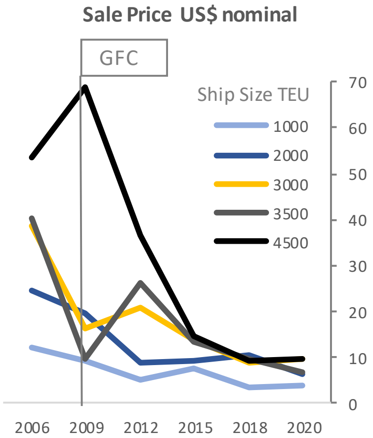
Second-hand Market: As an alternative to building a new ship, a deep and active second-hand market exists for ships of all categories, sizes and ages. Not all these sales are publicly recorded. Sales prices varied accordingly to date of sale, ship type, age, condition, specification and location or other undisclosed value drivers.

Rockpoint reviewed Alphaliner's database of more than 1400 container ship sales since 2004. The average age of ship sold was 11 years, the oldest being 29 years. As expected, newer ships of a given size proved to be more valuable. However, unlike new-build prices, a major factor driving second-hand container ship prices is the economic and ship market conditions prevailing at the time of sale. Across all size categories, market prices (shown in US$ nominal) peaked prior to the Global Financial Crisis ("GFC") in 2007/8, before falling sharply, appearing to bottom out in the period 2016-2018. An incipient recovery, evident since, may well prove to be reversed by a Covid19-led economic slowdown.

Figure 4. 2

Containership Sale Price - US$million (nominal)

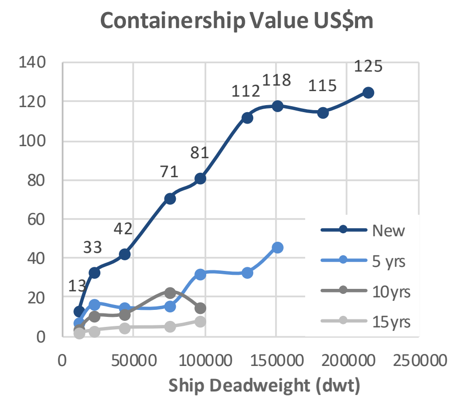
Year Sold	< 1000	1000-1500	1500-2000	2000-2500	2500-3000	3000-3500	3500-4000	4000-4500	4500-5000	5000-6000	6000-10000
	Ship Size Range - TEU										
2019-2020	**3.8**	**6.0**	**6.4**	**7.7**	**9.7**	**6.7**		**9.6**	**17.4**	**11.2**	**25.1**
2016-2018	3.5	6.5	10.3	6.6	8.9	9.8	8.0	9.3			35.2
2013-2015	7.5	6.7	9.1	13.1	13.9	13.4		14.7	18.8		
2010-2012	5.2	7.4	8.8	11.4	20.7	26.2	17.1	36.5	24.0		
2007-2009	9.2	17.3	19.7	21.0	16.3	9.7	24.1	69.0	30.7		
2004-2006	11.9	16.4	24.4	23.4	38.4	40.1	49.0	53.4			
Average	8.7	11.4	13.2	15.1	20.0	23.3	20.8	26.5	27.6	11.2	29.3
Sales #	275	288	216	113	152	60	38	101	59	3	40



Source: Alphaliner (period 2004 to 2019)

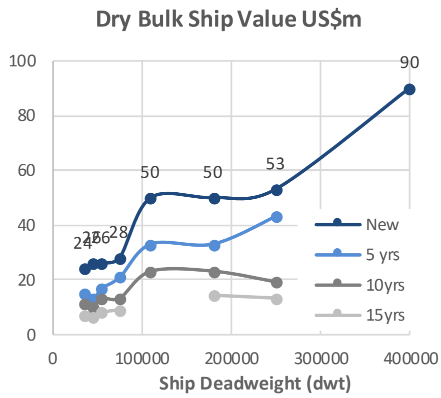
Similarly, the Drewry report also provides a summary of ship value, by type, size and age, for 2019, as presented in the following figures. As with Alphaliner's dataset, there is unexplained variability in the data, although the broader price-size-age trends remain apparent. Note: for consistency, we have presented here container ships on the basis of deadweight (dwt) – where dwt corresponds to approximately 12 times container slot capacity plus 3500. The observed decline in market value with age implies the life of a container ship is typically 18 years (and 22 years for dry bulk or tanker).

Figure 4. 3



Source: Drewry

Figure 4. 4



Source: Drewry

<u>Charter Market</u>: A third means of establishing ship value is through ship charter rates. Chartering provides shipping lines with an alternative to ownership. The Alphaliner "Top 100"[15] shows that the ten largest container ship lines all currently charter between 40% and 75% of their operating fleet. Most charters are termed Time Charters (see Glossary), typically for a period of 3-5 years. Chartering provides shipping lines with an opportunity to manage their capital and balance sheets, and gives some scope to shed or add fleet capacity when the market tightens or expands.

[15] Alphaliner Top 100 - https://alphaliner.axsmarine.com/PublicTop100/

Alphaliner's Spot Charter Rates (charter terms < 1 year), shown below, exhibit wide volatility in rates through time, while also higher rates for larger ships.

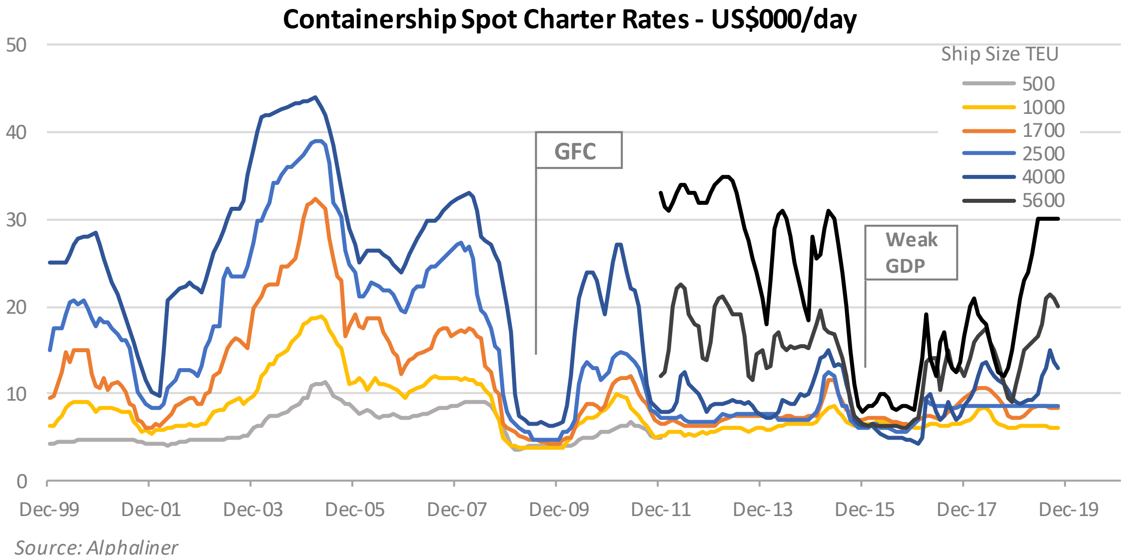
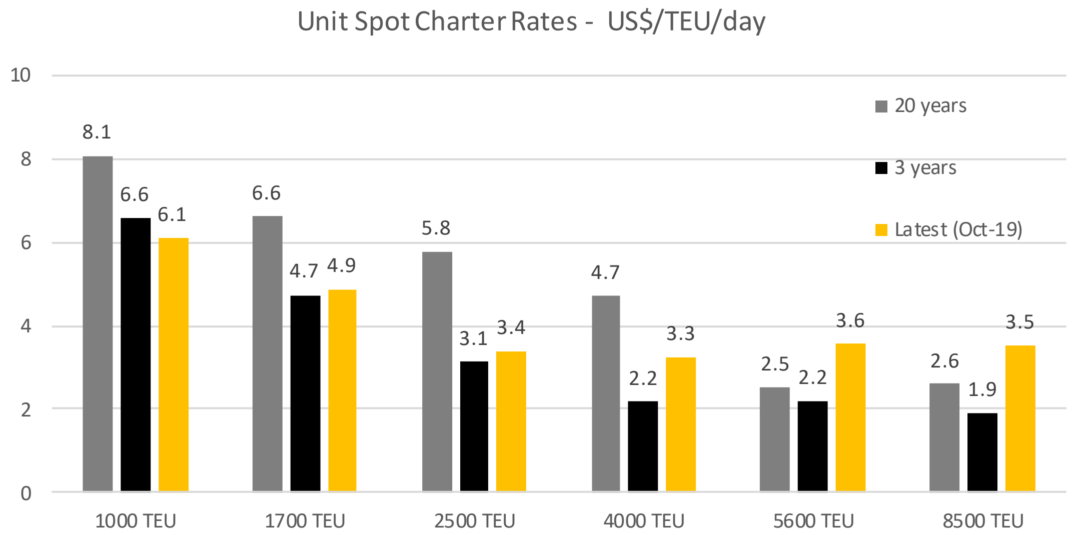


Figure 4. 5

While charter rates for different ship sizes generally mirror the same price swings, in detail differentials change over time, reflecting factors such as a strong shift to larger ships, the reconfiguration of fleets such as after commissioning of the expanded Panama Canal, and wider economic conditions. Scale economies for larger ships are evident, with unit Spot Charter Rates (US$/slot/day) falling with increasing ship size. The 20-year averages show a steady decline, while the slot rates flatten for the 3-year average and the October-2019 rates.

Figure 4. 6



Source: after Alphaliner

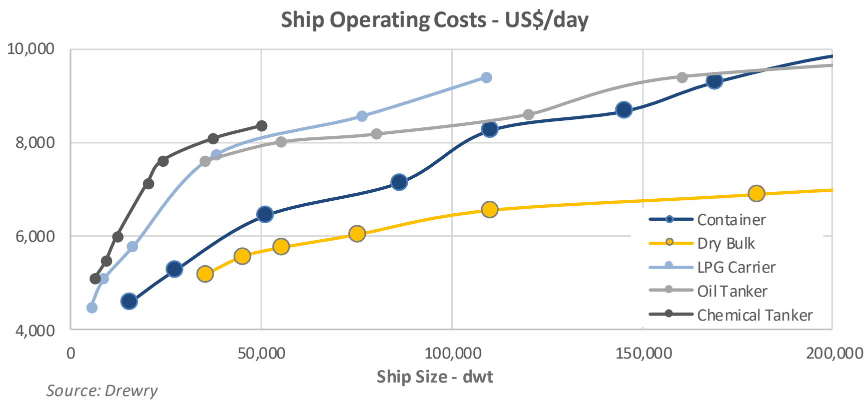
Ship charter companies will seek an acceptable risk-weighted return on employed capital (ROCE) over the life of a ship (say 20 years, or several charter cycles). Charter rates must capture all ship charter companies' risks. Observed high volatility in spot charter rates emphasises wide swings in demand for spot charters, noting that most charter terms are materially longer than these spot (<1 year) terms shown. Assessing the risk and impact of all factors driving spot charter rates (and any consequent implications for ship value) would require more data and analysis and is beyond the scope of this study. Accordingly, charter rates shown here simply serve to emphasise the volatility of global shipping markets.

4.2 Ship Operating Costs

This chapter draws extensively from Drewry's report, "Ship Operating Costs Annual Review and Forecast Annual Report 2019/20" (the "Drewry" report), which spans all ship types – container, dry bulk, liquid bulk (tanker), chemical, gas, RORO and others. Drewry assesses each ship type across wide size range, although we observe that most NZ domestic ships fall below) Drewry's range, requiring some extrapolation. While Drewry presents a global average for ship operating costs, our research suggests that NZ domestic ship operating costs are materially higher, as are NZ crew wages. Our modelling (Chapters 6 and 7) highlights these differences.

Drewry's core analysis is principally based on a generic 10-year-old ship in 2019, although some Drewry summaries span different age ranges and changes through time. Drewry ship operating costs across all ship types initially rise steeply with increasing size before flattening out above 30,000dwt.

Figure 4. 7



Drewry monitors six cost categories: crewing, insurance, R&M, consumables, surveys and administration.

Crewing levels and qualifications are set, at a minimum, by the International Maritime Organisation ("IMO", with NZ a signatory country) to ensure safe 24-7 operations in accordance with training (STCW), safety (SOLAS), port security (ISPS) and other maritime conventions. We observe that crew numbers and costs flatten off for ships larger than 30,000dwt. A premium is paid on chemical, LPG and oil ships.

Insurance is required in order to operate ships, spanning for Hull & Machinery, Protection & Indemnity, War Risk, FD&D and COFR. Rates rise generally linearly with ship size (value).

Figure 4. 8

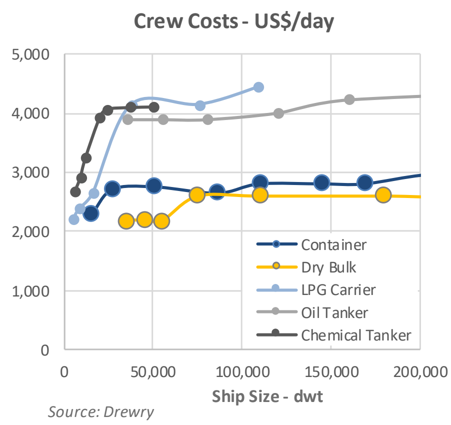
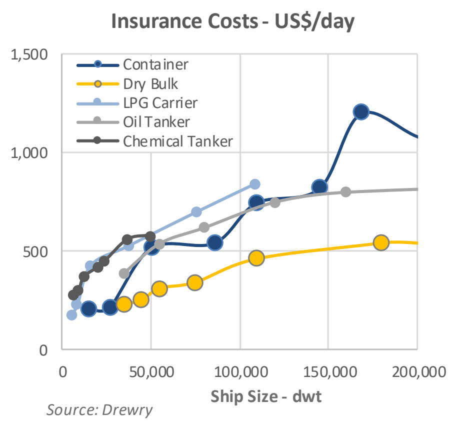


Figure 4. 9



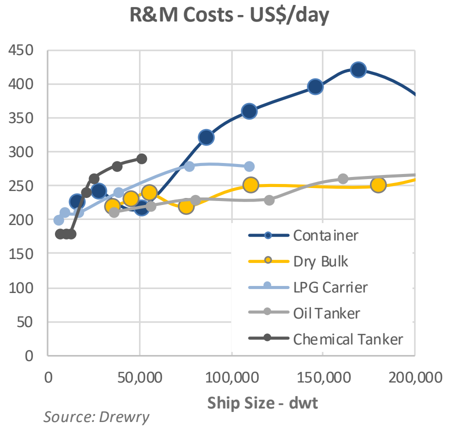
Repairs and maintenance (R&M) are required to ensure a ship remains seaworthy, and is a prerequisite before being permitted to operate and to hold insurance cover. The R&M expenditure is a function of ship size, and materially, ship age (and condition). In contrast to other ship types, the R&M costs for container ships continues to rise with ship size to 180,000dwt.

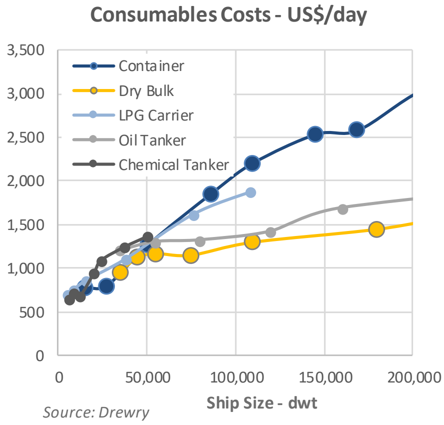
Consumables cover spare parts, stores and lubricating oils required to keep a ship maintained and operating. These costs rise generally linearly with ship size.

Figure 4. 10

Figure 4. 11

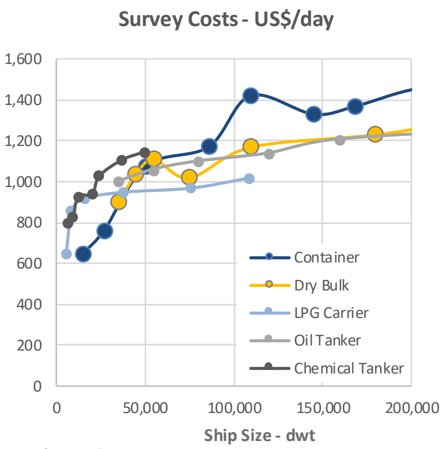
Surveys must be undertaken periodically, typically involving dry dock, for inspection, repair and





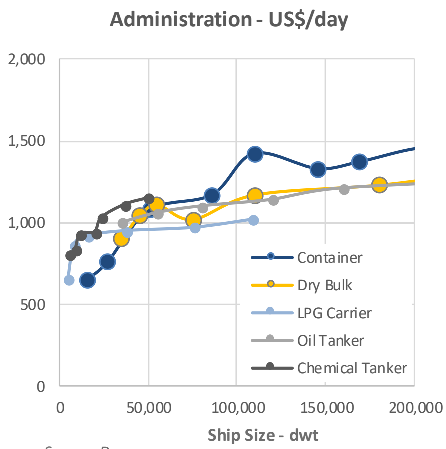
painting. Surveys are a pre-requisite for insurance. Finally, administration fees cover management fees, services, owner's costs and safety and environmental costs.

Figure 4. 12



Source: Drewry

Figure 4. 13

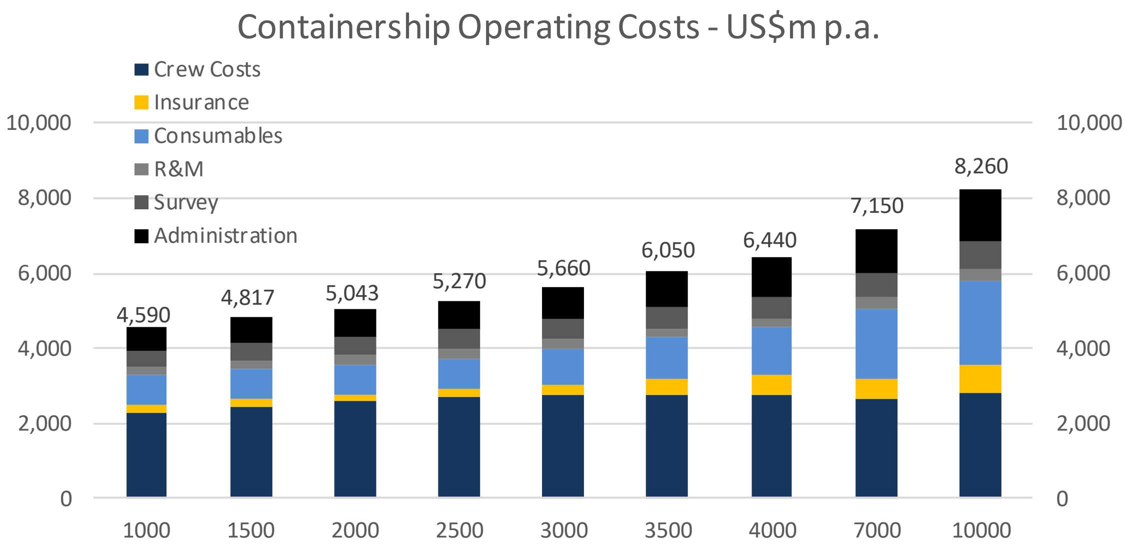


Source: Drewry

While all ship types are covered by Drewry, our detailed commentary will now focus principally on container ships for two reasons. First, container ship operating costs are broadly representative of all ship types, and along with dry bulk ships, account for the majority of the global shipping fleet. Second, coastal containers are significant and growing part of NZ's freight task, operating in direct competition with road and rail, and further is the sector where foreign ships have dominant market share.

Consistent with other ship types, container ship operating costs show a clear correlation with size. Crew costs combined with consumables account for two thirds of operating costs (declining slightly for larger ships).

Figure 4. 14



Source: Drewry - Ship Operating Costs 2019

Other secondary variables affecting ship operating costs are ship age, driven principally by rising R&M costs, and cost changes through time, reflecting changing market conditions (including trimming or deferring costs when profitability is being adversely affected).

Figure 4. 15

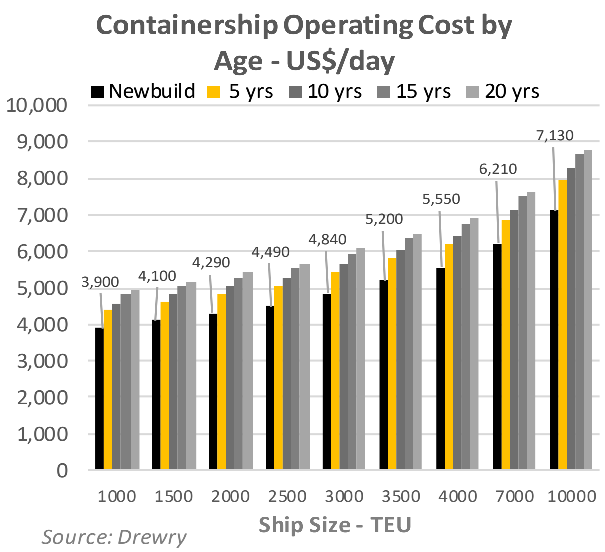
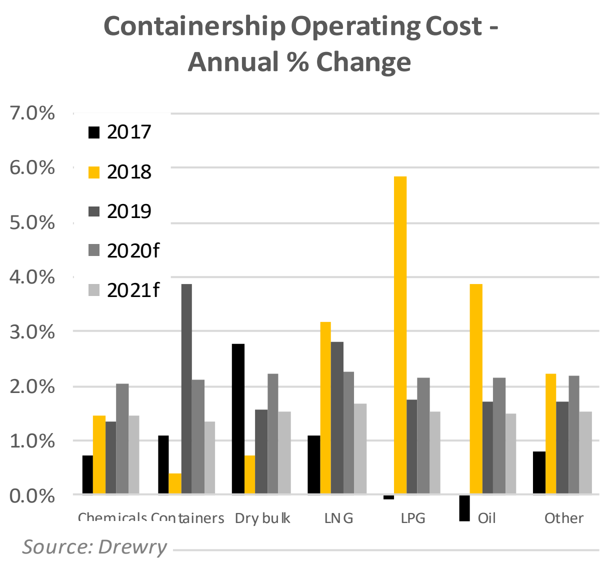


Figure 4. 16



In NZ, there are only a few participants in coastal shipping. The ships operated by Coastal Oil Logistics, Golden Bay Cement and Holcim are all owned or chartered by and for their cargo owners as part of an integrated supply chain. All other ships compete in their discrete markets. Due to NZ sector's small size and domestic participants commercial sensitivities, the data we present below provides our representation of likely costs.

Table 4. 1

NZ Coastal Cargo Shipping Operators

Operator	Owners	Ships dwt	Cargo	mtpa	Route
Coastal Oil Logistics	BP,Mobil,Caltex,Z	2 x 50000	petroleum	2.5	All NZ Ports
Golden Bay Cement	Fletcher Building	1 x 8024	cement	0.9	All NZ Ports
Holcim	Holcim	1 x 9092	cement	0.4	All NZ Ports
Coastal Bulk Shipping	private	1 x 820	bulk	0.05	Any NZ Port
Pacifica Shipping	China Navigation Co	1 x 1700TEU	containers	75k TEU	AKL,LYT,NSN,TRG
Chatham Islands Shipping	CI Enterprise Trust	1 x 1210	various	<0.05	NPE, TIU, CI
Interislander	KiwiRail	3 x 5-7000	vehicles, pax		Picton-Wellington
Bluebridge	Strait NZ	2 x 4-8000	vehicles, pax		Picton-Wellington

For its DTCC modelling, Rockpoint has assumed a 10 year old ship (per Drewry), noting the average age of the global fleet is 11years.

4.3 Bunker Costs

After capital costs and ship operating costs, Drewry identifies Voyage Costs, being those which relate to a particular port-port route. Voyage costs comprise fuel (bunkers), port charges (Chapter 6) and any other levies (such as canal charges – which are not applicable in NZ). Bunkers are the single biggest component of ship operating costs.

Ship fuel, termed fuel oil or bunkers, is derived from that residual viscous fraction of crude oil that remains after a refinery has distilled (boiled off) lighter petroleum fractions (distillates, such as petrol, jet oil and diesel), hence the term "bottom of the barrel". Residues comprise bunkers and also bitumen and asphaltenes (largely used in road building).

Bunker prices correlate closely with crude oil prices, which exhibit considerable volatility. The various refined petroleum products have maintained a broad relativity to crude oil prices, with distillates trading at price premiums, while bunkers (residues) at a small discount. Over 20 years, a benchmark crude oil, WTI, has averaged US$400/tonne, against diesel at US$690/tonne[16]. In late April 2020, crude oil (WTI) prices fell briefly to US$70/tonne (US$11/bbl), the lowest real$ price for 50 years. Correspondingly, on global markets for the year to 30June2019, crude oil averaged US$380/tonne and diesel US$620/tonne.

Figure 4. 17

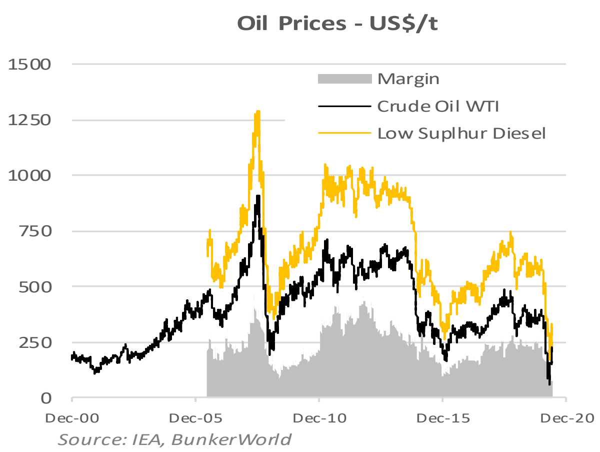
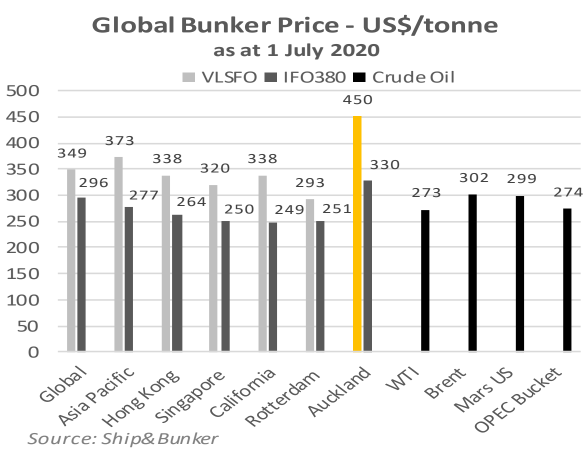


Figure 4. 18



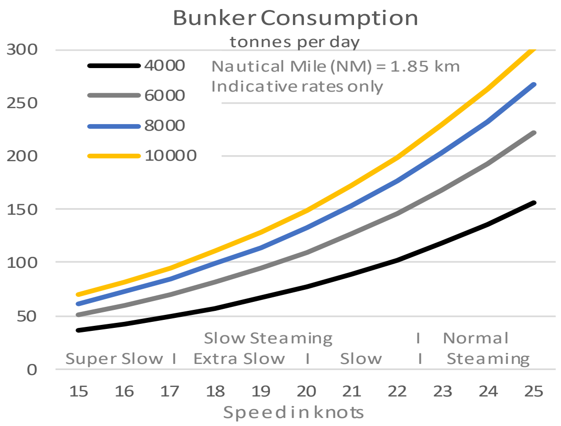
Shipping lines can protect themselves from swings in bunker prices through hedging (term supply contracts), but more commonly by simply including a clause in their shipping contracts allowing them to pass on any bunker price swings to shippers (cargo owners) – termed the Bunker Adjustment Factor. Bunker prices in NZ trade at a material (up to 30%) premium to global prices (such as in Singapore) which NZ domestic ships cannot avoid materially impacting their cost competitiveness.

Several factors affect a ship's bunker consumption rates, such as ship size, hull and engine design, sea conditions, and the ratio of time at sea vs in port. Yet none is more important than ship speed. Prior to the GFC, when trade growth was strong and the oil price lower, ever-larger container ships were being built for speed, typically designed to travel at more than 25kts (45km/hr). For a 4000TEU container ship, bunker consumption at 25kts is about 150 tonnes per

[16] International Energy Agency database, and Bunker World database

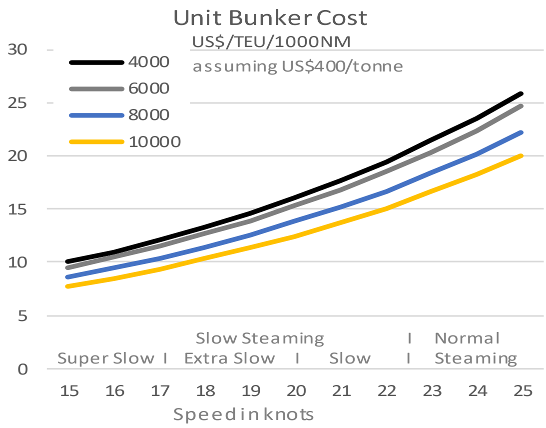
day (tpd) or 260 tonnes per 1000 Nautical Miles ("NM" = 1.85km)[17]. Reducing speed to 20kts [or 15kts] reduces bunker consumption to 80tpd [or 35tpd] and correspondingly to 160 [or 100] t/1000NM. While using more bunkers per day (or NM), larger ships achieve lower unit consumption rates (tonnes/TEU slot/day or tonnes/TEU slot/NM) – in addition to various other logistics gains.

Figure 4. 19



Source: adapted from Notteboom

Figure 4. 20



Source: adapted from Notteboom

Post-GFC, faced with falling (and erratic) global trade volumes and soaring bunker prices, shipping lines enthusiastically adopted "slow steaming". Operating ships at materially lower speeds served to both reduce overall costs and utilise more ships. With high bunker costs, slow steaming is expected to remain a core feature of shipping operations. For a 4000TEU container ship and assuming bunkers at US$400/tonne, unit bunkers costs (US$/TEU/1000NM) fell from $26 at 25kts to $16 at 20kts and $10 at 15 kts – yielding substantial savings.

Bunkers come in various grades, with the historically most prevalent being IFO380 (intermediate fuel oil with a maximum viscosity of 380 centistokes and <3.5% sulphur). Similarly, for the heavier IFO180. Yet on 1 January 2020, IMO's new MARPOL standards took effect, aiming to further reduce noxious ship emissions by lowering permissible sulphur levels from 3.5% to 0.5%. To meet these new standards, ship owners could either burn Very Low Sulphur Fuel Oil (VLSFO) with <0.5% sulphur, change to Marine Gas Oil (a grade of diesel, which is more expensive, and requiring engine modifications), or by retro-fitting their ships with sulphur scrubbers (expensive, time-intensive, and impairs engine performance) to continue using IFO380. Most ship operators have chosen to burn VLSFO. Note: while the scrubbers would remove sulphur and particulates from exhaust emissions, MARPOL rules do not prevent ships dumping these pollutants in the sea once remote from ports.

NZ will not adopt the new MARPOL standard until 1 January 2022. Until then, domestic ships can continue to use cheaper IFO380, so briefly narrowing their bunker price disadvantage relative to foreign ships bunkering overseas with more expensive VLSFO.

Refining NZ, as sole supplier of bunkers in NZ, sets bunker prices materially higher than global rates, being currently at a 40% premium for VLSFO and 30% for IFO380 relative to Singapore. In its current configuration, the refinery cannot meet the new MARPOL standards for bunkers – that is, to produce VLSFO. Any refinery upgrade is almost certainly uneconomical. The 1986 "Think Big" upgrade optimised the refinery to process then-cheap and abundant heavy sour (high sulphur)

[17] Maritime Economics, 3rd Edition, Martin Stopford, also Notteboom et al "Fuel surcharge practices of container shipping lines" - 2009 International Association of Maritime Economists (IAME) Conference.

crude oils. While the hydrocracker could improve distillate yields, as with all refineries, the production of residues is unavoidable, especially for heavy crude oil feedstocks. As growth in demand for petroleum products exceeded the refinery's capacity, the now 30% shortfall was imported – principally as lighter distillates petrol, diesel and jet-fuel.

At the time of starting to prepare this working paper, Refining NZ was undertaking a major strategic review. Subsequently, in November 2021, it elected to cease refining completely, and to operate its facility solely as an import terminal. Refining NZ operates by far the largest petroleum storage facilities in NZ. Subject to domestic storage capacity, refined product (distillates and bunkers) could be imported in tankers as large as those previously importing crude oil, nominally keeping geographic price variations small. By our calculations, the indicative costs for importing crude oil or refined products would be <US$20/tonne.

Larger offshore refineries have upgraded to produce VLSFO and offer capacity readily able to meet NZ's modest bunker demand. However, NZ would also need to import bitumen and asphaltenes for road construction (Refining NZ supplies the equivalent of 60,000km road/year), at materially higher cost than currently.

Chapter 5 Port Costs

This analysis is focussed on the eight principal container ports covered in FIGS, as shown in the following table (bold font). In this report, for brevity, we adopt international port codes. The details of cargo throughput and port performance, based on FIGS and cross-checked against port disclosures, are summarised in Appendices A, B and C.

Note: Every coastal container carried requires the source port to load it onto a ship and the destination port to unload (discharge) it from the ship. For imports, NZ ports provide the unload, for exports the load. For all coastal cargo, whether domestic or transhipment, NZ ports provide both a load and unload, and so statistics from ports and FIGS will double-count each coastal movement.

Table 5. 1

New Zealand Commercial Ports

				Containers - million TEU		Bulk Cargo million tonne	
Port Name	Code	Location	Key Trades	Total	Coastal	Total	Coastal
NorthPort	MAP	Marsden Point, Northland	Petroleum, Logs	0	0	11.0	3.4
Ports of Auckland	**AKL**	Auckland	Containers, Cars	820	218	6.5	0.7
Port of Tauranga	**TRG**	Mt Maunganui, Bay of Plenty	Containers, Logs	1158	200	16.3	0.9
Port Taranaki	NPL	New Plymouth, Taranaki	Petroleum, Logs	0	0	5.0	0.0
Gisborne Port	GIS	Gisborne, Poverty Bay	Logs	0	0	3.0	0.0
Napier Port	**NPE**	Napier, Hawkes Bay	Containers, Logs	260	68	3.3	0.3
CentrePort	**WLG**	Wellington	Containers, Logs, Ferrie	91	27	2.0	0.5
Port Marlborough	MLB	Picton, Marlborough	Logs	0	0	3.0	0.0
Port Nelson	**NSN**	Nelson	Logs, Containers	115	63	0.0	0.5
Lyttelton Port Co	**LYT**	Lyttelton, Canterbury	Containers, Coal	417	179	5.3	0.5
PrimePort Timaru	**TIU**	Timaru, South Canterbury	Containers, Cement	83	28	1.5	0.2
Port Otago	**POE**	Port Chalmers, Dunedin, Otag	Containers, Logs	192	59	1.8	0.4
South Port	BLU	Bluff, Southland	Aluminium, Logs	41	5	3.1	0.2

8 principal container ports in **bold**

5.1 Port Performance

NZ’s eight principal ports transferred 70 million tonnes (mt) of cargo in 2019. As part of this total, the 3.2 million TEU (mTEU) of containers accounted for some 40% of that tonnage (see Appendix C).

As summarised in Chapter 6, the key metric of port operational performance is the rate at which cargo is loaded and discharged from a ship, namely for containers the crane rate (containers per crane per hour) and ship rate (containers per ship per hour). NZ ports compare favourably with Australian and key global ports, despite their small scale. Another measure, berth utilisation, indicates the risk that a scheduled ship must wait for a berth, and can be addressed by ship rate (boosting crane rate or adding cranes) or adding berth capacity.

Rockpoint maintains a financial and operational database of key NZ ports dating back to 1994. The following commentary is focussed on the 8 principal container ports covered by FIGS, noting that coastal cargo task is only a small portion of these ports’ total cargo throughput. All historical financials are presented in real 2019$ (r$), having been adjusted using RBNZ CPI data. To compare ports on a common basis, we have unitised all NZ$ sums on the basis of cargo transferred, as r$/tonne or r$/TEU. Key observations are:

- Since 1995, annual port revenues have more than doubled from r$450 million to r$1,055 billion, while unit port revenues have risen only modestly, from r$15.4/tonne to r$17.2/tonne.
- Correspondingly, port Earnings Before Interest, Tax, Depreciation and Amortisation ("EBITDA") has risen from r$204 to r$464 million, again primarily due to volume with small unit increases from r$5.5/tonne to r5.8/tonne.
- In the same period, port assets have more than tripled from r$1.59 billion to r$5.63 billion, having been materially boosted by revaluations. On a per unit basis, port assets recorded a significant growth, from r$55/tonne to r$87/tonne.
- Since 2002, port capital expenditure has totalled r$3.71 billion. This indicates an overall port capex of r$2.7/tonne/year, or alternatively r$6.4 per incremental tonne of throughput.
- Average port gearing (debt/debt+equity) was a modest 21%, in 2019.

5.2 Port Charges

Ports are required to publicly disclose their tariffs, which, along with the Annual Reports, form the core of Rockpoint's pricing analysis. Ports set their tariffs to recover, over time, the full cost of providing port infrastructure and related operational services and with an acceptable return, and by-and-large, do so. Major port customers typically negotiate tailored (undisclosed and presumably more favourable) terms, while some charges such as stevedoring may remain undisclosed in the tariff sheets. Ports charges are split between fees charged for handling ships (marine or wet charges) and fees for handling cargo (dry or cargo charges). These are set out in Appendix E.

Marine (or Wet) Charges are based on ship size, typically Gross Tonnes GT, sometime ship Length Over All (LOA). Charges typically do not distinguish by ship type, whether dry bulk, liquid tanker or container, although special rates may apply to cruise ships (not covered). Marine Charges cover the provision of infrastructure and services required to safely secure a ship in its berth. While marine charges may be aggregated into a single comprehensive charge, traditional components include pilotage (supplying a qualified mariner to navigate ship into port), towage (provision of tugs to safely manoeuvre a ship into berth), berthage (charge for linesmen to secure the ship, and a charge while alongside) and channel fees (for channel dredging and navigation aids). Most container ships are in port for less than 1 day, and bulk ships up to 3 days. Berthage rates may be different for subsequent days.

Cargo (or Dry) Charges apply to the cargo handled, comprising loads and discharges from the ship, on-port movements, storage, port gates fees, and administration. Rates depend on the nature of cargo (container, breakbulk, bulk), with premiums for cargo requiring specialist port-owned infrastructure. Dry charges are almost all variable ($/tonne, $/TEU, sometimes including a time factor). The traditional breakdown of cargo charges is: Wharfage (loading and discharging cargo from the ship – nominally including stevedoring), Storage (Demurrage - after a grace period), administration fees (receiving cargo at the port gate), and premiums for hazardous materials and for various other services a port may provide (container repairs, equipment hire, provisioning).

Ports set tariffs for ship loading and discharging containers (Appendix E). On a $/TEU basis, 40' containers (FEU) typically attract a lower rate than 20' (TEU), and reefers a premium, while many ports offer discounts for transhipments. The weighted average $/TEU is based on each port's observed mix of containers (per FIGS).

5.3 Port Cost Analysis

We have applied each port's posted tariffs to all cargo throughput derived from FIGS to give a "bottom-up" assessment of revenues for containers vs bulk, across wet charges and dry charges. Our bottom-up revenue assessment assumes ports provide only basic services (ignoring reefer services, demurrage and other discretionary services). We did not model any non-port activities (land transport, property). Each port is unique, with different cargo and business mixes, different reporting conventions, and varying levels of disclosure. Estimates were made for non-cargo port activities such as cruise, ferries and fishing. We note that WLG is rebuilding following the 2016 earthquakes.

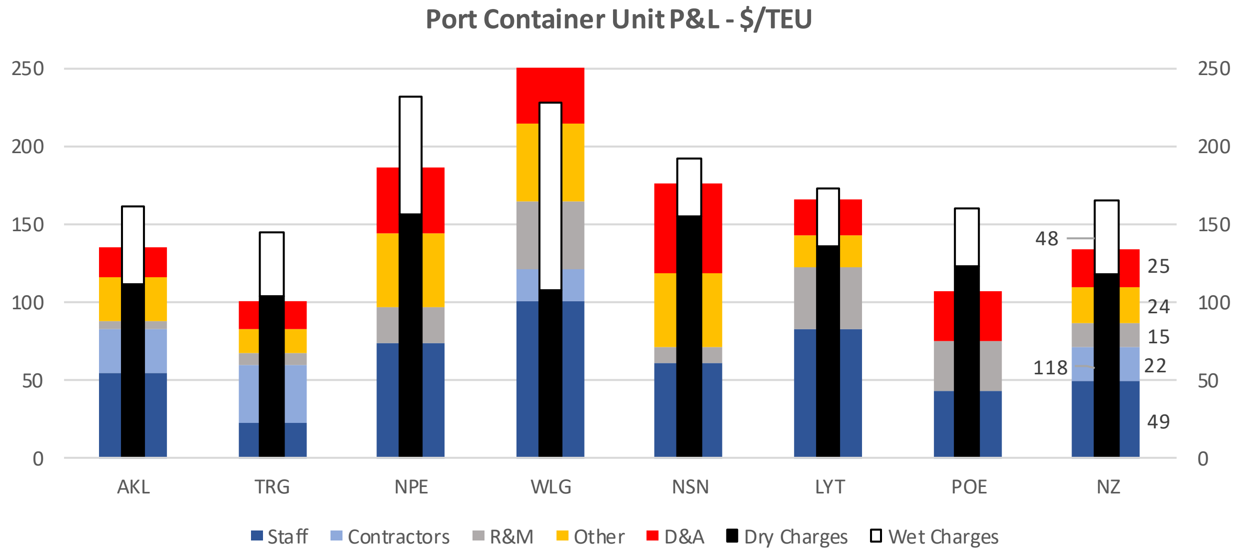
Most ports provide some revenue breakdown in their annual reports, where "port" revenues were distinguished from non-port activities (such as inland ports, land transport and logistics, property).

We sought and received input from port management to reconcile our "bottom-up" revenue calculations with the "top down" revenues provided in the annual financial statements, split between containers and bulk trades. While cooperative, commercial sensitives constrained most ports from any formal disclosure. The principal revenue gap for all ports was identified as stevedoring (typically not disclosed in port tariffs). Most ports undertake all container stevedoring in-house, while many ports permit third-party stevedoring for bulk cargo – especially for the dominant bulk trade, logs. Some ports were also willing to guide allocation of operating expenses and depreciation between container, bulk and other.

Our reconciliation is not comprehensive, being limited by data availability. However, for the purposes of this report, for FY2019 and when averaged across the key ports, we consider this analysis sufficiently robust to allow a meaningful first-pass assessment of typical unit prices and costs. In the following figure, the cumulative port costs (staff, contractors, R&M, D&A and other) are shown relative to each port revenues (dry charges and wet charges). Where revenues exceed costs, port operations report a pre-tax profit. Only WLG posts a loss, largely attributed to its recovery period post-earthquakes.

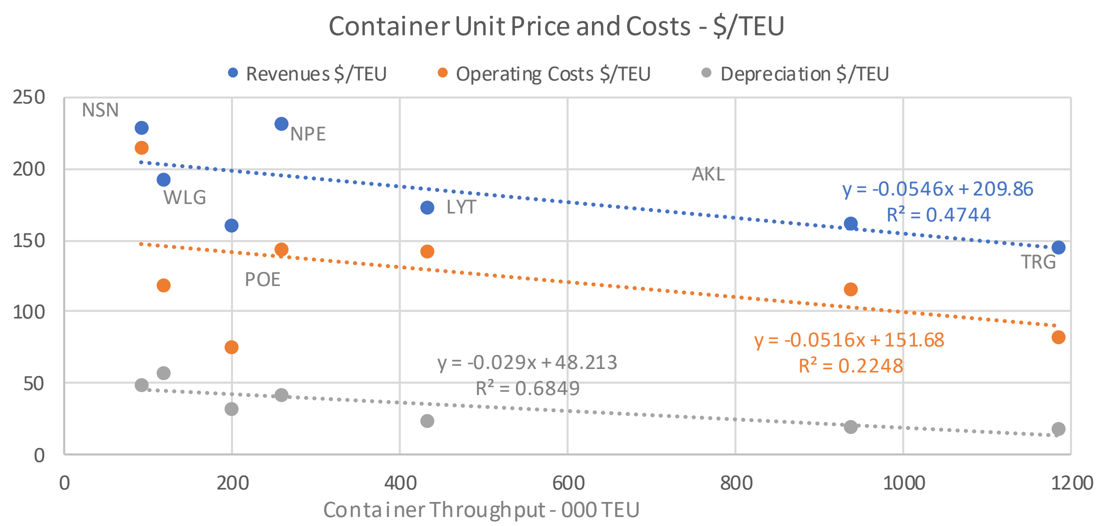
Figure 5. 1

Despite the constraints of the data and the simplicity of our analysis, economies of scale are



evident. TRG, the port with highest container throughput, records the lowest unit prices and costs, while prices and costs generally rise for ports with lower throughput. Given the narrow dataset, the correlations shown are not statistically strong.

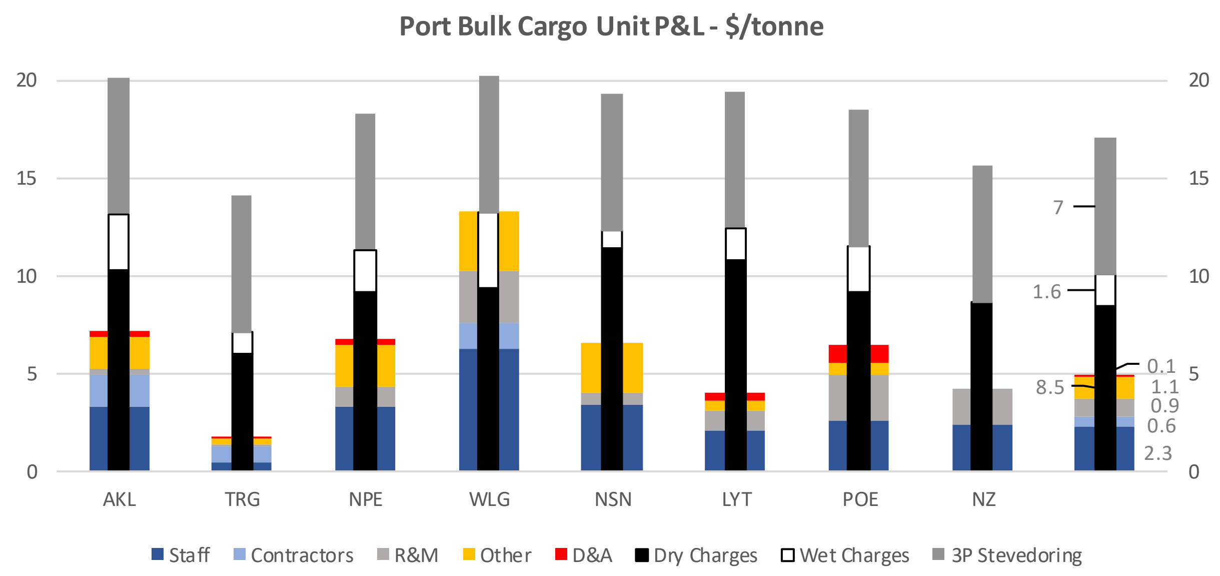
Figure 5. 2



Source: Port Company disclosures, Rockpoint

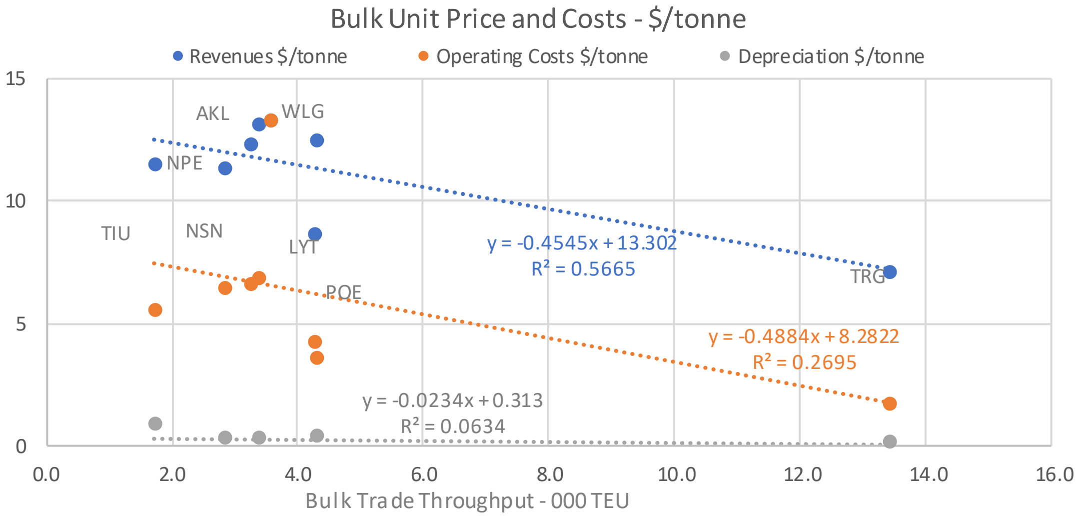
An equivalent analysis was applied to the bulk trades. In 2019, NZ ports handled 58 mt of bulk cargo, with the largest import component being 5.5mt (30% of total) of crude oil imports into Marsden Point. Forestry exports (primarily logs) accounted for 25mt (80% of bulk exports) and were handled across most NZ ports excepting AKL. Coastal bulk trade accounted for less than 8% of overall bulk cargo moved through NZ ports, of which 4.7% was petroleum products distributed by coastal ship ex-Marsden Point, while cement ex Portland and TIU accounted for another 2.7%. Variability in costs and revenues observed amongst the ports reflects widely different mix and scale of trade. For WLG, inter-island ferries and commercial property are significant contributors, although available data does not permit any accurate separation from cargo operations. Most ports permit third party stevedores and marshalling companies to provide services directly to shippers of bulk cargo, especially for logs. Stevedoring rates vary according to the company, the services provided, the port and the commodity, although indicative rates for combined on-port bulk services are $10-12/tonne, comprising marshalling (receiving and stacking goods, $2-3/tonne), port charges ($3-4/tonne, captured elsewhere) and stevedoring (loading and unloading cargo, $4-5/tonne). For the purposes of this study, we apply an indicative $7/tonne third-party bulk stevedoring rate (grey shading below), although we note that port revenues and pre-tax profitability exclude stevedoring.

Figure 5. 3



As with the container trade, scale economies are evident. TRG sets the highest volume at 13.4 mt and achieves the lowest unit price and cost. All other ports are clustered in the range 1.5 - 4.5 mt p.a.

Figure 5. 4



Source: Port Company disclosures, Rockpoint

In summary, while most bulk cargo is handled efficiently in large volumes with specialist equipment, standardisation and scale permits ports to achieve greater efficiencies in containers. On average NZ ports charge $166/TEU (equating to $15.8/tonne cargo equivalent) for handling containers against $17.5/tonne for handling bulk cargo.

Table 5. 2

Port Unit Costs and Charges

Weighted Average of 8 Ports			Containers				Bulk
Cargo - 000TEU, mt			3231	*307.7*			36.8
Ships per year			2568				2307
Ships Avg GT 000			52	*52*			34.1
	min	max	$/TEU	*$/tonne*	min	max	$/tonne
Dry Charges	104	157	118	*11.2*	6.0	13.0	8.9
Wet Charges	36	121	48	*4.6*	0.1	3.9	1.6
3P Stevedoring							*7*
Total Charges			166	*15.8*			17.5
Operating Costs							
Staff	23	100	49	*4.7*	0.5	6.2	2.3
Contractors	0	38	22	*2.1*	0.0	16	0.6
R&M	5	43	15	*1.4*	0.1	2.7	0.9
Other	0	51	24	*2.2*	0.0	3.1	1.1
Total	75	216	110	*10.5*	17	13.3	4.8
EBITDA			56	*5.3*			5.7
D&A	19	58	25	*2.4*	-0.2	0.9	0.1
EBIT			31	*2.9*			5.6
EBIT Margin			19%	*19%*			53%

Chapter 6 Coastal Shipping Model - Containers

For this DTCC report we have constructed a cost model for coastal shipping in NZ, building upon the FIGS database, ship cost data from Drewry (and Alphaliner), and our reconciled port data. Deriving a meaningful unit cost and unit price involves numerous variables and many assumptions. Ship capital and operating costs vary with ship size, while bunker costs also vary with ship speed. Yet unitisation is largely driven by the volume of cargo transferred per ship at each port. While there are patterns in ship schedules and cargo transfers, our modelling is necessarily a simplification.

Our modelling focusses on the coastal container trade, given that our analysis suggests that this trade offers the clearest growth opportunity for coastal shipping, both through sector growth and increased competition with road and rail. The cost structures for domestic and international container ships are materially different. Accordingly, we have modelled container ships across representative sizes:

- domestic – 1,000, 1,500, 2,000 and 2,500 TEU
- foreign – 2,500, 3,000, 3,500, 4,000, 7,000 and 10,000 TEU

Key assumptions for NZ domestic ships are:

- Compete only for coastal containers (domestic and transhipment).
- Crewing costs are taken to be +150% (2.5x) that of an equivalent foreign ship, reflecting different employment and safety laws (see 6.1 below)
- Ship operating costs are higher given the NZ marine industry lacks the scale of large offshore facilities while key consumables (lubricants, spares) must be imported.
- Bunker costs are +30% higher (1.3x) than for foreign ships. Our modelling assumes ships are in transit 65% of the time while operating on NZ coast (based on known schedules), while bunker use while in port (at idle) is taken to be 10% of the rate consumed while in transit.

A detailed summary of coastal container movements is presented in Appendix C, which forms the basis of our modelling. FIGS data shows NZ ports handled 3.22 mTEU containers in 2019, of which 0.82 mTEU were coastal (being 0.54 mTEU domestic and 0.28 mTEU transhipments). Adjusting for double counting (where each coastal container is handled by the loading and the receiving port) the coastal container freight task was 0.27 mTEU domestic and 0.14 mTEU transhipment containers. Empty containers are task for both ships and ports (as a cost for shipping lines, yet generating revenue for ports). 48% of all domestic containers moved by ship are full, as are 95% of all transhipments.

Table 6. 1

Containers Handled at NZ Ports *

Year to Sep-19		Coastal			International				Total
	Domestic	Transhipment		Coastal	*Null*	Re-export	Export	Import	
000TEU		Export	Import	Total	~	^			
Load Empty	143	4	4	151	*11*	15	165		341
Load Full	120	97	33	251	*2*	68	928		1,249
Discharge Empty	147	4	4	155	*0*	15		327	497
Discharge Full	129	100	33	261	*2*	68		802	1,133
Total	540	205	74	**818**	*16*	165	1,092	1,128	**3,220**
Unique #	270	102	37	**409**		83	1,092	1,128	**2,712**
Unique Full #	129	100	33	**261**		68	928	802	**2,058**
% Full	*48%*	*97%*	*90%*	*64%*		*82%*	*85%*	*71%*	*76%*
Import-Export 000t						-	11,792	7,118	-
Implied t/TEU	*8.9*	*12.7*	*8.9*				12.7	8.9	
Coastal 000t (calc)	1,142	1,265	294						**2,701**

* the 9 principal container ports, AKL, TRG, NPE, WLG, NSN, LYT, TIU, POE, BLU

^ a container imported, then without leaving that port exported on a different ship ~ an unallocated container

each coastal container is handled twice, once each by loading and discharging ports

Source: MOT FIGS

FIGS data allows us to map and/or infer volumes of containers by type on each coastal route (domestic port-port pair). Both domestic and transhipment containers are considered contestable, although transhipment containers, being contracted to foreign shipping lines, will more typically be carried by foreign ships. In the following figures, the average annual flow (in 000TEU) is shown for each route (port-port pair), while the depth of shading represents the number of weekly coastal shipping services. Pacifica's weekly route linking 4 ports (AKL-LYT-NSN-TRG-AKL), shown superimposed as red circles in the figure below-left, covers a potential 135,000TEU per annum of coastal container movements (or 33% of all coastal flows). FIGS data suggests Pacifica carried 75,000 TEU in 2018/2019, over half of the potential market on its 4-port route.

Table 6. 2

Domestic Container Flows - 000TEU

	MAP	AKL	TRG	NPE	WLG	NSN	LYT	TIU	POE	BLU
MAP										
AKL			40	30	0	20	75			
TRG		15					15			
NPE							5			
WLG			10							
NSN			5							
LYT			10	10	5	5			25	
TIU										
POE										
BLU										

Pacifica 100 ship calls per week <1 1 2 3 4+

Table 6. 3

Coastal Container Flows - 000TEU

	MAP	AKL	TRG	NPE	WLG	NSN	LYT	TIU	POE	BLU
MAP										
AKL			45	32	5	24	80			
TRG		20		2			24			
NPE			20				5			
WLG		2	12							
NSN			30							
LYT			20	11	6	5			25	
TIU			10		1				14	
POE		6	5				3			
BLU							1			

Pacifica 135 ship calls per week <1 1 2 3 4+

Our modelling focuses on the 7 representative routes, shown as black boxes in the figure above-right, and listed in the following table. These 7 routes, in 2018/19, accounted for 215,000 TEU domestic containers (80% of all domestic) and 250,000TEU coastal containers (61% of all coastal).

Pacifica and several foreign shipping lines each offer weekly services. For example, on the AKL-LYT route, Pacifica and 4 foreign shipping lines each offer a direct weekly service (and a further 3 services offer a link with one intermediate port call). All compete for the annual 80,000 TEU, averaging 320TEU/ship for those 5 direct services. The final column indicates the average weekly container loadings per direct ship on each route. Where only one direct service is available, an indirect service is added. In practice, not all foreign ships seek to serve domestic containers.

Table 6. 4

Coastal Container Movements by Key Routes

Route		Domestic Full	Domestic Empty	Tran-shipment	Coastal Total	Weekly Shipping Services Pacifica	International		Containers per Ship
From	To	000TEU	000TEU	000TEU	000TEU	Weekly	Direct	Indirect	TEU/ship
AKL	LYT	65	10	5	80	1	4	3	320
AKL	TRG	0	40	5	45	+2	1	6	450
AKL	NPE	0	30	2	32			3	320
AKL	NSN	10	10	4	24	+1	1		240
TRG	LYT	15	0	9	24	+1		1	240
LYT	TRG	10	0	10	20	+1	1	5	200
LYT	POE	10	15	0	25		1		500
Total of 7 Key Routes		110	105	35	250				
NZ Total		125	145	138	408				
share of 7 key routes		88%	72%	25%	61%				

Pacifica: 1 = direct, +1 = 1 intermediate port.   International: indirect = 1-4 intermediate ports

For any ship on a scheduled service, ship capital and operating costs are considered fixed, whether in transit or in port. The schedules allow for time in transit (based on transit speed and distance) and time in port (based on the rate at which the anticipated cargo is loaded and discharged), and an assumed allowance for unforeseen delays (slower or larger cargo transfers, weather, minor mechanical, waiting on berth). Bunker costs reflect the mix of time in transit (distance and speed, both driving consumption) and in port (where, with engines at idle, ships consume at a lower rate – 10%).

Port crane performance data shows us that average Ship Rate (containers handled per ship per hour) exceeds 90 TEU per hour. Foreign container ships on average transfer 1350 TEU (import-export, transhipment and coastal) at each port (more for larger ships), yielding an average exchange time of 15 hours. We add an extra 2 hours per port call to allow for berthing.

Transit time is calculated for each route, based on known sea-distance and an assumed transit speed. Across the selected 7 routes, the ratio between nominal port and transit times of 17kts suggests 64% of a ship's time is in transit on the coast (and so 36% in port). This is consistent with 60% transit time calculated for Pacifica's weekly service.

Ships have some scope to recover time from unforeseen delays, particularly on longer voyages. Transit speed can be raised (at the expense of higher bunker consumption). Raising transit speed from 17kts to 20kts would save almost 2 full days Singapore-Auckland and 6hrs AKL-LYT. Alternatively, ships could eschew loading all available cargo (domestic cargo would have lower priority). Most frequently, ships may elect to miss a port (and so recover a day or more). It is our understanding that, where Pacifica exceeds 90% service reliability (on schedule, on time), foreign container ships may achieve only 70%.

6.1 Ship Costs

Our cost analysis is based on 10 representative container ship sizes: domestic ships of 1,000, 1,500, 2,000 and 2,500TEU (noting Pacifica replaced its 1,100TEU *Spirit of Canterbury* with the 1,700TEU *Moana Chief* in 2019), and foreign ships of 2,500, 3,000, 3,500, 4,000, 7,000 and 10,000TEU. Ship capital costs are incurred equally every day and we make no distinction in capital costs between domestic and foreign ships (domestic operators can readily seek to buy any ship on the global market).

Table 6. 5

Ship Capital Costs

				Domestic Ships	Foreign Ships					
Ship Size TEU	1000	1500	2000	2500	2500	3000	3500	4000	7000	10000
Capital Costs				NZ Ship	Foreign Ship Capital Costs					
New Build Price NZ$m	18	29	39	39	39	51	62	64	97	127
Ship Value at 10yrs NZ$m	9	13	16	18	18	21	20	24	37	52
Input:	Discount Rate (WACC)			5%	5%					
	Remaining Ship Life (yrs)			15	15					
	Overhead Premium			15%	15%	includes margin, insurance, administration				
Capital Charge NZ$/day	1820	2750	3400	3740	3740	4360	4120	5130	7830	11010

Source: after Drewry - Ship Operating Cost Review 2019

Operating costs excluding voyage costs (bunkers) are also incurred equally every day. There is however a material structural difference in operating cost structures between domestic and foreign ships.

Key assumptions for NZ domestic ship operating costs are:

- Compete only for coastal containers (domestic and transhipment).
- Crewing costs are taken to be +155% (2.55x) that of an equivalent foreign ship, reflecting employment and safety laws. Based on our discussion with industry parties, the key elements of crewing agreements are:
    - ***Crewing levels***: Discussion with several domestic ship operators indicates that NZ-registered ships are required to operate with higher crew numbers than an equivalent foreign open register ship: this is consistent with research by SIRC[18]. We assume a NZ premium of 1.2x.
    - ***Base rates***. While rates vary by ship type, NZ crews are paid more per hour/day than an equivalent foreign crew. 1.25x.
    - **Leave**. NZ ship crew work one month on, one month off (vs foreign crew typically six months on, one month off). 1.7x.

[18] An Analysis of Crewing Levels: Seafarers International Research Centre, Cardiff,2006

- Ship operating costs are also significantly higher, given that the NZ marine industry lacks the scale of large offshore facilities while key consumables (lubricants, spares) must be imported. Based on general discussions with local operators and suppliers, we assume:
  - Spares, lubricants and R&M are taken to be double equivalent costs offshore, to reflect the cost of importation, and the local labour component. 2.0x.
  - Survey. While domestic ships face equivalent in-water intermediate inspection costs, the IMO SOLAS requirement that all cargo ships must complete a full dry dock inspection twice within any five year period adds a burden on domestic ships. The NZ Navy's Devonport dry dock could accommodate Golden Bay Cement's and Holcim's ships, but not those of Coastal Oil Logistics or Pacifica. The nearest suitable dry docks are in Sydney or Brisbane (3 days in transit each way) or Singapore (12 days each way). We model a +50% domestic cost premium, as we do with largely domestically-supplied store/provisions. 1.5x
  - Insurance and administration are assumed to be at parity with foreign ships. 1.0x
- Bunker costs are +30% higher (1.3x) than those of foreign ships. Our modelling assumes ships are in transit 65% of the time while operating on NZ coast (based on known schedules), while bunker use while in port (at idle) is taken as 10% of the rate consumed while in transit.

Overall, operating costs for a 2500TEU domestic ship are estimated to be double (2x) those of a foreign ship of similar size Table 6.6).

Table 6.6

Ship Operating Costs - NZ$/day

	Domestic Ships				Foreign Ships					
	1000	1500	2000	2500	2500	3000	3500	4000	7000	10000
Core Ship Costs	NZ Ship Operating Costs				Foreign Ship Operating Costs					
Manning	8700	9520	10350	10390	4070	4090	4106	4120	3960	4200
Insurance	300	310	320	430	430	540	658	770	810	1110
Stores	490	510	540	540	360	360	360	360	520	680
Spares	660	690	720	710	350	350	342	340	470	630
Lubricants	1010	980	950	1310	660	840	1023	1210	1780	1980
R&M	680	700	720	700	350	340	333	320	480	540
Survey	990	1090	1190	1220	810	830	853	870	900	1060
Administration	960	1050	1130	1250	1250	1370	1488	1610	1750	2120
Containership Total	13790	14850	15920	16550	8280	8720	9163	9600	10670	12320

Source: after Drewry - Ship Operating Cost Review 2019

Bunkers are consumed continuously, at "full" rate, while the ship is in transit at 17kts (modelled to be an average of 65% of their time while operating on the NZ coast), and at a reduced rate (assumed 10% of the 'full" in-transit rate) while at idle in port. While consumption rates for domestic ships mirror those of foreign ships, the latter benefit from competitive bunker prices offered at their various global ports of call, while domestic ships pay a premium (modelled at 1.3x) for Refining NZ-supplied bunkers, and in addition incur $70/tonne for Emission Trading Scheme (ETS) levies (from which foreign ships are exempt). Inclusive of ETS, NZ ship bunker costs are 1.5x those of an equivalent foreign ship (Table 6.7).

Table 6.7

Ship Bunker Costs - NZ$/day

NZ$/day	1000	1500	2000	2500	2500	3000	3500	4000	7000	10000
	Domestic Ships				Foreign Ships					
Bunker Costs	Auckland bunker pricing				Singapore bunker prices					
Consumption tpd (at 17kts)	27	30	33	37	37	40	42	45	65	110
Bunkers NZ$/tonne	550	550	550	550	370	370	370	370	370	370
Cost NZ$ per day (60%)	10200	11300	12400	13900	9400	10100	10600	11400	16500	27900
as % Ship Operating Costs	*40%*	*39%*	*39%*	*41%*	*44%*	*44%*	*44%*	*44%*	*47%*	*54%*

Note: ships on the NZ coast typically spend 65% of time in transit, the balance in port at idle (at 10% bunker consumption)

Source: after Drewry - Ship Operating Cost Review 2019

In summary, at each ship's rated slot capacity, daily costs rise with ship size. Against equivalent foreign ships (2500TEU), capital costs are similar, ship operating costs for domestic ships are double, while bunker costs are 1.5x higher, resulting in overall costs being 1.6x more (Table 6.8).

Table 6. 8

Overall Ship Costs - NZ$/day

Ship Size TEU	1000	1500	2000	2500	2500	3000	3500	4000	7000	10000
	Domestic Ships				Foreign Ships					
Capital Costs	1820	2750	3400	3740	3740	4360	4120	5130	7830	11010
Operating Costs	13790	14850	15920	16550	8280	8720	9163	9600	10670	12320
Bunker Costs (65% in transit)	10200	11300	12400	13900	9400	10100	10600	11400	16500	27900
Total	25810	28900	31720	34190	21420	23180	23883	26130	35000	51230
% bunkers	40%	39%	39%	41%	44%	44%	44%	44%	47%	54%
Implied $/TEU										
at 100% capacity	25.8	19.3	15.9	13.7	8.6	7.7	6.8	6.5	5.0	5.1
at 50% capacity	51.6	38.5	31.7	27.4	17.1	15.5	13.6	13.1	10.0	10.2
at 20% capacity	129.1	96.3	79.3	68.4	42.8	38.6	34.1	32.7	25.0	25.6

Ships do not (and do not seek to) operate at capacity (where all slots are always occupied) given the availability of cargo, ships weighting out (meeting load capacity) when full containers are carried, but primarily given rising inefficiency of port transfers when nearing slot capacity. Anecdotally the sweet spot (for the typical mix of full and empty containers) is at 60-80% of slots being occupied. In Table 6.8 above, ship operating costs are calculated for a range of capacity utilisation levels.

6.2 Port Costs

Ports charge visiting ships for recovery of the cost of providing infrastructure and operating costs. Port marine (wet) charges apply to the ship, on the basis of their size (GT or LOA), while port dry charges apply to the cargo, on the basis of scale (containers or tonnes)

Port wet charges cover navigation, pilotage, towage, berthage and lines. These charges are set independently by each port: some ports may aggregate wet charges into a comprehensive charge, while others may set some or all elements separately. Ports make no charge distinction between domestic and foreign ships. Table 6.9 shows a typical structure of port wet charges.

Table 6. 9

Port Wet Charges - $/visit	Domestic Ships				Foreign Ships					
Ship Size TEU	1000	1500	2000	2500	2500	3000	3500	4000	7000	10000
AKL	17000	24900	32700	40600	40600	48400	56200	64100	111100	158200
TRG	14800	22800	29500	36100	36100	42700	49400	56100	96000	135900
NPE	19800	25200	31800	31800	31800	40300	40300	49700	69200	69200
WLG	16000	23200	28600	33200	33200	37700	42300	46900	74200	101600
NSN	11700	16100	20500	24600	24600	28700	32700	48500	81600	114700
LYT	14800	17100	24100	30900	30900	30700	38700	40300	51800	61700
TIU	18200	26600	35100	43500	43500	51900	60300	68700	119100	169500
POE	12700	17500	25900	32500	32500	38200	50100	56600	102200	126700
BLU	22800	27700	35400	42100	42100	46200	50200	50200	50200	50200
NZ Average	16400	22300	29300	35000	35000	40500	46700	53500	83900	109700

Port dry charges apply to the cargo and are based on the nature and volume of cargo being transferred. Ports generally apply the same rate for loading and discharge, and do not distinguish between domestic and import-export cargo (although they may offer concessionary rates for transhipment containers). Based on ports' published price sheets, container charges vary by container type (TEU or FEU, dry or reefer, full or empty). It is expected ports may offer special rates to their largest shipping customers.

Table 6.10 applies the public price schedules to the mix of containers observed in FIGS data for each port, so reflecting the various premiums / discounts which apply for reefers, FEU and transhipments. In our reconciliation, assisted by port management, the weighted average price is then adjusted to match the publicly reported total revenues, so providing overall unit dry charges for containers. We note that few ports disclose their stevedoring rates. Many ports also generate revenues from non-core or non-port activities. This reconciled overall port dry charge $/TEU (last line in Table 6.10) is applied to each port and each of the 7 selected routes in our modelling.

Table 6. 10

Port Dry Charges - $/TEU

	AKL	TRG	NPE	WLG	NSN	LYT	TIU	POE
Public Price schedules								
Full	64	64	92	62	84	51	61	67
Empty	38	20	20	24	63	52	16	30
Weighted Average	57	55	64	51	76	51	42	55
Reconciliation								
- including Stevedoring	112	104	157	107	155	136	124	118

Source: Port public price schedules

6.3 Coastal Container Modelling

Deriving meaningful prices and costs for a unit of coastal freight (container or bulk tonne) involves estimation of a large number of variables. We have reduced these variables to:

- 7 key coastal routes (typically exhibiting the highest volume)
- Volumes based on observed FIGS data (2019)
- Nominally 4 domestic ship sizes carrying only coastal (domestic and transhipment) containers (noting the only domestic container ship, *Moana Chief*, is 1,700 TEU)
- 6 foreign ship sizes carrying coastal and import-export containers (noting the largest foreign container ship currently serving coastal routes is 6,000 TEU).

FIGS data provides the mix of containers exchanged at each port (TEU-FEU, dry-reefer, full-empty, domestic-tranship-import-export), and further the average number of TEU exchanged by ship size. For the matrix in Table 6.11 below, exchanges are nominally matched to ship size for each port, with the same mix of container types assumed for all ships and ports (noting that domestic ships compete only for domestic and transhipment containers and carry a higher ratio of empties).

Table 6. 11

Port Container Exchanges - TEU/ship visit

	Domestic Ships				Foreign Ships					
TEU	1000	1500	2000	2500	2500	3000	3500	4000	7000	10000
Exchange by Ship Size	*250*	*375*	*500*	*625*	*1025*	*1100*	*1175*	*1250*	*1700*	*2150*
AKL	170	260	350	440	1070	1150	1220	1300	1770	2240
TRG	130	190	260	320	1290	1390	1480	1580	2140	2710
NPE					690	740	790	840	1150	1450
WLG					480	520	550	590	800	1010
NSN	200	310	410	510	650	700	750	790	1080	1360
LYT	280	420	560	700	1080	1160	1240	1320	1800	2270
TIU					500	540	570	610	830	1050
POE					760	810	870	930	1260	1590
BLU					440	470	510	540	730	930

Note: FIGS data shows container exchanges increase with ship size. These exchanges are driven by market demand (available containers). Ship operators may introduce a larger ship when market demand pushes capacity utilisation too high – whereas introducing a larger ship cannot be assumed to drive greater market activity.

As for any infrastructure providers, the key drivers of unit costs are capital costs, scale economies and capacity utilisation (peak and average). Ship operators will design their schedules to capture as much cargo as its chosen ships can efficiently carry.

For a given ship, time-based costs are primarily fixed, while bunker costs are fixed by a given route or schedule (and implied speed) (refer Chapter 6.1 above). Unit costs are therefore driven by these costs being averaged across the cargo volume actually transferred (rather than ship capacity). Foreign operators, focussed on their core import-export cargo, typically employ larger ships, and so capture considerable ship scale benefits ($/slot/NM). They will design their schedules to visit the key import port first, typically AKL, while departing from the key export port last, often TRG, and so they have more empty slots on coastal legs enabling them to accommodate coastal containers.

Note: dry bulk ships and tankers do not have the same flexibility to utilise spare capacity for domestic cargo, given the challenge to accumulate viable cargo quantities, the availability of efficient loading/unloading infrastructure, and the compatibility (cross contamination) of bulk cargos.

Key assumptions in our modelling include:

- Ship costs are fixed, noting operating costs for domestic ships are double those of foreign ships.
- Bunker consumption assumes ships are in transit 65% of the time (based on observed NZ schedules), while bunker prices for domestic ships (including ETS) are 50% higher.
- Wet charges applied are national averages, and do not differentiate between domestic and foreign ships.
- Dry charges are also national averages, and do not differentiate between coastal and import-export cargo, or domestic and foreign ships. Transhipments attract discounts at some ports.
- Time allocated to each route (port-port pair) comprises time in transit (distance at 17kts, allowing an extra 15% for berthing, weather and schedule flexibility) and time in port (time required to exchange containers at the stated ship rate, plus a 20% allowance for delays).
- The containers exchanged by foreign ships for each route (port-port pair) are broadly derived from FIGS data for average exchanges by port and average exchanges by ship size.
- Domestic ships carry only coastal (domestic and transhipment) containers. FIGS data shows that domestic ships (that is Pacifica's *Moana Chief*) carry 75,000 TEU p.a., implying 55% market share on its route. Our model assumes a generic domestic ship captures 40% of estimated available coastal volumes on each specific route.

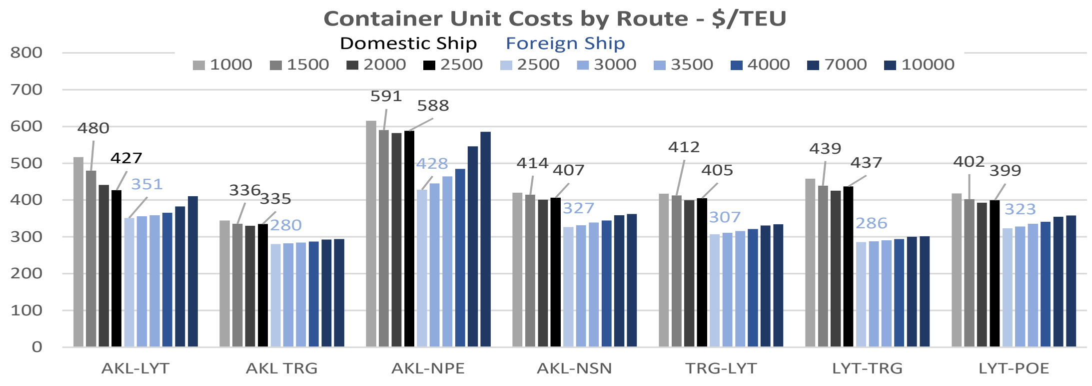
Within the limitations of the data and our modelled assumptions, we observe that calculated unit costs $/TEU for foreign ships generally rise with rising ship size, while being flat for domestic ships. For foreign ships, while our modelling correctly reflects observed FIGS NZ exchanges (import, export and coastal), it cannot capture those containers carried through NZ from previous foreign ports destined for subsequent foreign ports. Our domestic ship exchanges are based on observed FIGS domestic flows by route, and assume domestic ships capture 40% market share. However, with only a single domestic ship operating, it is not possible to be confident how different ship sizes may affect exchanges and market share. However, Pacifica did replace its smaller *Spirit of Canterbury* (1100TEU) with *Moana Chief* (1700TEU) in September 2019, and has since achieved an increase in exchanges and market share. Assuming a new larger domestic ship is introduced in response to higher market demand, we might expect scale economies to drive unit prices down. One clear observation was that, across these 7 routes, domestic ship unit costs are notably higher, at approximately $430-440/TEU, while an equivalent foreign ship achieved $330-350/TEU.

Table 6. 12

Unitisation of Coastal Container Costs - $/TEU by Route

Ship Costs - NZ$/day	Domestic Ships				Foreign Ships					
Ship Size TEU	1000	1500	2000	2500	2500	3000	3500	4000	7000	10000
Capital Costs	1820	2750	3400	3740	3740	4360	4120	5130	7830	11010
Operating Costs	13790	14850	15920	16550	8280	8720	9163	9600	10670	12320
Bunker Costs (65% in transit)	10200	11300	12400	13900	9400	10100	10600	11400	16500	27900
Total	25810	28900	31720	34190	21420	23180	23883	26130	35000	51230
Port Charges										
Port Wet Charges $/visit	*16400*	*22300*	*29300*	*35000*	*35000*	*40500*	*46700*	*53500*	*83900*	*109700*
Port Dry Charges $/TEU	*127*	*127*	*127*	*127*	*127*	*127*	*127*	*127*	*127*	*127*
Time for Route - Transit (at 17kts) plus Container Exchange (at Ship Rate)										
Route										t
AKL-LYT	63	72	73	69	78	81	83	85	99	113
AKL TRG	18	23	24	22	48	51	53	56	73	90
AKL-NPE	45	49	49	47	59	60	62	63	72	81
AKL-NSN	48	50	51	50	57	58	59	61	67	73
TRG-LYT	46	48	48	47	60	61	63	64	73	81
LYT-TRG	45	47	47	46	73	75	78	80	94	108
LYT-POE	18	21	21	20	28	29	30	31	38	44
Containers Exchanged - TEU	809	884	960	1036	1036	1112	1187	1263	1718	2172
Route \ Ship Rate TEU/hr	45	45	60	80	80	80	80	80	80	80
AKL-LYT	320	480	670	770	1070	1150	1220	1300	1770	2240
AKL TRG	180	270	380	430	1290	1390	1480	1580	2140	2710
AKL-NPE	130	200	270	310	690	740	790	840	1150	1450
AKL-NSN	100	140	200	230	480	520	550	590	800	1010
TRG-LYT	100	140	200	230	650	700	750	790	1080	1360
LYT-TRG	80	120	170	190	1080	1160	1240	1320	1800	2270
LYT-POE	100	150	210	240	500	540	570	610	830	1050
Total Route Cost - $/TEU										
Route \ Ship Size TEU	1000	1500	2000	2500	2500	3000	3500	4000	7000	10000
AKL-LYT	517	480	441	427	351	356	359	366	382	410
AKL TRG	344	336	330	335	280	282	285	287	292	294
AKL-NPE	615	591	582	588	428	445	464	484	546	586
AKL-NSN	420	414	401	407	327	332	339	344	359	362
TRG-LYT	417	412	400	405	307	311	315	321	331	334
LYT-TRG	458	439	426	437	286	288	291	294	300	302
LYT-POE	418	402	393	399	323	328	335	341	354	358
simple average	456	439	425	428	329	335	341	348	366	378

Figure 6. 1


Container Unit Costs by Route - $/TEU
Domestic Ship
Foreign Ship
1000
1500
2000
2500
2500
3000
3500
4000
7000
10000
800
700
600
500
400
300
200
100
0
480
427
351
336
335
280
591
588
428
414
407
327
412
405
307
439
437
286
402
399
323
AKL-LYT
AKL TRG
AKL-NPE
AKL-NSN
TRG-LYT
LYT-TRG
LYT-POE

Chapter 7 Coastal Shipping Model - Dry Bulk

We present an abbreviated summary of unit costs for domestic dry bulk carriers and liquid bulk tankers – "bulk ships". The nature of these shipping operations differs materially from container ships.

- Bulk ships typically operate on repeated, regular (but rarely "scheduled") services. The cargo is typically loaded at a single port and discharged at a destination port (or perhaps succession of ports). The ships will load to capacity for the outward leg, and almost always return empty.
- Bulk ships typically carry a single commodity, whether crude oil, iron ore, coal, LPG or logs, or in NZ domestic waters, petroleum products or cement. (The exceptions are breakbulk ships such as vehicle carriers or RORO's). These bulk commodities are transported unpackaged (in several separate ship holds) to meet an agreed specification (grade of ore or cement or oil product). As such, they cannot be mixed with a different grade, let alone a different commodity. Even between shipments, there are standards to ensure a previous cargo does not contaminate the current cargo (such as diesel vs petrol), so requiring holds to be washed and prepared between different commodities. This greatly restricts backhaul opportunities.
- Infrastructure must be available to efficiently exchange these large, usually-repeated, cargos. Bulk ships may be geared (with on-board cranes and/or pumping equipment) to load and discharge cargo independent of port infrastructure while ports will need receival, conveyance (pipes, conveyors) and storage facilities (tanks and silos) able to handle and keep separate these commodities.

These constraints limit scope for bulk ships to carry opportunistic cargo, and accordingly foreign bulk ships rarely carry domestic bulk cargo. The exceptions may be bulk fertiliser ships repositioning between NZ fertiliser stores to accommodate unanticipated demand patterns (such as in a drought).

The key NZ domestic bulk cargos are petroleum products (liquid bulk) and cement (dry bulk). Both use dedicated ships designed for a limited suite of products, each operating from a single source port and distributing to multiple NZ ports. Our modelling is based on the observed pattern of movements, and assumes ships depart full, and deliver to 2 (or 3) ports on each voyage, then return empty.

Cement is distributed by coastal ship by two competing companies, Golden Bay Cement and Holcim. Golden Bay Cement manufactures 0.95 mtpa[19] at its Portland, Northland plant, and distributes it to all NZ ports in its *Aotearoa Chief* (8745dwt). Assuming delivery to 2 ports per voyage, Aotearoa Chief makes about 110 voyages and 220 port calls annually, with an average voyage distance estimated at 650km.

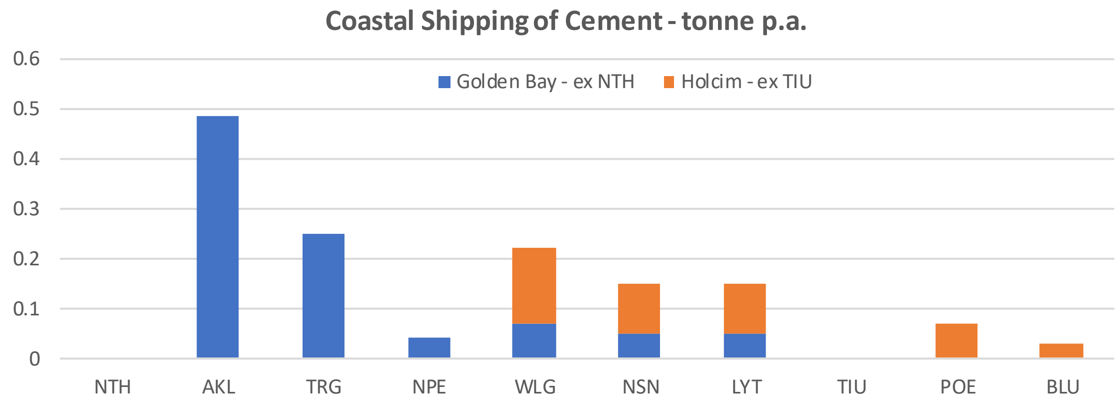
Holcim imports an estimated 0.5 mtpa annually[20], split between AKL (for local consumption) and TIU. Holcim's ship *Buffalo* (6311dwt) delivers about 0.4 mtpa from TIU to many NZ ports. Assuming delivery to 3 ports per voyage, *Buffalo* makes about 70 voyages and 200 port calls annually. While both Golden Bay and Holcim compete nationally, it is likely that the market share of

[19] Golden Bay Cemenet Profile, 0.967mtpa capacity

[20] Holcim volumes estimated from observed import ship visits, and StatsNZ readimix concrete production

each will be greater nearer their source port (see figure 7.1). On this basis, we estimate the weighted average voyage distance for Holcim is 600km.

Figure 7. 1



Dry bulk ship capital costs rise with ship size. We note that the range of ship sizes in Drewry's report was 30,000dwt and higher, requiring a long extrapolation down to NZ's smallest dry bulk ship, *Anatoki* (820dwt). We do not attest to the accuracy of our extrapolation to smaller ships in the following tables.

Table 7. 1

Dry Bulk Ship Capital Costs - NZ$ million				Domestic Ships		Foreign Ships			
dwt	1000	5000	10000	25000	50000	10000	25000	50000	100000
Capital Costs		NZ Ship Capital Costs		Foreign Ship Capital Costs					
New Build Price NZ$m	*9*	*15*	*22*	*33*	*39*	*22*	*33*	*39*	*75*
Ship Value at 10yrs NZ$m	3	6	9	13	16	9	13	16	34
Inputs	Discount Rate (WACC)		5%	5%					
	Remaining Ship Life (yrs)		15	15					
	Overhead Premium		15%	15%	includes margin, insurance, administration				
Capital Charge/day	630	1250	1880	2820	3450	1880	2820	3450	7210

Source: after Drewry - Ship Operating Cost Review 2019

As with container ships, domestic dry bulk ships incur higher operating costs than foreign ships, notably in crew costs. The Devonport dry dock appears able to accommodate *Aotearoa Chief, Buffalo, Anatoki* and *Southern Tiare,* so no premium is assumed for survey costs.

Table 7. 2

Dry Bulk Ship Operating Costs - NZ$/day				Domestic Ships		Foreign Ships			
dwt	1000	5000	10000	25000	50000	10000	25000	50000	100000
Core Ship Costs	NZ Ship Operating Costs			Foreign Ship Operating Costs					
Manning	4360	6540	6980	7850	8290	2740	3080	3250	3880
Insurance	130	190	220	310	460	220	310	460	690
Stores	360	450	490	630	760	330	420	510	540
Spares	450	570	630	810	980	310	400	490	550
Lubricants	690	810	860	1040	1490	430	520	750	850
R&M	240	360	420	600	720	210	300	360	370
Survey	780	830	860	950	1120	860	950	1120	1160
Administration	820	970	1040	1270	1650	1040	1270	1650	1740
Dry Bulk Total	7830	10720	11500	13460	15470	6140	7250	8590	9780

Source: after Drewry - Ship Operating Cost Review 2019

Dry bulk ships transit at slower speeds than container ships, given their greater hull resistance, through greater displacement and hull surface per metre of hull length. Accordingly bulk ships have similarly adopted slow steaming to reduce bunker costs, down 20-25% from 15-16kts to now typically 10-13kts.

Table 7. 3

Dry Bulk Ship Bunker Costs - NZ$/day				Domestic Ships		Foreign Ships			
dwt	1000	5000	10000	25000	50000	10000	25000	50000	100000
Bunker Costs			Auckland bunker pricing with ETS			Singapore bunker prices			
Consumption tpd (at 12kts)	8	11	14	17	19	14	17	19	24
Bunkers NZ$/tonne	550	550	550	550	550	370	370	370	370
Cost NZ$ per day (60%)	3000	4100	5300	6400	7200	3500	4300	4800	6100
as % Ship Operating Costs	*28%*	*28%*	*32%*	*32%*	*32%*	*36%*	*37%*	*36%*	*38%*

Note: ships will typically spend 60% of time in transit burning fuel at full consumption rate, and 40% in port at idle at 10% rate

Source: after Drewry - Ship Operating Cost Review 2019

In summary, at each bulk ship's rated capacity, daily costs rise with ship size. Against equivalent foreign ships, capital costs are similar, ship operating costs for domestic ships are double, while bunker costs are 1.5x higher, overall 1.7x greater. Dry bulk ships typically load to capacity (weight), being the prime driver of unit rates ($/tonne).

Table 7. 4

Dry Bulk Ship Costs - NZ$/day				Domestic Ships		Foreign Ships			
Ship Size TEU	1000	5000	10000	25000	50000	10000	25000	50000	100000
Capital Costs	630	1250	1880	2820	3450	1880	2820	3450	7210
Operating Costs	7830	10720	11500	13460	15470	6140	7250	8590	9780
Bunker Costs (60% in transit)	3000	4100	5300	6400	7200	3500	4300	4800	6100
Total	11460	16070	18680	22680	26120	11520	14370	16840	23090
% bunkers	26%	26%	28%	28%	28%	30%	30%	29%	26%
implied $/tonne									
at 100% capacity	11.5	3.2	1.9	0.9	0.5	1.2	0.6	0.3	0.2
at 50% capacity	22.9	6.4	3.7	1.8	1.0	2.3	1.1	0.7	0.5
at 20% capacity	57.3	16.1	9.3	4.5	2.6	5.8	2.9	1.7	1.2

Port wet charges are based on ship size (GT or LOA), irrespective of ship type (refer to Table 7.5).

Table 7. 5

Port Wet Charges - $/visit

Ship Size dwt	1000	5000	10000	25000	50000	10000	25000	50000	100000
AKL	10700	13500	16900	27400	44700	16900	27400	44700	79500
TRG	9500	12300	15600	24600	39400	15600	24600	39400	69100
NPE	9800	9800	13100	19800	31800	13100	19800	31800	60700
WLG	9800	12700	15900	30200	35600	15900	28300	35600	55800
NSN	8100	9700	11600	17600	26700	11600	17600	26700	59300
LYT	10100	9900	14700	20900	29200	14700	20900	32600	45200
TIU	11400	14400	18100	29300	47900	18100	29300	47900	85200
POE	9300	10400	14500	22000	35500	14500	25100	40500	69600
BLU	0	0	22800	30600	46200	22800	30600	46200	50200
NZ Average	8700	10300	15900	24700	37400	15900	24800	38400	63800

Each port sets dry charges (wharfage) which may vary by commodity, as indicated in Table 7.6. These charges do not include stevedoring costs.

Table 7. 6

Port Bulk Cargo (Dry) Charges - $/tonne (or equivalent)

	AKL	TRG	NPE	WLG	NSN	LYT	TIU	POE
Pure Bulk								
Wharfa¡Logs $/JASM		4.51	8.75	4.80	6.85		6.14	7.75
Liquid Bulk $/t				4.50	7.90		5.54	4.90
Cement $/t				3.42	6.25		5.34	3.50
Other Bulk X $/t	5.01	4.75	6.25	4.62	7.40	5.12	5.34	5.80

Ship costs per voyage are derived from day rates and days per voyage. Wet charges apply to each of the 2-3 ports visited per voyage, while dry charges of $12 per tonne apply to both loading and unloading. This rate includes for average port wharfage of $5.5/tonne and an assumed $6.5/tonne for stevedoring. We note that for regular bulk shipments, such as cement and petroleum, the cargo owner will have invested in infrastructure and operations to load, transport and store the commodity. No costings are provided for foreign ships given they do not materially participate in these coastal bulk trades.

Table 7. 7

Unitisation of Dry Bulk Costs

Ship Costs - NZ$/day			Domestic Ships			Foreign Ships			
Ship Size dwt	1000	5000	10000	25000	50000	10000	25000	50000	100000
Ship Costs $/day	11460	16070	18680	22680	26120	11520	14370	16840	23090
Port Wet Charges $/visit	8700	10300	15900	24700	37400	15900	24800	38400	63800
Port Dry Charges at $12/t	12000	60000	120000	300000	600000	120000	300000	600000	1200000
Assumptions:									
ships depart load port at capacity, return empty									
average transit time 65hrs (750NM incl return at 12kts)									
transfer rate - load at 650 tph, unload at 400 tph									
route time (out and back)	80	100	120	200	320				
Route Cost $m per voyage	88300	217900	381100	863100	1660500				
Route Cost $/tonne	88	44	38	35	33				

Chapter 8 Coastal Shipping Model - Liquid Bulk

Liquid bulk ships serving NZ principally carry crude oil imports (and exports), and the import and domestic distribution of refined petroleum product. Other liquid bulk products are industrial chemicals. Liquid chemicals present greater risk than dry bulk, given fluids need to be better containerised and baffled than dry bulk (to maintain ship stability), and the products are often flammable/combustible and toxic. The incremental ship design and safety precautions add to ship capital and operating costs.

As with dry bulk ships, liquid bulk shipments are not scheduled (although make regular journeys), depart the loading port full, and discharge to one (or a few) ports. With separate holds, different products can be carried on a single ship (such as petrol, diesel and avgas). Liquid cargo requires specialist loading and discharging infrastructure and storage facilities. More so than dry bulk ships, given product specifications, there is little scope for opportunistic loads, and foreign liquid bulk ships do not carry domestic liquid cargo.

Petroleum products moved on NZ's coast are all sourced from Refining NZ at Marsden Point, Northland and distributed by Coastal Oil Logistics' two dedicated coastal ships (*Matuku* 29735dwt and *Kokako* 29470dwt). We note that up to 30% of NZ's demand for refined petroleum products is now met by importing directly into various NZ ports. Further, the Refinery-Auckland Pipeline (RAP) carries 2.5 mt pa, meeting all Auckland's needs, excepting bunker fuels which are barged on AKL's *Awanuia* (2750dwt). MOT/MBIE data summarises the coastal deliveries that are made to 10 NZ ports. Coastal Oil Logistics indicates that their ships make more than 200 port calls per year, implying 12,500 tonnes per port call, and suggesting on average each ship makes 3 port calls per voyage. Weighting on the basis of petroleum deliveries by port, the weighted average voyage distance is 1,000km.

The operating costs for liquid bulk ships are presented in the following figures. Capital costs are higher than for dry bulk ships, as are ship operating costs. Bunker costs are very similar, although they represent a lower portion of total ship costs.

Table 8. 1

Liquid Bulk Ship Capital Costs - NZ$ million	Domestic Ships					Foreign Ships			
dwt	1000	5000	10000	25000	50000	10000	25000	50000	100000
Capital Costs	NZ Ship Capital Costs			Foreign Ship Capital Costs					
New Build Price NZ$m	*15*	*27*	*37*	*48*	*54*	*37*	*48*	*54*	*72*
Ship Value at 10yrs NZ$m	*7*	*10*	*13*	*18*	*22*	*13*	*18*	*22*	*36*
Inputs — Discount Rate (WACC)			5%	5%					
Remaining Ship Life (yrs)			15	15					
Overhead Premium			15%	15%	includes margin, insurance, administration				
Capital Charge/day	1570	2190	2820	3760	4700	2820	3760	4700	7520

Source: after Drewry - Ship Operating Cost Review 2019

Table 8. 2

Liquid Bulk Ship Operating Costs - NZ$/day	Domestic Ships					Foreign Ships			
dwt	1000	5000	10000	25000	50000	10000	25000	50000	100000
Core Ship Costs	NZ Ship Operating Costs			Foreign Ship Operating Costs					
Manning	6740	11460	12140	14150	14820	4760	5550	5810	5980
Insurance	160	280	340	520	810	340	520	810	1120
Stores	450	540	590	720	810	390	480	540	580
Spares	980	1040	1080	1160	1200	540	580	600	670
Lubricants	1160	1220	1260	1340	1620	630	670	810	860
R&M	420	480	500	600	660	250	300	330	340
Survey	1210	1430	1550	1880	2190	1030	1250	1460	1550
Administration	1280	1340	1370	1460	1580	1370	1460	1580	1700
Dry Bulk Total	12400	17790	18830	21830	23690	9310	10810	11940	12800

Source: after Drewry - Ship Operating Cost Review 2019

Again, the key to managing unit costs ($/tonne) is operating the ship fully utilising ship capacity.

Table 8. 3

Liquid Bulk Ship Costs - NZ$/day

	Domestic Ships					Foreign Ships			
Ship Size TEU	1000	5000	10000	25000	50000	10000	25000	50000	100000
Capital Costs	1570	2190	2820	3760	4700	2820	3760	4700	7520
Operating Costs	12400	17790	18830	21830	23690	9310	10810	11940	12800
Bunker Costs (60% in transit)	3000	4100	5300	6400	7200	3500	4300	4800	6100
Total	16970	24080	26950	31990	35590	15630	18870	21440	26420
% bunkers	18%	17%	20%	20%	20%	22%	23%	22%	23%
implied $/tonne									
at 100% capacity	17.0	4.8	2.7	1.3	0.7	1.6	0.8	0.4	0.3
at 50% capacity	33.9	9.6	5.4	2.6	1.4	3.1	1.5	0.9	0.5
at 20% capacity	84.9	24.1	13.5	6.4	3.6	7.8	3.8	2.1	1.3

Table 8. 4

Liquid Bulk Ship Bunker Costs - NZ$/day

	Domestic Ships					Foreign Ships			
dwt	1000	5000	10000	25000	50000	10000	25000	50000	100000
Bunker Costs	Auckland bunker pricing with ETS					Singapore bunker prices			
Consumption tpd (at 12kts)	8	11	14	17	19	14	17	19	24
Bunkers NZ$/tonne	550	550	550	550	550	370	370	370	370
Cost NZ$ per day (60%)	3000	4100	5300	6400	7200	3500	4300	4800	6100
as % Ship Operating Costs	*19%*	*19%*	*22%*	*23%*	*23%*	*27%*	*28%*	*29%*	*32%*

Note: ships will typically spend 60% of time in transit burning fuel at full consumption rate, and 40% in port at idle at 10% rate

Source: after Drewry - Ship Operating Cost Review 2019

Incorporating port wet and dry charges, and assuming ships load to capacity for each voyage, unit costs for COLL-sized ships are estimated at $36/tonne (Table 8.5).

Table 8. 5

Unitisation of Liquid Bulk Costs

Ship Costs - NZ$/day	Domestic Ships					Foreign Ships			
Ship Size dwt	1000	5000	10000	25000	50000	10000	25000	50000	100000
Ship Costs $/day	16970	24080	26950	31990	35590	15630	18870	21440	26420
Port Wet Charges $/visit	8700	10300	15900	24700	37400	15900	24800	38400	63800
Port Dry Charges at $12/t	12000	60000	120000	300000	600000	120000	300000	600000	1200000
Assumptions:									
ships depart load port at capacity, return empty									
average transit time 85hrs (1000NM incl return at 12kts)									
transfer rate - load at 650 tph, unload at 400 tph									
route time (out and back)	100	120	150	220	340				
Route Cost $ per voyage	120800	271300	456100	967300	1816400				
Route Cost $/tonne	121	54	46	39	36				

Chapter 9 Marginal Cost Appraisal

9.1 Introduction

Marginal costs are the additional costs arising from a small increase in demand. The current situation in the New Zealand coastal shipping market suggests that marginal demand, if small, can be accommodated without any significant increase in ship or port costs. International shipping serving the New Zealand coast does so using existing excess capacity. Container ships typically visit the key import port first (often Auckland) and the key export port (usually Tauranga) last, so ship slot capacity utilisation based on import-export containers will always be lower while in coastal waters. Container ship capacity utilisation is believed to be in the 20-50% range (Appendix C.3) based on the cumulative ship capacity to observed throughput ratios at NZ ports.

As outlined in this chapter, four measures of marginal cost are likely to be relevant from a policy perspective:

- The marginal cost considering only ships based in New Zealand
- The marginal cost incurred when international ships carry domestic containers
- The short run marginal port handling costs
- The long run marginal port capital costs.

9.2 Ship costs

FIGS 2019 data suggests that NZ's sole domestic container ship, Pacifica's *Moana Chief*, achieves average slot utilisation of around 30%, although it may be close to capacity on the key AKL-LYT leg. Nevertheless, so long as spare capacity does exist, in the very short run, the marginal ship cost is zero (although port dry charges will be incurred). However, from a policy perspective, it is more informative to think in terms of a unit increase in capacity rather than a unit increase in demand – it will then be easy to adjust the figure in any real example to take account of the expected future utilisation. On this basis, the ship unit operating costs are the total steaming costs divided by the ship container capacity plus the in-port ship operating costs per container. We have included ship capital costs in this calculation – additional capacity could be acquired (or shed) at relatively short notice.

Container ships operate on fixed schedules, typically weekly. These schedules balance optimising efficiency and ship utilisation against the risks and penalties that may arise from unplanned (yet common) time delays. Average steaming speed is 17 knots, but an allowance of 15% has been made for unexpected delays. The time in-port allowed in the schedule can be assumed to be proportional to the number of containers shifted. On average 60 containers – equivalent to 90 TEU based on a typical mix of 10 ft and 20 ft containers - are exchanged per berth hour. The scheduled in-port time allowed is 20% higher to provide flexibility.

We can use the ship in-port cost and the container transfer rate to derive a cost per shifted container. While the steaming cost per container slot reduces with ship size, ship and port costs per container increase unless ship capacity is utilised. The costs for domestic container ships are summarised in Table 9.1.

A ship sailing directly from AKL to LYT will cover 683 Nautical Miles (NM) and would take 40 hrs at 17 knots. Allowing 15% for weather and unexpected delays increases this to 46 hours. Auckland averages 64 container exchanges (96 TEU) per hour and Lyttelton averages 50.

Table 9.1 Estimated ship costs for domestic container movements ($ per movement)

Ship capacity	1000 TEU	1500 TEU	2000 TEU	2500 TEU
Steaming /nm	80	90	100	110
In-port cost /hour	700	800	875	925
Steaming /TEU-km	0.04	0.03	0.03	0.02
In port / TEU	9	10	11.5	12
Auckland - Lyttleton	74	62	57	54

For foreign ships, the simplest assumption would be that they only serve ports where they have international containers to transact, and then only in the order of the schedules. If this were the case, then the marginal steaming cost per container would be zero. However, the in-port cost will be higher than for a domestic ship because larger ships have greater standing costs, expected the be offset by more containers being exchanged. One alternative (extreme) scenario would be to assume that without domestic trade, the ships would call at only one NZ port, with the import and export containers repositioned around the country by road and rail (or another ship). In this case, the steaming cost should be counted as part of the marginal cost. Ship capital costs are included on the basis that if the container ship circuit takes longer, more or larger ships will be required for a given schedule21. The costs for international container ships are summarised in Table 9.2.

Table 9. 2 Estimated ship costs for international container movements ($ per movement)

	2500 TEU	3000 TEU	4000 TEU	7000 TEU
Steaming /nm	70	80	90	120
In-port cost /hour	560	600	680	870
Steaming /TEU-km	0.016	0.014	0.012	0.009
In port / container	7	8	9	11
Auckland - Lyttleton	35	34	33	35

9.3 Port costs

For the port charges, there is no distinction between domestic and international movements except that import-export containers incur only one NZ port transfer, whereas all coastal containers incur two (the loading port and the discharging port). Wet charges per vessel average $8,650 + $10/TEU (where TEU is the ship capacity not the number of TEU carried or exchanged). These cover both direct and capital costs.

Dry costs include direct costs such as stevedoring that are assumed to be variable with number of containers moved and charges for the use of cranes and other capital equipment. The stevedoring charge is assumed to be a cost to the port that is passed on to the ship owner. Based on the port charges at AKL and TRG (where idle time of stevedores and other workers would be minimised),

[21] Although in practice the extra time may be made up by faster steaming or skipping port calls.

the direct costs are estimated to be $160 per TEU of which direct costs are estimated to be $110 per TEU.

9.4 Port capital utilisation

Port capacity is set by the tightest constraint, be it berth, crane or other. Observed utilisation of key port and other infrastructure appears to be materially below practical or theoretical capacity. Measured as container throughput divided by the ship rate per berth, NZ ports average 35% berth utilisation, with improvements available from increasing the ship rate or adding a berth (Appendix E). Similarly, crane utilisation averages 30% across key NZ ports, with utilisation lowered by increasing the Crane Rate (training, systems) or adding more or better cranes.

In the short run, the marginal cost of the port capital items appears to be zero. However, in practice ports come under pressure to increase capacity when berth utilisation approaches 60%, beyond which there is an unacceptable risk of a scheduled ship being delayed by a ship still occupying the berth. A delay in berthing can be costly, both from the immediate wait and from flow-on implications for subsequent port calls. There is thus an externality in that if one ship stays longer (e.g. due to exchanging extra containers) the next ship may face consequential delays. We can calculate the cost to the delayed ship as the in-port cost per container calculated in Tables 9.1 and 9.2, but for the average ship, multiplied by the probability that the next ship is delayed. This probability can be estimated as the ratio of the number of containers handled at the port to the capacity of the port, as measured by the greater of the crane and the berth utilisation.

Table 9. 3 Assessment of externality costs per TEU movement

Port	Crane utilisation %	Berth utilisation %	Probability of delay	Externality $/TEU
AKL	43%	55%	.55	5.00
TRG	40%	52%	.52	4.75
NPE	31%	53%	.53	4.80
WLG	18%	12%	.18	1.60
NSN				0
LYT	31%	37%	.37	3.40
TIU	17%	13%	.17	1.60
POE	28%	19%	.28	2.60
BLU				0

9.5 Long run marginal costs

The long run marginal cost is the direct cost plus the capital cost per TEU of an additional crane, berth or other enabling infrastructure, whichever is the critical factor determining capacity.

Providing an additional 250m berth would have an indicative capital cost of $50 million:allowing for a margin and maintenance costs, it would be charged at say $3.6 million/year. Assuming it would have the capacity to handle 0.75 million TEU/yr, the pro-rata cost would be $4.00/TEU.

A state-of-the-art quay crane would cost up to $20 million, which at a crane rate of 30 exchanges (45 TEU) per hour could handle 375,000 TEU/yr. Assuming a 20 year life, the cost would be in the order of $4.50 /TEU.

Investment is warranted if the long run cost is less than the short run cost – in this case the externality. This suggests that additional cranes should be provided if crane utilisation exceeds 50% (and subject to sufficient berthing capacity) and additional berths provided if berth utilisation at the port exceeds 45%.

This compares with the industry “rule of thumb” that says ports reach practical capacity when utilisation exceeds 60%.

AKL is commissioning a new berth and three new cranes as part of fully automating Fergusson Container Terminal, claiming it will increase capacity from 0.9m TEU per year to 1.6-1.7m TEU per year. While it is experiencing early teething problems, this is equivalent to about $12.00 per additional TEU. This figure appears to assume the cranes only achieve 60% utilisation.

9.6 Summary

For an industry where capacity can only be added in relatively large increments, it is difficult to provide a single measure of marginal cost that is useful for policymakers. Both ship owners and ports typically operate with a degree of slack to provide flexibility to meet unplanned customer requirements and to have the ability to absorb delays due to weather and unexpected events. Thus, in the very short run, there is always some spare ship, infrastructure and port worker capacity on the New Zealand coast and as a consequence, the marginal cost in the strictest sense is zero. This is likely to also be the case for other modes of transport. However, for the policy maker, if we simply report that there is spare capacity at the margin in ships and trains so the marginal cost in each case is zero, this may be interesting but is unhelpful. The marginal cost depends on which traffics are treated as the margin.

When considering issues relating to cabotage, we could consider the carriage of domestic containers the marginal activity. In this case we could make the assumption that the foreign ship itinerary is fixed by the need to service its import-export cargo. The cost of handling domestic containers comprises the direct port costs and the in-port costs of ships transferring their domestic cargo. The latter increase per container with ship size. The marginal cost is estimated to be $120 per TEU per port or, given each coastal voyage involves two domestic ports, $240 in total, applying equally to both domestic and international ships. Around $220 of this total is port handling cost and $20 is ship costs.

However international shipping has the option of making a single port call and aggregating/ dispersing cargo by land, in which case the entire coastal operation is a marginal activity. Viewed in this light, the appropriate cost to use would include the steaming cost for international ships. This increases the marginal cost by 3.5 cents/TEU-km and 0.9 cents/TEU-km for domestic and international ships respectively. This is an additional $50/TEU for the *Moana Chief* or $25/TEU for a 4000 TEU international vessel between Auckland and Lyttleton. If we calculate the costs on this basis, this will be more helpful to Te Manatū Waka and other parties making policy decisions such as “should we invest in port facilities to handle international cargo at Napier”.

The ports also appear to have spare capacity, but this is not so significant when we compare the utilisation with the industry norm of 60% utilisation, above which there is pressure to increase capacity. This is because there is a marginal externality cost associated with port calls since one ship taking longer to load/unload due to the marginal container potentially delays the subsequent port user. This cost depends on the utilisation of the current infrastructure and is estimated to be as high as $5 per TEU for AKL and as low as $1.50 per TEU for WLG.

The long run marginal port cost will include the capital costs of additional cranes, berths and other infrastructure. This is estimated to be $4/TEU for berths and $4.50/TEU for cranes. Port capacity should be expanded if this cost is less than the externality cost calculated above. We estimate that this will be the case if either crane utilisation exceeds 50% or berth utilisation exceeds 45%. This compares with the industry norm of 60%.

Chapter 10 Suggestions for Further Work

While this study has essentially fulfilled the DTCC study scope, prevailing market conditions (associated principally with the Covid-19 pandemic) restricted access to sound data, information and discussions with key industry players.

10.1 Covid-19 effect

The DTCC study period was the year to 30 June 2019, although the study was substantially undertaken through 2020/21. This coincided with Covid-19 acutely impacting all aspects of the transport and shipping sectors (and indeed the wider economy). Where past experience had shown a willingness of transport industry players to contribute to studies such as DTCC, the demands of dealing with Covid-19 interrupted supply chains and distracted industry players from the anticipated level of participation in this study. Industry willingness to contribute in the future may be enhanced by recognition of the value of insights arising from this present study.

10.2 Unusual market volatility

The cycles of national and global economic activity over recent years appear greatly amplified in the international trade and transport sectors, driving wide fluctuations in the costs of operating ships. Since 2008 (pre-GFC), we have observed order-of-magnitude swings in the key drivers of ship operating costs – bunker (oil) prices from US$10/bbl to US$140/bbl, ship spot charter rates from US$1,000 to US$10,000 per TEU/day. Such swings, with peak-to-peak periods as short as 12 months, have greatly affected the costs of operating ships globally and nationally. Covid-19 has imposed particularly challenging volatility, compromising access to and reliability of shipping prices. We anticipate follow-up research in less demanding economic times will yield more reliable cost and price data.

10.3 Fuel pricing

Domestic ship operators face materially higher costs than international ship operators. Some aspects such as ship crewing terms and tax arrangements are issues of national policy and legislation and so beyond the scope of this study. One aspect which may warrant further investigation is better understanding of the price differential between global and NZ fuel costs, particularly in light of major changes recently made by Refining NZ's resulting from its strategic review.

10.4 Transport policy

This DTCC study has sought to quantify the economic, health and social costs and prices in comparative terms across the transport modes – road, rail and sea. This holistic approach may yield new insights into policies and initiatives which could better encourage or facilitate optimal transport outcomes.

Appendix 1 : Bibliography

Books:

A part in a book:

Maritime Economics - Martin Stopford (2009)

Journal papers:

Fuel surcharge practices of container shipping lines- **Notteboom and Carriou (2009)**

Published reports:

NZ

Te Manatū Waka - National Freight Demands Survey (various editions), Freight Information Gathering System (FIGS) quarterly reports

Auditor General – Results of our 2019/20 Audits of Port Companies

Deloitte – 2019 Ports and Freight Yearbook

NZ Shipping Federation - Full Stream Ahead

Rockpoint – Coastal Shipping and Modal Freight Choice (2009) – for Te Manatū Waka

Global

ASX Marine's Alphaliner reports and database – via Rockpoint subscription

Drewry – Ship Operating Cost Annual Review and Forecast 2019/20 - via Te Manatū Waka subscription

International Chamber of Shipping – Annual Review 2019

Lloyd's List – Total Cost of Operation, 2018

Seafarers International Research Centre, Cardiff - An Analysis of Crewing Levels (2006)United Nations Conference on Trade and Development – Review of Maritime Transport (2019)

Websites:

Te Manatū Waka (Ministry of Transport)

Waka Kotahi (NZ Transport Agency)

Maritime NZ

Statistics NZ

NZ commercial ports – Northland, Auckland, Tauranga, Napier, Taranaki, Wellington, Marlborough, Nelson, Lyttelton, Timaru, Otago and Bluff

Domestic shipping companies (Pacifica Shipping/Swire Shipping, Golden Bay Cement, Holcim, Coastal Oil Logistics, Coastal Bulk Shipping, Chatham Islands Shipping, KiwiRail/"Interislander", StraitNZ/"Bluebridge")

International shipping companies: including A P Moller/Maersk, MSC, CMA CGM, COSCO, Hapag Lloyd

Refining NZ (now Channel Infrastructure)

Global organisations

International Maritime Organisation

World Trade Organisation

International Energy Agency

Ship Bunkers – including Ship and Bunkers, Bunkerworld, Live Bunkers, Bunker Index

Appendix 2 : Listing of DTCC Working Papers

The table below lists the Working Papers prepared as part of the DTCC Study, together with the consultants responsible for their preparation.

Ref	Topic/Working Paper title	Principal Consultants	Affiliation
MODAL TOPICS			
C1.1	Road Infrastructure – Marginal Costs	David Lupton	David Lupton & Associates
C1.2	Road Infrastructure – Total & Average Costs		
C2	Valuation of the Road Network	Richard Paling	Richard Paling Consulting
C3	Road Expenditure & Funding Overview		
C4	Road Vehicle Ownership & Use Charges		
C5	Motor Vehicle Operating Costs		
C6	Long-distance Coaches	David Lupton	David Lupton & Associates
C7	Car Parking	Stuart Donovan	Veitch Lister Consulting
C8	Walking & Cycling		
C9	Taxis & Ride-hailing		
C10	Micro-mobility		
C11.2	Rail Regulation	Murray King	Murray King & Francis Small Consultancy
C11.3	Rail Investment		
C11.4	Rail Funding		
C11.5	Rail Operating Costs		
C11.6	Rail Safety		
C12	Urban Public Transport	Ian Wallis & Adam Lawrence	Ian Wallis Associates
C14	Coastal Shipping	Chris Stone	Rockpoint Corporate Finance
C15	Cook Strait Ferries		
SOCIAL AND ENVIRONMENTAL IMPACT TOPICS			
D1	Costs of Road Transport Accidents	Glen Koorey	ViaStrada
D2	Road Congestion Costs	David Lupton	David Lupton & Associates
D3	Health Impacts of Active Transport	Anja Misdrak & Ed Randal	University of Otago (Wellington)
D4	Air Quality & Greenhouse Gas Emissions	Gerda Kuschel	Emission Impossible
D5	Noise	Michael Smith	Altissimo Consulting
D6	Biodiversity & Biosecurity	Stephen Fuller	Boffa Miskell

Note:

The above listing incorporates a number of variations from the initial listing and scope of the DTCC Working Papers as set out in the DTCC Scoping Report (May 2020).

Appendix 3 : Coastal Shipping Overview

At any one time, over 200 cargo ships are plying New Zealand's coastal waters, bringing goods from overseas, delivering local products to distant markets, and moving domestic cargo between NZ ports. The key stakeholders in this endeavour are the shippers (the cargo owners), shipping lines (the owners and operators of the ships), ports (providers of infrastructure to enable transfer of cargo to/from ships), and local and central government.

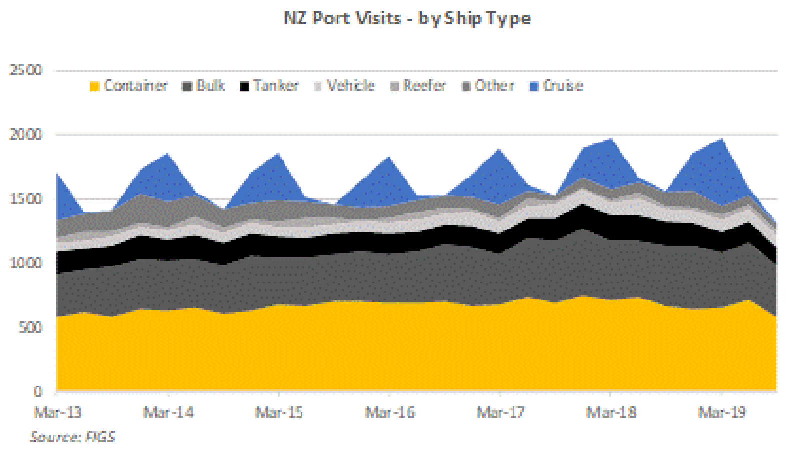
By virtue of its long coastline, and distance from its markets, New Zealand has always been a seafaring nation. Its early history was built upon a reliance on every navigable harbour and river. Most cities grew around natural harbours (Wellington, Auckland and Lyttelton, Tauranga and Otago) or river ports (Wanganui, Greymouth and Westport). On hostile coasts with productive hinterlands, breakwater ports were established at great effort (Timaru, Oamaru, Napier and New Plymouth).

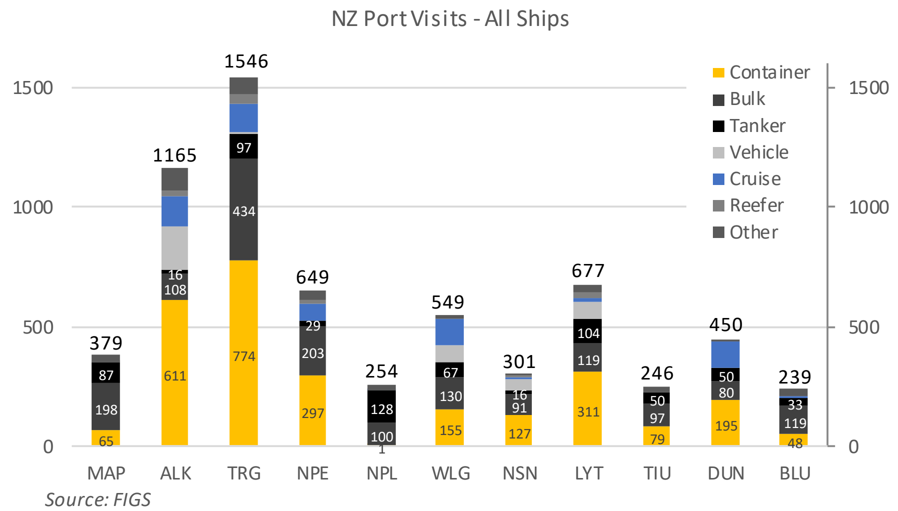
The configuration of coastal shipping changed as road and rail networks expanded, and cargo demands changed, whittling many ports down to just 13 in 2020. This steady evolution is periodically interrupted by step-changes:

- **Legislation**. The Port Companies Act 1988 corporatised the port sector. The Maritime Transport Act 1994 introduced international maritime standards and permitted foreign ships to carry domestic cargo (termed cabotage).
- **Cook Strait Ferries**. The establishment of inter-island RORO rail ferry service in 1962 provided a vital "land bridge" to complete national road and rail network, and materially reduced the coastal shipping task.
- **Trade**. When the United Kingdom joined the European Union in 1973 NZ was deprived of its historical trading partner, forcing it to establish new markets, especially in Asia. Globalisation has accelerated trade and driven new coastal shipping patterns.
- **Containerisation**. Standardising the unit of cargo has transformed the transport industry through secure efficient movement of goods across all modes and between all markets.

NZ ports receive almost 7000 foreign cargo ships each year, across all ship types - dry bulk, liquid bulk, break bulk, container. The nature of goods being carried has changed over the last 50 years, from raw materials (when countries maintained independent manufacturing capacity) to manufactured goods (as a result of globalisation and consumerism).

Figure A. 1





Infrastructure requirements vary with each cargo type - conveyors and silos for dry bulk, pipelines and tanks for liquid bulk, and quay cranes and straddle carriers for containers. In 2019, 45% of port calls were container ships (from nil in 1970), 30% bulk ships and 12% tankers. Others are car carriers, reefer ships, and cruise ships.

13 commercial ports operate in NZ, and are abbreviated to their International Port Codes.

Table A. 1

New Zealand Key Commercial Ports

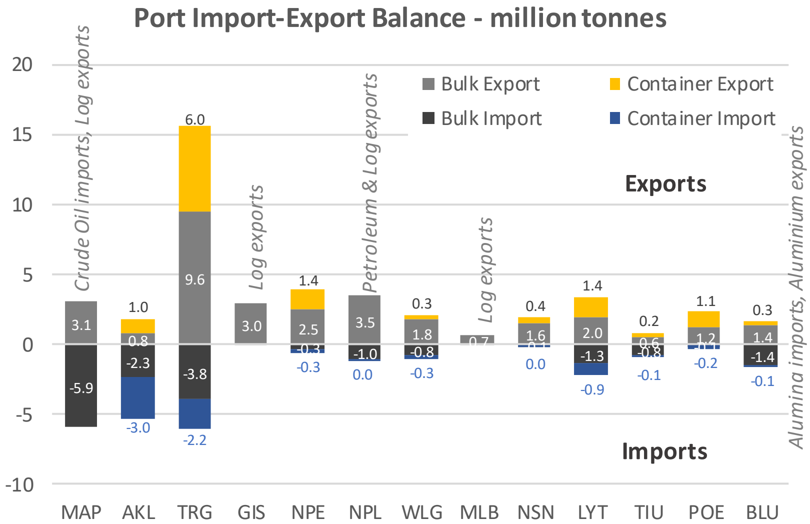
Port Name	Code	Location	Key Trades
NorthPort	MAP	Marsden Point, Northland	Petroleum, Logs
Ports of Auckland	**AKL**	Auckland	Containers, Cars
Port of Tauranga	**TRG**	Mt Maunganui, Bay of Plenty	Containers, Logs
Port Taranaki	NPL	New Plymouth, Taranaki	Petroleum, Logs
Gisborne Port	GIS	Gisborne, Poverty Bay	Logs
Napier Port	**NPE**	Napier, Hawkes Bay	Containers, Logs
CentrePort	**WLG**	Wellington	Containers, Logs, Ferrie
Port Marlborough	MLB	Picton, Marlborough	Logs
Port Nelson	**NSN**	Nelson	Logs, Containers
Lyttelton Port Co	**LYT**	Lyttelton, Canterbury	Containers, Coal
PrimePort Timaru	**TIU**	Timaru, South Canterbury	Containers, Cement
Port Otago	**POE**	Port Chalmers, Dunedin, Otag	Containers, Logs
South Port	BLU	Bluff, Southland	Aluminium, Logs

TRG has emerged as NZ's busiest, serving over 1500 ships in 2019, followed by AKL, LYT and NPE.

Our analysis is based on the 8 largest ports (in **bold** in preceding table), with the other 5 serving specialist trades such as forestry, fishing, or ferries. Smaller ports still continue to operate, serving fishing fleets and minor cargo flows.

Trade through NZ ports is dominated by international trade, with the import-export volumes typically unbalanced. Bulk cargo imports account for 32 million tonnes ("mt"), and bulk exports 18 mt, while full container exports and imports were 12 mt and 7 mt respectively. Domestic bulk cargos total <5mt.

Figure A. 2



Source: FIGS, Rockpoint

NZ was a fast adopter of containers, quickly serving larger container ships, now typically in the 4000 TEU to 6000 TEU range. Since 1960, the global growth in the container trade has been at 2-3x economic (GDP) growth, reflecting both globalisation and capture of erstwhile breakbulk cargos. This growth has driven improvements in global logistics and dramatic declines real$ pricing.

Appendix 4 : Coastal Bulk Freight

While a variety of public sources have been used, the principal sources of cargo data are Te Manatū Waka ("MOT") publications, the National Freight Demand Study ("NFDS") and the Freight Information Gathering System ("FIGS"). The NFDS 2019 estimated the 2017/18 Coastal Shipping Freight Task to be 4.6 million tonnes per annum (mtpa), as summarised in the following table.

Table B. 1 Coastal shipping freight task

Coastal Shipping Freight Task - million tonnes (source: NFDS 2019)

Origin \ Destination		NTH	AKL	WAI	BOP	GIS	HBY	TAR	MNW	WGN	TNM	WCT	CAN	OTG	STH	Total	Principal Cargo
Northland	NTH		0.6		0.6		0.2	0.1		0.3	0.3		0.4	0.3	0.2	2.9	Petroleum, cement
Auckland	AKL										0.1		0.6			0.7	Containers
Waikato	WAI																
Bay of Plenty	BOP												0.2			0.3	Containers
Gisborne	GIS																
Hawke's Bay	HBY																
Taranaki	TAR															0.1	Crude Oil
ManawatuWanganui	MNW																
Wellington	WGN																
TasmanNelsonMarlb	TNM																
West Coast	WCT																
Canterbury	CAN		0.1		0.1					0.1			0.1			0.5	Containers, cement
Otago	OTG																
Southland	STH																
Total	Total	0.1	0.7		0.7		0.3	0.1		0.4	0.4		1.3	0.4	0.2	4.6	
Principal Cargo		Crude Oil	Petroleum, cement,		Petroleum, containers		Petroleum, cement,	Cement		Petroleum, cement,	Petroleum, cement,		Petroleum, cement,	Petroleum, cement,	Petroleum, cement,		

Note: excludes inter-island ferries

Source: NFDS 2019

This coastal freight task (as distinct from import-export flows) falls into five distinct cargo segments (liquid bulk, dry bulk, general bulk, containers and ROPAX), each offering differing scope for growth and intermodal competition:

Bulk Freight - Petroleum

Refining NZ operates the country's only oil refinery at Marsden Point, near Whangarei, Northland, processing predominantly imported crude oil. Refinery capacity and output have been materially unchanged since the major "Think Big" upgrade in 1986. Oil intake was 5.55 million tonnes (mt) (42.7 million barrels (mmbbls)) in 2018/19, with product output of 5.52 mt.

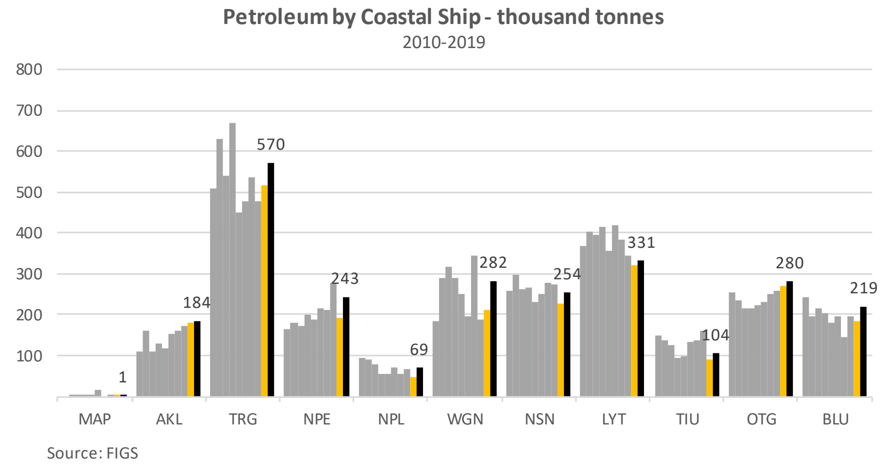
Refining NZ operates as a tolling refinery, accepting crude oil supplied by its shareholders, BP, ExxonMobil and Z-Energy, and producing product to their specifications, within the capacity of the refinery. Refining NZ shareholders retail petroleum products through their national networks, or supply wholesale product to "independents" such as Waitomo, NPD, G.A.S. The only truly independent provider is Gull, which directly imports into its Mt Maunganui storage facility, and distributes from there by truck.

NZ's demand for petroleum products has grown steadily, at 2.0% p.a. since 1990. Refining NZ meets 100% of ship bunker oil demand, 85% of jet fuel, 67% of diesel and 58% of all petrol demand. The shortfall is imported directly into storage facilities at various NZ ports.

Weak global demand and strong regional refining capacity supply has driven tolling fees and profitability down. Refining NZ's current strategic review includes the option of closing the refinery and becoming simply a product import terminal.

The Refinery to Auckland Pipeline (RAP), commissioned in 1986 along with the upgrade, carries 2.7 mt (52%) of the refinery's output to its Wiri terminal in Auckland. The balance is distributed to all NZ ports by a refinery associate company (same shareholders), Coastal Oil Logistics Ltd (COLL). COLL operates 2 ships, Matuku (50,143 deadweight tonnes, dwt) and Kokako (49,218 dwt), while SeaFuels (owned by Ports of Auckland and leased by Z-Energy) operates the barge Awanuia (3,900 dwt) serving Auckland only. The coastal shipping task of some 2.5 mtpa involves about 50 voyages and 200 port calls annually.

Figure B. 1 Petroleum



Conclusion. COLL faces no competition in the coastal trade in petroleum products. There are no backhaul opportunities, so COLL's ships return to Marsden Point empty.

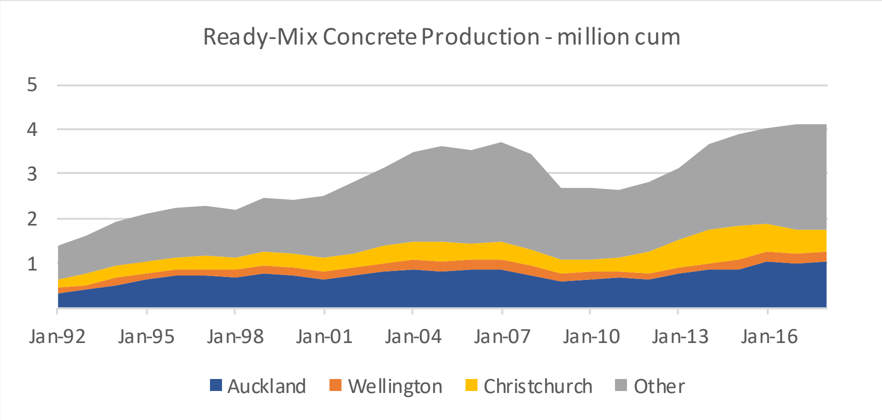
Bulk Freight - Cement

Cement is a key construction material, manufactured by mixing ground limestone (calcium) with silicon, aluminium and iron in a furnace. Golden Bay's Portland facility near Whangarei, the only substantial cement manufacturing plant remaining in NZ, has a 2500 tonnes per day (0.967 mtpa) capacity. Golden Bay distributes most output by its coastal ships, *Aotearoa Chief* (8,200 dwt) serving all NZ ports while a barge *Golden Bay* (1,800 dwt) serving only Auckland. Golden Bay built a 25,000 tonne storage silo in Auckland in 2012.

Holcim, following closure of its Westport facility in 2016, elected not to build a new cement plant near Oamaru, and now imports all its cement from Asia. It has built 30,000 tonne storage silos in each of Auckland (2015) and Timaru (2014). The former serves the Auckland region by rail and truck, while Holcim operates its *Buffalo* (9,092 dwt) out of Timaru to serve all South and lower North Island ports. Shipping records show Holcim imports approx. 0.5 mtpa on chartered bulk ships (typically 35,000dwt). Buffalo is estimated to carry 0.4 mtpa on 45-50 coastal voyages.

Golden Bay and Holcim's combined output of 1.4mtpa corresponds to the 1.2 mtpa of cement used to produce 7 mtpa of ready-mix concrete. Cement demand varies according to economic activity and major events (such as the post-earthquake rebuild of Christchurch).

Figure B. 2



Conclusion. Golden Bay Cement and Holcim operate ships as part of their duopolistic vertically integrated supply chains, and as such the coastal shipping of cement faces no competition. Their shipping operations offer no backhaul opportunities.

Bulk Freight - Other

Bulk cargos account for over 70% of NZ's imports and exports by volume through NZ ports, carried on over 2,800 foreign ship of various configurations – dry bulk, break bulk, liquid tanker, vehicle and reefer. Bulk products typically have low unit value yet face high handling costs unless scale warrants investment in specialist equipment (conveyors, pipelines, cranes and linkspans) into storage facilities (tanks and silos). Such investment is usually secured by contracts with a dedicated customer.

Coastal Bulk Shipping has operated a small bulk carrier, *Anatoki* (820 dwt) since 2008. It moves an estimated 50,000 tonnes p.a. of various dry bulk and break bulk cargo, on tramp (unscheduled) services, usually for a single party. CBS calls at many ports, including smaller ports outside the 13 listed previously.

Chatham Islands Shipping (CIAS) provides a scheduled 30 day loop service from NPE to TIU, Chatham Islands, Pitt Island, operating *Southern Tiare* (12,10 dwt, a geared ship), carrying bulk, general and container cargo.

Pure car and truck carriers ("PCTC") made 384 calls to NZ ports in 2018/19 (AKL 183, LYT at 71, WLG 69, NSN 49 and TRG 12), bringing new and imported cars, trucks and other machinery. PCTCs use general wharves, offloading via their own link spans. There is little evidence that PCTCs carry much domestic cargo.

Section 198 of the Marine Transport Act 1994 permits foreign ships making multiple port call on a scheduled voyage to carry domestic cargo. In the absence of firm data, we estimate that foreign ships carry up to 0.2 mtpa of domestic bulk cargo, primarily irregular relocation of regional stockpiles in response to unanticipated demand (Kapuni urea, fertiliser or palm kernel).

Bulk Freight - Summary

The theoretical growth opportunity for carrying domestic bulk cargo has not attracted more domestic ship capacity. The key impediment is the irregular and dispersed nature of the task, undermining the business case for establishing efficient low-cost (high throughput) facilities for low-value products.

Appendix 5 : Coastal Containers

Containers represent the key coastal shipping activity after bulk petroleum and cement, and are carried in direct competition with road and rail transport modes. Coastal containers are carried by several competing shipping lines, including one domestic operator, Pacifica Shipping. The same physical infrastructure and facilities are utilised to move a coastal containers and imports and exports. The coastal task comprises domestic and transhipment (import and export).

Container Types

While the container is a “standard” unit of freight, there are many variants not readily interchangeable, each requiring an independent supply chain:

The standard container measures L 20’ x W 8’ x H 8’6”, being the Twenty-foot Equivalent Unit or “TEU”. With improving infrastructure the 40’ container “FEU” is increasingly adopted. Both have hi-cube (H 9’6”) variants. FIGS data (2012 to current) shows that the share of FEU has risen from 31% to 35%.

Dry (or general purpose) containers account for 76% of container shipments, with variants being unlined (for breakbulk), lined (for loose bulk – grain, minerals) and food grade. These are not interchangeable. 24% of containers are temperature controlled (refrigerated or “reefers”) to carry perishable goods.

A freight task (full container movement) is by definition one way. Once devanned, the empty container must be repositioned, an expensive task which occupiers ship and port capacity otherwise available for full containers (cargo). Both full and empty containers generate revenue for ports. Full containers generate revenue for shipping lines, while repositioning empties bears a cost. Empty containers account for 56% of all coastal movements (and 21% of import and export movements). AKL is NZ’s principal container import port, discharging only 3% empties, yet loading 46% empties. TRG is NZ’s key export port, loading only 4% empties, yet discharging 31% empties.

Coastal container movements are either domestic or transhipment (the repositioning of import and export containers between ports). Transhipment “clients” are usually foreign shipping lines.

Port Container Flows

Te Manatū Waka complies the Freight Information Gathering System (“FIGS”), published quarterly, which provides a comprehensive database of import-export and coastal trade.

Ports, which provide much of the data collected for FIGS, recorded 3.2 million TEU (mTEU) cross-wharf container moves in 2018/19. We note that all coastal containers are counted twice, by both the loading (source) and discharging (receiving) ports. Adjusting for this, the number of unique containers handled by NZ ports is assessed as 2.7 mTEU, of which 0.41 mTEU are coastal. Re-exports are imported containers destined for a foreign port without leaving the NZ port, and are principally transhipments to Pacific Island countries. Full containers account for 2.06 mTEU overall, and 0.26 mTEU coastal.

Table C. 1

Containers Handled at NZ Ports *

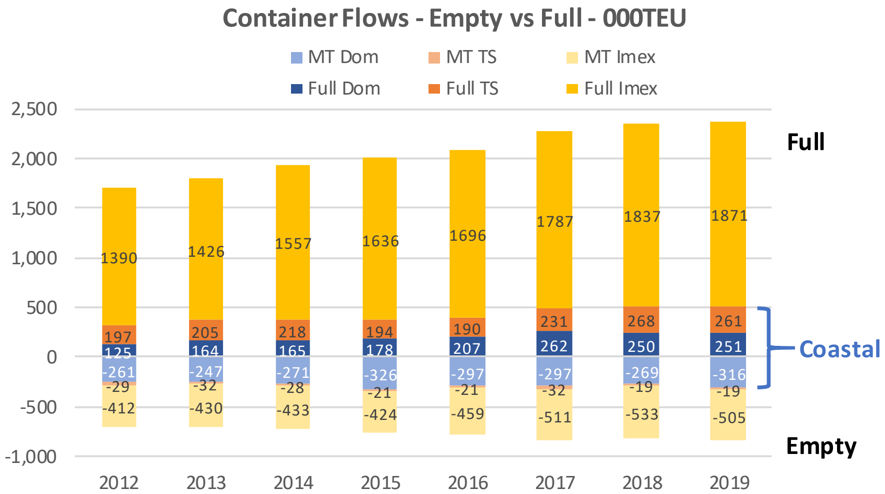
Year to Sep-19		Coastal				International		Total
	Domestic	Transhipment		Re-export	*Null*	Export	Import	
000TEU		Export	Import	^				
Load Empty	143	4	4	15	*11*	165		341
Load Full	120	97	33	68	*2*	928		1,249
Discharge Empty	147	4	4	15	*0*		327	497
Discharge Full	129	100	33	68	*2*		802	1,133
Total	540	205	74	165	*16*	1,092	1,128	**3,220**
Unique #	270	102	37	83		1,092	1,128	**2,712**
Unique Full #	129	100	33	68		928	802	**2,058**
% Full	*48%*	*97%*	*90%*	*82%*		*85%*	*71%*	*76%*
Import-Export 000t				-		11,792	7,118	-
Implied t/TEU	*8.9*	*12.7*	*8.9*			12.7	8.9	
Coastal 000t (calc)	1,142	1,265	294					**2,701**

* the 9 principal container ports, AKL, TRG, NPE, WLG, NSN, LYT, TIU, POE, BLU
^ a re-export is a container imported, then without leaving that port exported on a different ship
# each coastal container is handled twice, once each by loading and discharging ports

FIGS provides data for containerised imports and exports in both TEU and tonnes. Accordingly, we calculate 8.9 tonnes/TEU for each full import TEU, and 12.7 tonnes/TEU for exports (heavier given NZ exports meat and dairy). We observe:

- 26% of port container moves are coastal (domestic plus transhipment)
- 26% of port moves are empties (down from 29% in 2012)
- 40% of coastal moves are empties (down from 47% in 2012)
- 56% of domestic moves are empties (down from 68% in 2012)

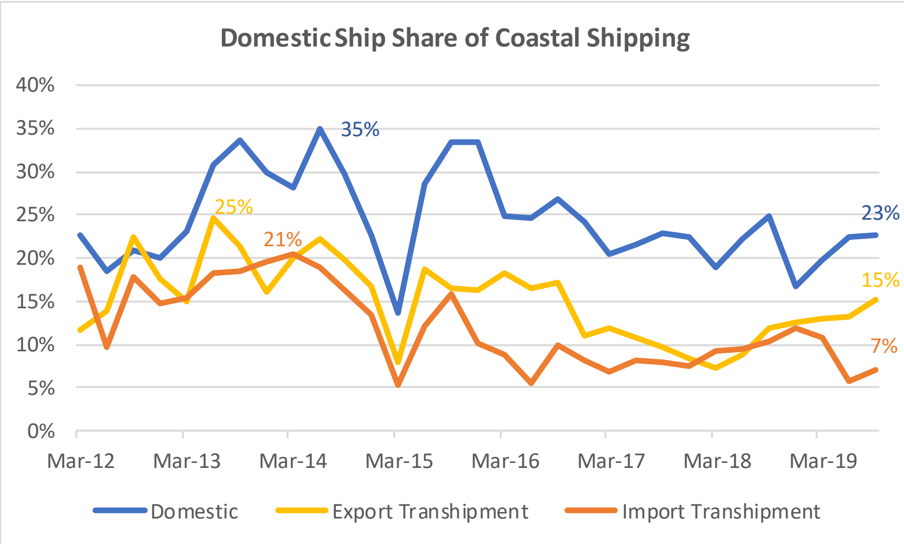
Figure C. 1



Source: MoT FIGS

The coastal freight task has been growing, from 0.61 mTEU in 2012 to 0.85 mTEU in 2019. Of this total, the domestic task accounts for 0.565 mTEU (67%), up from 0.385 mTEU (63%) in 2012. Foreign ships carried 82% of the containerised coastal freight task in 2019. The market share of domestic ships has been slipping across each component.

Figure C. 2



Container Ship Visits

NZ ports were visited by 2380 container ships in 2019. The smallest ships are typically geared (fitted with on-board cranes, see Sec 6.1) suitable for serving small ports across the Pacific. Ships exceeding 6,000 TEU are part of a single service calling only on TRG (no coastal legs). Of the 2380 ships, 49% by number exceed 4,000 TEU. TRG, the busiest port, received 765 container ships, followed by AKL, LYT and NPE.

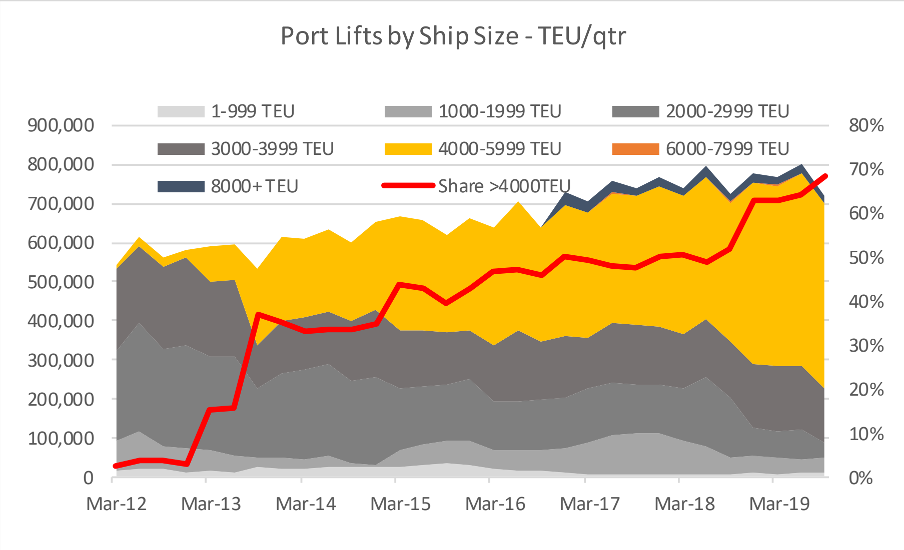
Table C. 2

International Ship Visits - 2019

Ship Size	AKL	TRG	NPE	WLG	NSN	LYT	TIU	POE	BLU	Ships
1-999 TEU	11	48	5		3	24	1			82
1000-1999 TEU	66	61	1	31	35	37				197
2000-2999 TEU	70	82	8	26	57	23	25	4	11	262
3000-3999 TEU	126	175	85	36	43	46	84	96	74	666
4000-5999 TEU	349	353	215	67	14	206	21	118	7	1,130
6000-7999 TEU		2								2
8000+ TEU		45								45
Grand Total	619	765	314	160	152	335	131	218	92	2,380
ships exceeding 4000TEU	56%	52%	68%	42%	9%	61%	16%	54%	8%	49%

NZ port container flows (loads and discharges) have been growing from 2.3m TEU 2012 to 3.2m TEU in 2019, a compound annual growth rate (CAGR) of 4.4%. While this alone would justify more and/or larger ships, the rising ship size is driven by heavy investment by shipping lines in ever larger ships into an over-crowded market. In NZ, market share for ships larger than 4,000 TEU has risen from 2% in 2012 to 68% by 2019.

Figure C. 3



Assuming these ships fall at the top end of each size band (following table), the cumulative capacity of visiting container ships was 12.7mTEU.

Table C. 3

International Ships - 2019

Nominal Capacity - 000TEU	AKL	TRG	NPE	WLG	NSN	LYT	TIU	POE	BLU	Ships
1-999 TEU	11	48	5	0	3	24	1	0	0	92
1000-1999 TEU	132	122	2	62	70	74	0	0	0	462
2000-2999 TEU	210	246	24	78	171	69	75	12	33	918
3000-3999 TEU	504	700	340	144	172	184	336	384	296	3060
4000-5999 TEU	2094	2118	1290	402	84	1236	126	708	42	8100
6000-7999 TEU	0	16	0	0	0	0	0	0	0	16
8000+ TEU	0	45	0	0	0	0	0	0	0	45
Grand Total	2951	3295	1661	686	500	1587	538	1104	371	12693
capacity on ships >4000TEU	71%	66%	78%	59%	17%	78%	23%	64%	11%	64%
Port Throughput - 000TEU	788	1203	261	91	115	434	77	203	50	3222
Nominal Ship Utilisation	27%	37%	16%	13%	23%	27%	14%	18%	13%	25%

It is difficult to derive a definitive measure the Capacity Utilisation of visiting ships, especially where the scheduled routes traverse multiple countries – that is, not all container slots are available to be utilised for or within NZ. Our calculated utilisation of 25% assumes ships fall at the top end of each size band. Assuming middle [bottom] of each band, utilisation rises from 25% to 29% [36%]. Should a ship theoretically be fully unloaded then fully reloaded at every port, utilisation on this measure would be calculated at 200%. Utilisation falls where a slot is occupied by containers loaded at some previous port destined for any subsequent port.

Ships typically cannot be loaded to its design capacity (number of slots):

- Design capacity – the number of unique container slots.
- Load Capacity – limits the cumulative weight and location of containers, to maintain buoyancy and stability.

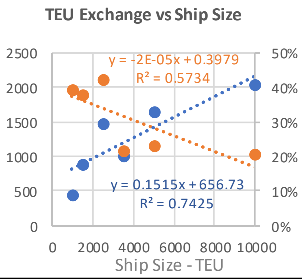
- Effective capacity – loading involves mathematically optimising the ship manifest, based on container size, weight and contents, and significantly the sequencing of ports of loading and discharge to ensure efficient access at port of discharge (without need for double-handling).

Across all NZ ports, container exchanges (discharges plus loads) increase with ship size. The Average Exchange (TEU / ship) rises with ship size. Nominal Capacity (Exchange over Ship Size) falls for larger ships, likely given the scheduled journeys of larger ships pass through more ports and countries.

Table C. 4

Capacity Utilisation of International Ships - Year to Jun19

Ship Size	Port Visits	Ship Capacity	Load & Discharge	Average Exchange	Nominal Capacity
TEU	#	000 TEU	000 TEU	TEU/ship	%
1-999 TEU	82	92	36	442	39%
1000-1999 TEU	197	462	175	888	38%
2000-2999 TEU	262	918	388	1480	42%
3000-3999 TEU	666	3060	665	999	22%
4000-5999 TEU	1130	8100	1857	1643	23%
6000-7999 TEU	2	16	9	4583	57%
>8000 TEU	45	450	92	2047	20%
Grand Total	2384	13098	3222	1352	25%

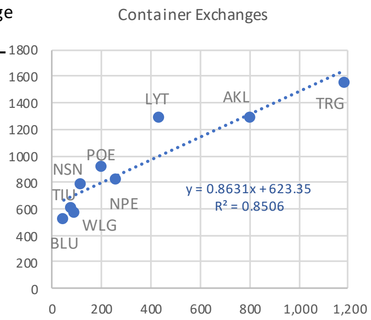


Larger ports attract higher container exchanges.

Table C. 5

Port Container Exchanges

	Load (000TEU)			Discharge (000TEU)			Total	Ships	Exchange
	Dom	T'ship	IMEX	Dom	T'ship	IMEX		#	TEU
AKL	164	21	177	18	12	409	801	619	1294
TRG	30	17	571	65	79	424	1,186	765	1551
NPE	2	20	108	41	5	84	259	314	826
WLG	11	4	32	7	7	32	92	160	577
NSN	4	26	30	28	4	28	119	150	792
LYT	60	12	139	92	19	113	434	335	1297
TIU	2	23	16	2	0	36	79	131	606
POE	4	14	82	23	15	62	200	218	917
BLU	1	2	21	2	0	24	49	92	530
NZ	277	138	1,175	279	140	1,211	3,220	2380	1353



Coastal Flows

Foreign shipping lines design their schedules around expected volumes at target ports, balancing visit frequency with ship size (although almost all international services are weekly). This has a direct impact on capacity available to domestic shippers (cargo owners), and more broadly NZ's investment decisions in wider transport infrastructure. Key schedule design factors are which ports (NZ and foreign) generate volumes to warrant a call, the resultant optimisation of route (sequence of port calls), ship size and service frequency. The allocation of shipping costs reflects the respective shares of domestic/coastal and import-export cargo volumes.

Coastal container flows reflect the characteristics of regional supply and demand. Auckland's historic population growth leveraged its ideal natural harbour. As NZ's largest city, AKL is NZ's hub of consumption and industrial activity, and so AKL represents the national centre for imports. (and national distribution centres). TRG grew as an export port for its productive hinterland, largely forestry. Since developing Sulphur Point as a container terminal in 1992, TRG has drawn containers from an ever-widening hinterland, notably via its MetroPort facility in South Auckland, and the growing transhipment trade.

NZ ports handle 0.818mTEU coastal containers, 25% of the 3.22mTEU total.

Table C. 6

Port Container Flows - Jun-19 Year

000 TEU	AKL	TRG	NPE	WLG	NSN	LYT	TIU	POE	BLU	NZ
L Dom MT	86.6	5.7	1.1	10.4	1.8	35.3	0.3	1.6	0.7	143.4
D Dom MT	5.2	53.1	39.0	5.0	16.9	8.4	1.9	16.4	1.5	147.5
L Dom Full	71.9	23.6	0.6	0.2	2.1	17.8	1.7	2.2	0.3	120.4
D Dom Full	12.3	11.2	2.3	1.8	11.2	82.7	0.5	6.6	-	128.6
L XT MT	2.2	-	0.5	0.3	0.5	0.1	0.1	0.2	-	3.9
D XT MT	0.7	3.1	0.2	-	-	0.0	-	0.1	-	4.2
L XT Full	0.7	3.3	19.2	3.8	24.9	11.0	21.9	10.9	1.4	97.1
D XT Full	9.9	74.3	0.7	0.0	0.0	1.2	-	13.4	-	99.5
L IT MT	1.6	0.4	0.1	0.0	-	0.9	0.5	0.0	0.0	3.5
D IT MT	-	0.2	1.4	0.3	0.8	0.3	-	0.5	-	3.6
L IT Full	16.5	12.9	0.3	0.1	0.1	0.5	0.0	2.5	0.5	33.3
D IT Full	1.6	1.4	2.3	6.6	2.7	16.9	0.1	1.5	-	33.1
Total Coastal	209.0	189.4	67.6	28.5	61.1	175.2	26.9	56.0	4.4	**818.1**
IMEX	591.7	996.9	191.8	63.8	57.7	259.3	52.5	144.0	44.3	2,402.0
Total Containers	800.7	1,186.2	259.4	92.3	118.8	434.5	79.4	200.0	48.7	**3,220.1**
Net Coastal (D-L)	-149.6	97.4	24.0	-0.9	2.3	44.0	-22.0	21.0	-1.4	14.8
Domestic Full	48%	37%	7%	12%	42%	70%	50%	33%	12%	46%
Coastal Loaded	86%	24%	32%	52%	48%	37%	91%	31%	66%	49%
Coastal Domestic	84%	49%	64%	61%	52%	82%	16%	48%	57%	66%
Coastal Full	54%	67%	37%	44%	67%	74%	90%	66%	50%	63%
Coastal / Total	26%	16%	26%	31%	51%	40%	34%	28%	9%	25%

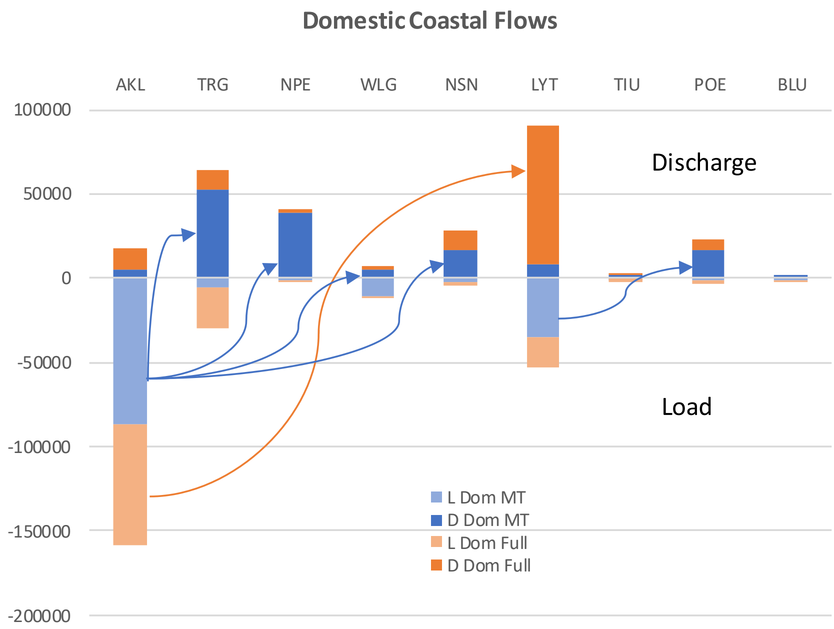
Key: L=Load, D=Discharge, Dom=Domestic, XT=Export Trabshipment, IT=Import Transhipment, MT=Empty, Full=Ful

Source: MOT FIGS

The pattern of coastal flows varies greatly between NZ ports.

- Loads: Of the 0.26mTEU domestic containers, AKL loads 60%, LYT 20% and TRG 11%.
- Full: AKL loads 60% of the total, while LYT discharges 64% of the total.

Figure C. 4



Source: MOT FIGS

Transhipments involve the coastal relocation of import and export containers on ships different from those employed on the international journey. Export transhipments account for 25% of coastal container flows, of which 90% are full, sourced largely from southern ports feeding export containers north for ultimate dispatch from TRG. Import transhipments account for 9% of coastal flows, dominated by LYT receiving full imports via AKL and TRG.

Figure C. 5

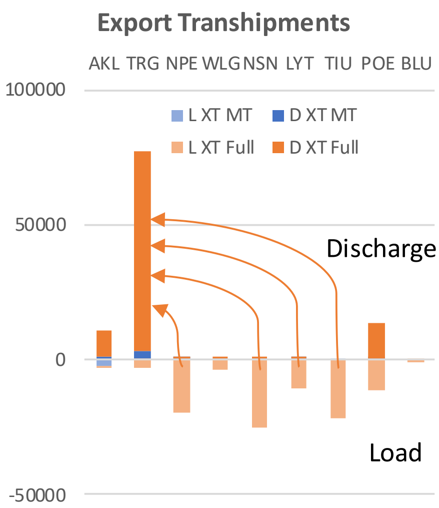
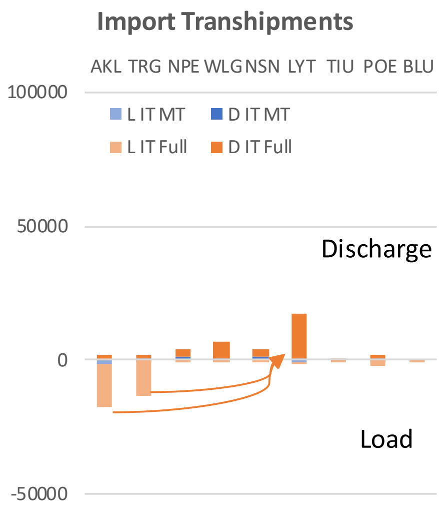


Figure C. 6



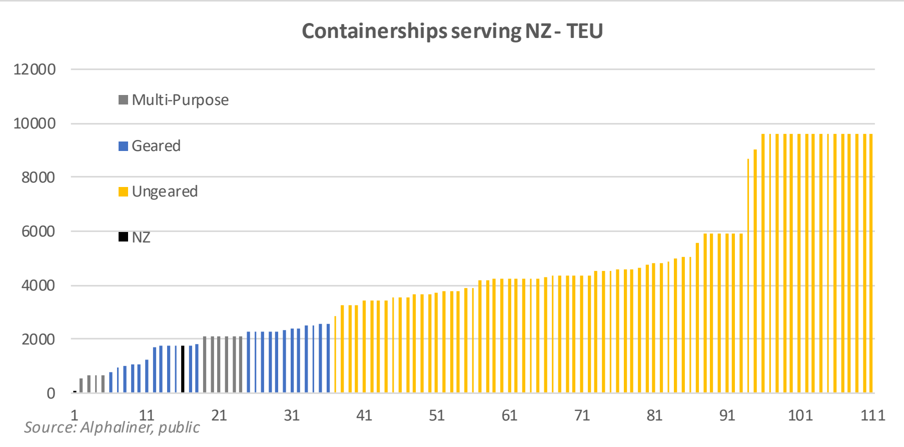
While pattern for coastal containers movements do emerge, the picture is complex. Given domestic flows are a secondary consideration for foreign lines, they will not materially factor into schedule design, although do represent attractive marginal volume. Domestic flows, however, are central for domestic shipping lines, which cannot presume any material role in attracting transhipments (which are "owned" by foreign lines).

Appendix 6 : Providers of Coastal Shipping

The Container ship Fleet

In 2018/19, port records show 111 individual container ships connected NZ to its global markets, operated by several competing foreign shipping lines. Only 68 individual ships are required to serve all current schedules, indicating ships are periodically substituted for servicing or to meet seasonal demand peaks. Of these 111, all 36 ships below 2550 TEU capacity were "geared" (that is, fitted with on-board cranes, with 11 of these ships being multi-purpose – container and breakbulk). All 75 ships over 2550 TEU were ungeared (dependent on port cranes).

Figure D. 1



Collectively these container ships operate a diverse range of scheduled services, each calling on a unique selection of domestic and foreign ports designed to capture maximum trade (and revenues) for minimum effort (and cost). Slow steaming lowers bunker costs yet will increase transit times and so require more ships for a weekly service.

The Container Ship Operators

NZ is served by all of the largest 5 global container ship lines, with the largest, Maersk, holding the dominant position. Maersk offers over 4.2 million TEU in global ship capacity, followed by MSC, COSCO, CMA CGM and Hapag Lloyd, with each fleet comprising a mix of owned and chartered ships.

NZ is a small market, accounting for 2.4 million TEU, or 0.3% of the global trade of 802 million TEU. To maintain the breadth of service (regular calls to a wide range of ports), shipping lines may form alliances for certain regions or routes, where each line secures an agreed share of ship slot capacity on a shared fleet of container ships. Under alliances, ship utilisation will increase, with the savings shared, including with cargo owners through lower slot costs.

Scheduled shipping services are almost always weekly (if not, then multiples of weeks), so securing regular port berth slots (same day same time each week). The number of ships on each weekly service equates to the number of weeks for each ship to complete the full loop. Direct services to and from NZ are available for the closest destinations (Australia, China), although increasingly imports and transhipped through regional hub ports such as Singapore.

Pacifica Shipping is the only domestic participant in the container market. Pacifica was founded in 1982 as specialist coastal operator to carry general break bulk cargos, vehicles and machinery, and containers. At its “peak” in 1990’s, Pacifica operated four RORO ships serving ports from Auckland to Dunedin. In 1999, Pacifica transitioned from RORO operations into ungeared container ships, initially with *Spirit of Resolution* (384TEU), replaced by *Spirit of Endurance* (698TEU) in 2012, then *Spirit of Canterbury* (1100TEU) in 2015 and now *Moana Chief* (1700TEU) since 2019. In doing so, Pacifica committed to using port container terminals, so benefitting from higher transfer rates (albeit at higher cost) and better integration into national container supply chains. Since 2013, Pacifica has been owned by China Navigation Company.

Coastal Container Services

The 16 container ship schedules linking NZ ports are summarised in the following table. Of these, 14 are provided by foreign shipping lines, which collectively make 2400 port calls, of which 90% are on weekly calls. Pacifica Shipping operates a weekly service calling on 4 ports (250 annual calls), while Chatham Island Shipping operates a 30 day service calling at 4 ports (2 being mainland NZ).

Table D. 1

NZ Coastal Servives

Operators	Service (by operator)	Freq	Loop	Ships	TEU	NZ Ports					
International Services											
CMA CGM, COSCO, OOCL, ANL, PIL	Asia-NZ Express	7	49	7	4500	AKL	LYT	WLG	NPE	TRG	
PIL, OOCL,APL, ANL, COSCO	NZS/NZX/NZS/KIX/NZE	7	42	6	5000	AKL	LYT	WLG	NPE	TRG	
Maersk, ONE	Southern Star/NZ1	7	49	7	5900	TRG	NPE	LYT	TIU	LYT	POE
MSC	New Capricorn	7	42	6	3500	BLU	POE	LYT	NPE	TRG	
MSC	New Kiwi Express	7	42	6	3500	AKL	NSN	WLG	TRG	AKL	
COSCO, ONE, Hamburg Sud	Japan-China-NZ	7	49	7	4450	AKL	LYT	NPE	TRG		
Maersk,H'Sud,MSC,CMA CGM	OC1/Trident/PAD2/Oc2	7	77	11	3500	TIU	POE	NPE	AKL	TRG	
ANL,CMA CGM	TransTas/TTZ	7	21	3	1700	AKL	LYT	NSN	WLG	TRG	
Neptune, PDL,Sofrana	NZ-Fiji	7	14	2	1700	TRG	AKL				
Swire	NEAsia-PNG-NZ NAT	16	65	4	2000	AKL	TIU	TRG	MAP		
Swire	EAsia-NZ-Spac (ESEA)	15	60	4	2300	AKL	TRG				
Swire	TransTasman	17	34	2	1000	AKL	MAP	LYT	TRG		
Sofrana	WESTPAC	17	34	2	1000	TRG	AKL				
PDL, Neptune,Sofrana	NZ-SPac	14	14	1	500	TRG	AKL				
Domestic Services											
CIAS		30	30	1	60	NPE	TIU				
Pacifica		7	7	1	1700	AKL	LYT	NSN	TRG	AKL	

The regular schedules plied by foreign ships result in matrix of domestic port-port links, In the following tables, the numbers (and shading) represent direct (and indirect) calls each week for each port-port pair. In total there are 34 direct weekly port-port links, and 25 indirect links (with a single intermediate port). Indirect connections are less attractive to shippers of full containers given extended transit times (an extra day per additional port call). Pacifica’s weekly schedule (TRG-AKL-LYT-NSN-TRG) is added as superimposed red circles. While it is apparent these port-port matrices leave many potential coastal connections unserved, Chapter 4.3 above confirms the weighting on a few key port-port links.

Table D. 2 Port-port links

Direct - weekly port connections

	MAP	AKL	TRG	NPE	WLG	NSN	LYT	TIU	POE	BLU
MAP							0.5			
AKL	0.5		0.5			1	4	0.5		
TRG	0.5	2		1						
NPE			4				1			
WLG			2	3						
NSN					2					
LYT			0.5	2	2			1	1	
TIU			0.5				1		1	
POE							1			
BLU									1	

Indirect - 1 intermediate port

	MAP	AKL	TRG	NPE	WLG	NSN	LYT	TIU	POE	BLU
MAP			0.5							
AKL			0.5	1	3	1	0.5			
TRG							1			
NPE			1					1		
WLG		1	2							
NSN			2							
LYT			2	2	1					
TIU	0.5			1					1	
POE		1		1						
BLU							1			

A ship sailing directly from AKL to LYT will cover 683 Nautical Miles (NM) and at 17 knots will take 40.2 hrs (in blue below). Adding time for receiving, loading and discharging containers, the task may take 100 hrs, compared to 24 hrs by truck and 36 hrs by rail. Time is typically not an issue for moving empties.

Table D. 3

NZ Port Matrix

Port Distances in NM and Transit Time in hrs (at 17 kts)

17	NTH	AKL	TRG	NPE	NPL	WGN	NSN	LYT	TIU	OTG	BLU
NTH		73	151	386	452	570	586	692	781	849	970
AKL	4.3		131	377	509	561	633	683	772	840	960
TRG	8.9	7.7		290	587	430	582	596	665	753	873
NPE	22.7	22.2	17.1		382	221	325	336	425	500	621
NPL	26.6	29.9	34.5	22.5		180	148	335	387	482	618
WGN	33.5	33.0	25.3	13.0	10.6		126	174	266	339	457
NSN	34.5	37.2	34.2	19.1	8.7	7.4		278	370	428	558
LYT	40.7	40.2	35.1	19.8	19.7	10.2	16.4		131	192	315
TIU	45.9	45.4	39.1	25.0	22.8	15.6	21.8	7.7		94	237
OTG	49.9	49.4	44.3	29.4	28.4	19.9	25.2	11.3	5.5		140
BLU	57.1	56.5	51.4	36.5	36.4	26.9	32.8	18.5	13.9	8.2	

Based on FIGS data, we plot domestic container flows which comprise 120,000 TEU full and 150,000 TEU empties. Adding 140,000 TEU of transhipments gives to coastal total of 410,000TEU. In the tables below we overlay in shading ship calls per week, and Pacifica's route in red circles.

The 7 key routes (black squares) account for 80% of domestic flows (and 61% of coastal flows). Pacifica's weekly route covers 100,000TEU (80%) domestic movements, and 135,000 TEU (61%) of coastal.

Table D. 4 Container flows

Domestic Container Flows - 000TEU

	MAP	AKL	TRG	NPE	WLG	NSN	LYT	TIU	POE	BLU
MAP										
AKL			40	30	0	20	75			
TRG		15					15			
NPE							5			
WLG			10							
NSN			5							
LYT			10	10	5	5			25	
TIU										
POE										
BLU										

Pacifica 100 ship calls per week <1 1 2 3 4+

Coastal Container Flows - 000TEU

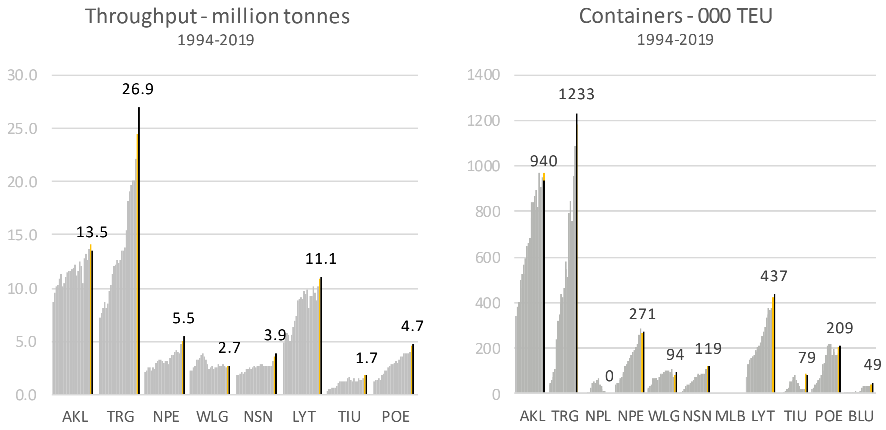
	MAP	AKL	TRG	NPE	WLG	NSN	LYT	TIU	POE	BLU
MAP										
AKL			45	32	5	24	80			
TRG		20		2			24			
NPE			20				5			
WLG		2	12							
NSN			30							
LYT			20	11	6	5			25	
TIU			10		1				14	
POE		6	5				3			
BLU							1			

Pacifica 135 ship calls per week <1 1 2 3 4+

Appendix 7 : Port Performance

The eight principal ports transfer 70 million tonnes of cargo annually, including 3.2 million TEU. Productive hinterlands drive key bulk trades, often forestry (logs) exports. Containers, now accounting for almost 40% of trade volume, have shown strongest growth for most ports. Globalisation has driven NZ's cargo growth at 4.4% CAGR over the last 25 years, in large part driven by forestry exports. Beyond that, containers throughput reached 1.0 million TEU in 2000, and 3.2 million in 2019, a 6.1% CAGR. TRG has outperformed, achieving 13% CAGR over this period.

Figure E. 1 Port performance



The key metric of operational performance is the rate at which cargo is loaded and discharged from a ship. AKL, TRG, WLG, LYT and POE all operate quay (or gantry) cranes, which achieve high transfer rates, while NPE, NSN, TIU and BLU use mobile cranes. Crane Rates is the number of containers loaded or discharged per crane per hour. Ship Rate is the Crane Rate by the number of cranes working a ship which, using the mix of 20'/40' in FIGS, we have converted to TEU/hr in the following table. The Vessel Rate is containers transferred per labour hour per ship. The Ministry's FIGS database, and the Australian equivalent, BITRE's Waterline survey, keep a quarterly record of port operational performance. FIGS and BITRE data reflect containers, not TEU (on average, 31% of containers handled are TEU, or 1.5TEU/container). TRG has long been Australasia's most efficient port by Crane Rates although AKL had posted the highest Ship Rates until 2016. NPE fares remarkable well given it operates mobile cranes.

Table E. 1

Containerport Performance Statistics

Calendar Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Crane Rate - Containers/hr											
Auckland	26.7	25.5	26.5	29.2	31.8	33.5	35.0	36.6	34.7	35.7	32.5
Tauranga	35.1	34.9	34.5	32.4	34.5	36.9	35.8	35.6	36.2	35.7	32.9
Napier	23.5	23.2	23.1	23.1	22.5	23.1	24.0	23.8	23.3	22.9	23.3
Wellington	28.0	29.0	30.9	32.5	34.7	34.0	31.1	29.7	33.2	22.0	22.6
Lyttelton	28.1	28.5	28.8	27.7	29.8	29.1	30.6	31.9	31.0	29.8	29.6
Otago	26.4	28.0	28.3	31.4	33.0	33.1	33.7	33.3	33.6	33.5	31.9
Weighted avg.	*28.6*	*28.3*	*28.9*	*29.8*	*31.8*	*32.9*	*33.4*	*33.9*	*33.6*	*33.3*	*31.1*
Ship Rate - TEU/hr/ship											
Auckland	73.3	71.2	77.1	82.9	96.1	105.5	105.6	107.5	102.7	106.6	95.9
Tauranga	75.9	80.1	81.1	79.1	79.4	89.7	91.6	99.2	104.5	100.3	102.9
Napier	50.3	50.6	50.0	51.2	57.1	58.0	67.0	66.7	67.2	64.7	66.4
Wellington	48.4	51.7	52.6	59.4	68.6	78.0	66.8	62.9	65.5	56.5	51.1
Lyttelton	58.5	60.8	62.3	61.0	63.5	64.9	63.5	70.5	73.6	74.9	75.7
Otago	68.5	73.7	74.9	72.0	77.7	78.0	72.7	73.9	75.0	75.1	70.5
Weighted avg.	*68.5*	*69.6*	*72.6*	*73.9*	*79.8*	*87.6*	*87.9*	*91.5*	*93.7*	*92.7*	*90.3*

Applying the annual Containers Handled to Ship Visits, we observe that TRG achieves an average Container Exchanged of 1600 TEU per ship visit. Ship Turnaround Time, being Containers Exchanged by Ship Rate, shows all ports achieving turnaround in 11-17 hours.

Port Berth Utilisation is calculated as Ship Turnaround Time * Ship Visits / (#Berths * Annual Hours) (allowing an extra 2hrs per ship visit in preparation for the exchange). AKL’s terminal berth utilisation is highest at 55%, with NPE and TRG close behind. We note that some containers are handled on general wharves using geared container ships, such as the Pacific Island services berth at AKL and TRG.

Table E. 2

Containerport Performance Statistics

Calendar Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
TEU Exchanged - #/ship											
Auckland	1274	1311	1306	1213	1191	1317	1183	1145	1229	1323	1305
Tauranga	936	988	1013	1099	1203	1103	1213	1310	1259	1430	1616
Napier	551	721	707	751	718	656	723	720	844	890	857
Wellington	371	419	458	537	593	559	537	633	477	414	586
Lyttelton	852	984	992	1047	1219	1304	1215	1169	1187	1390	1305
Otago	1199	1528	1344	950	1075	1123	1076	1077	1293	1407	941
Weighted avg.	*1035*	*1127*	*1107*	*1061*	*1127*	*1153*	*1123*	*1138*	*1192*	*1321*	*1348*
Ship Turnaround Time - hours [a]											
Auckland	17.4	18.4	16.9	14.6	12.4	12.5	11.2	10.6	12.0	12.4	13.6
Tauranga	12.3	12.3	12.5	13.9	15.2	12.3	13.2	13.2	12.0	14.3	15.7
Napier	11.0	14.3	14.1	14.7	12.6	11.3	10.8	10.8	12.6	13.7	12.9
Wellington	7.7	8.1	8.7	9.0	8.6	7.2	8.0	10.1	7.3	7.3	11.4
Lyttelton	14.6	16.2	15.9	17.2	19.2	20.1	19.1	16.6	16.1	18.6	17.3
Otago	17.5	20.7	17.9	13.2	13.8	14.4	14.8	14.6	17.2	18.7	13.4
Weighted avg.	*15.1*	*16.2*	*15.3*	*14.4*	*14.1*	*13.2*	*12.8*	*12.4*	*12.7*	*14.2*	*14.9*
Port Berth Utilisation % [b]											
Auckland - 2	64%	68%	65%	54%	50%	55%	55%	51%	54%	53%	55%
Tauranga - 3	26%	26%	29%	41%	44%	35%	39%	40%	46%	50%	52%
Napier - 1	40%	42%	44%	48%	48%	49%	47%	50%	54%	55%	53%
Wellington - 2	12%	13%	13%	11%	9%	9%	12%	14%	5%	9%	12%
Lyttelton - 2	27%	27%	28%	33%	34%	36%	37%	33%	35%	36%	37%
Otago - 2	22%	20%	20%	16%	16%	15%	15%	15%	15%	17%	19%
Weighted avg.	*41%*	*43%*	*42%*	*41%*	*41%*	*41%*	*42%*	*40%*	*45%*	*46%*	*47%*

[a] = Containers Exchanged / Crane Rate [b] = Ship Turnaround Time+2hrs * Ships per Year / Hrs per Year

Source: Ministry of Transport - FIGS, Rockpoint

As a rule of thumb, ports are considered at capacity when Berth Utilisation exceeds 60%, beyond which arriving ships will regularly face berthing delays. Utilisation has been rising as Containers Exchanged has risen faster than improvements in Ship Rate, boosted by double-handling of the transhipments, while container trade is being focussed on fewer ports (Port Taranaki no longer serves container ships).

Ports have progressively added berth space for container ships and cranes to boost capacity. AKL is currently commissioning (July 2020) a third berth as part of the full automation of Fergusson Container Terminal, which will reduce berth utilisation to 33%. TRG extended its Sulphur Point wharves in 2013 (and has scope to add more wharf length), NPE added a general wharf in 2010 and construction of another container berth is approved to commence in 2020. WLG is rebuilding its Thorndon Wharf post-2016 earthquakes, NSN is strengthening and extending its Main Wharf North, while in 2016 LYT commissioned its extended Cashin Quay container wharves post-2010 earthquakes. POE extended its container wharf in 2018.

Ports can add cranes to boost Crane Intensity (cranes employed per ship, or Ship Rate / Crane Rate). Assuming all berths are occupied simultaneously, and worked at observed Crane Intensity, we calculate AKL, TRG, NPE and LYT have spare Raw Crane Capacity (#Cranes / (Crane Intensity * Berths). Considering Berth Utilisation, and assuming crane capacity is similarly reached at 60% utilisation, all ports exhibit headroom in Effective Crane Capacity.

Table E. 3

Port Crane Utilisation %

	Berths	Cranes	Crane Intensity	Raw Crane Capacity	Berth Utilisation	Effective Crane Capacity
	a	b	c	d	e	f
Auckland	2	5	2.0	128%	55%	139%
Tauranga	3	8	2.1	129%	52%	150%
Napier	1	3	1.8	171%	53%	192%
Wellington	2	2	1.5	67%	12%	325%
Lyttelton	2	4	1.7	120%	37%	195%
Otago	2	2	1.5	69%	19%	216%

c = Ship Rate/Crane Rate d = b/(c*a) f = e/(d/60%)

Rockpoint maintains a financial and operational database of key NZ ports dating back to 1994, with 2018/19 summarised in the following table. While we distinguish revenues attributed to port activities from total revenues, disclosed "port" revenues may include some non-port and off-port activities.

FY 2019	AKL	TRG	NPE	WLG	NSN	LYT	TIU	POE	NZ
NZ$m	Jun	Jun	Sep	Jun	Jun	Jun	Jun	Jun	
Revenue	248.1	313.3	99.6	84.6	70.7	166.8	22.9	121.7	1127.7
Revenue - Port	230.9	313.3	97.5	82.6	62.7	166.8	20.3	81.8	1055.9
Expenses	155.4	140.1	57.6	74.2	40.2	103.4	14.6	77.8	663.3
Gross Profit	92.6	173.2	42.0	10.4	30.5	63.4	8.3	43.9	464.3
Associate Earnings	2.5	8.1	0.0	8.0	0.0	0.0	0.0	0.2	18.8
One-Offs	-0.9	-0.5	-6.3	-9.1	0.0	0.0	0.0	3.9	-12.9
EBITDA	94.2	180.8	34.6	78.3	30.5	63.4	8.3	47.9	538.0
Deprn&Amort	23.6	27.6	12.2	6.5	7.6	16.0	1.7	10.0	105.2
EBIT	70.6	153.2	22.5	71.8	22.9	47.3	6.6	60.6	455.6
Net Interest Expense	18.4	18.2	10.4	-0.5	2.9	0.2	1.0	2.7	53.3
Taxation Expense	8.1	34.4	5.2	-0.7	4.8	4.9	1.6	8.7	67.0
Reported Profit	44.1	100.6	6.8	72.9	15.3	42.2	4.0	49.3	335.2
Other Comp Income	0.0	65.0	8.3	-2.6	-1.7	-0.5	1.1	0.8	70.5
Comprehensive Income	44.1	165.5	15.2	70.4	13.5	41.7	5.2	50.1	405.7
Normalised ProfitP	40.0	100.9	11.4	79.5	15.3	42.2	4.0	46.5	339.8
Net Operating CF	68.1	112.2	29.3	16.0	20.0	51.9	6.9	35.9	340.3
Port Fixed Assets	1061.6	1531.2	317.2	126.9	240.5	524.8	82.5	212.8	4097.5
Total Assets	1431.4	1748.9	371.1	346.3	278.1	584.2	90.2	602.3	5452.5
Net Debt	488.7	442.3	-31.2	-3.0	61.4	26.2	27.2	55.5	1067.1
SHF	799.8	1178.8	335.5	303.4	190.4	516.9	58.0	508.1	3890.8

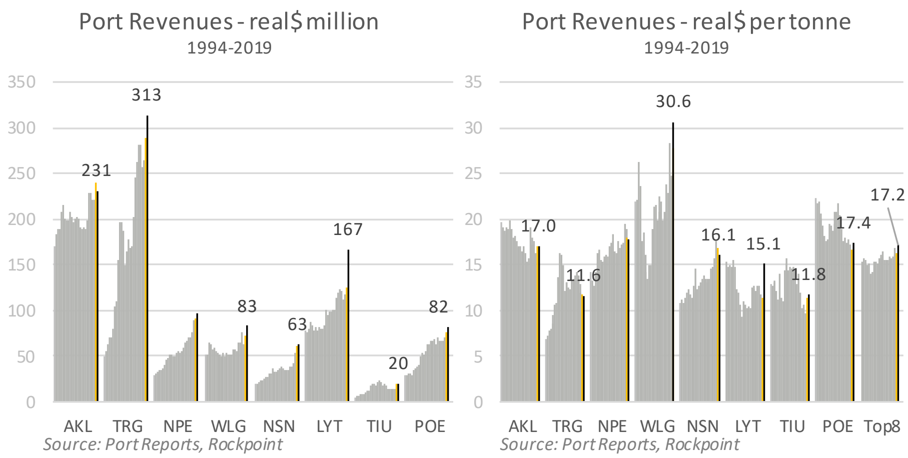
Table E. 4

Many ports have diversified beyond core port operations (which is simply providing a facility for ships to load and unload cargo) into other activities. AKL and TRG have invested in other ports, several have established inland ports to aggregate cargo, others have invested in land transport and logistics. WLG and POE have invested in commercial or industrial property. For this DTCC study, where possible, we have sought to exclude non-port activities.

The following commentary covers the 8 key container ports. Historical financials (1994-2019) are presented in real$ (r$) terms (nominal$ inflation-adjusted using RBNZ CPI data). In addition, we unitise the financials by denominating the financial measures with cargo throughput (yielding real$/tonne), to provide a more direct and meaningful comparator of port performance.

The 8 key container ports shown generated $1.1 billion in revenue and $340 million in reported profits in FY2019, from a combined fixed asset base of $5.4 billion. Average gearing (debt/debt+Equity) was a modest 21%. Collective revenues have grown from real$450 million to r$1,055 billion since 1995, a real CAGR of 3.6%, with TRG showing remarkable rCAGR of 7.5%. Averaged across the 8 ports, unit revenues have risen slightly, from r$15.4/tonne to r$17.2/tonne.

Figure E. 2



Over this same period, operating earnings, EBITDA, have risen from r$204 to r$464 million, (rCAGR 3.5%). Unit EBITDA rose from r$5.5/tonne to a r$6.5/tonne, since easing back to r5.8/tonne.

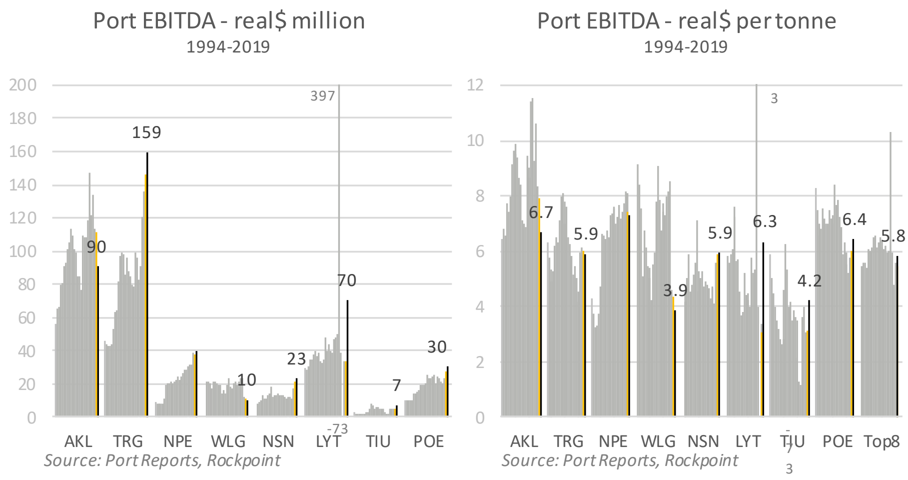
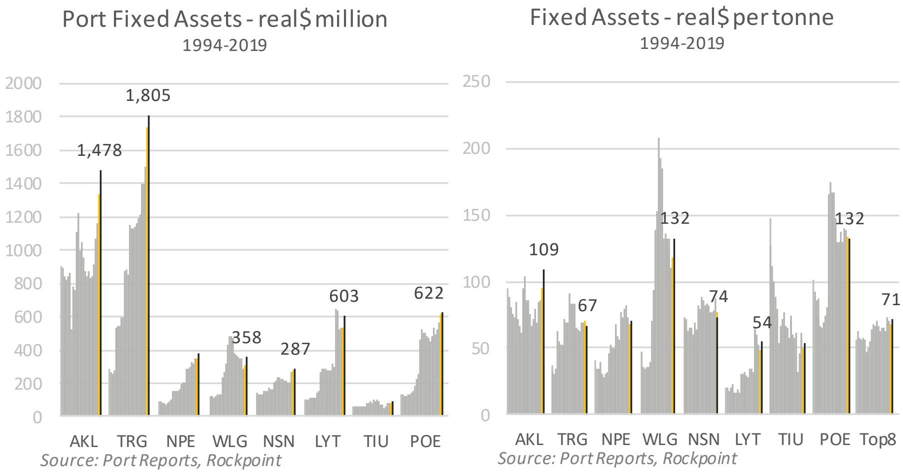


Figure E. 3

Earnings are generated off an asset base which has risen from r$1.59 billion to r$5.63 billion, (rCAGR 5.4%), where fixed assets typically account for 75% of total asset base. The increase in asset value arises from both capital investment and periodic revaluations. These revaluations are an accounting adjustment, nominally to present assets at assessed market value, with some methodology variation amongst the ports (POE changed its reporting policy after 2016). In 2018/19, the revaluation reserves of the 8 ports stood at r$1.56 billion. Across the 8 ports, assets/tonne rose from r$55 to r$87, while excluding WLG and POE (assets boosted by property), assets/tonne rise r$57 to r$71/tonne.

Figure E. 4



Capital investment is necessary to replace ageing infrastructure, to meet trade growth and to invest in new technologies, with containerisation being a major driver. Containers require a large open layout space, prompting extensive reclamations since the 1960's (AKL, TRG, NPE, WLG, LYT, POE and BLU). Containers require heavy-duty wharves to bear quay cranes - AKL operates 5 quay cranes (soon to be 8), TRG 9, WLG 2, LYT 4, POE 3. NPE operates 3 mobile cranes, NSN 2, and TIU 3.

Unlike containers, the individual bulk trades usually involve single (or a few) parties with long-term commitments to on-port or near-port facilities – storage silos and pipelines for cement and petroleum, bulk loaders/conveyors and storage facilities for fertiliser and coal. The demands of forestry trade are simpler, with ports providing land for log storage and forklifts - loading employs ship-board cranes.

Infrastructure assets exhibit long lives – some operational wharves are over 50 years. The cumulative capital expenditure over the last 20 years has been r$3.71 billion across the 8 ports, with key recent investment projects including AKL's new berth and automation of Fergusson, new wharves, cranes and dredging at TRG, LYT's post-earthquake rebuild (ongoing at WLG). Across the 8 ports, median port capex per tonne is r$3.3/tonne/year (raw average r$5.3/tonne). Excluding key investment peaks and non-port investment listed above, the median background (maintenance) port capex is assessed to be r$2.7/tonne/year. Considered the capex required to meet throughput growth (capex less background capex/throughput growth), averaged across the 8 ports since 1995, we calculate r$6.4/incremental tonne.

Figure E. 5

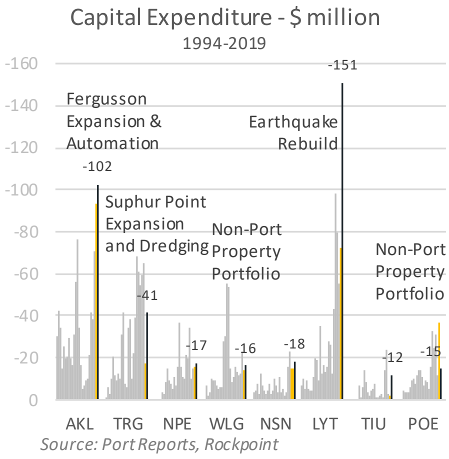
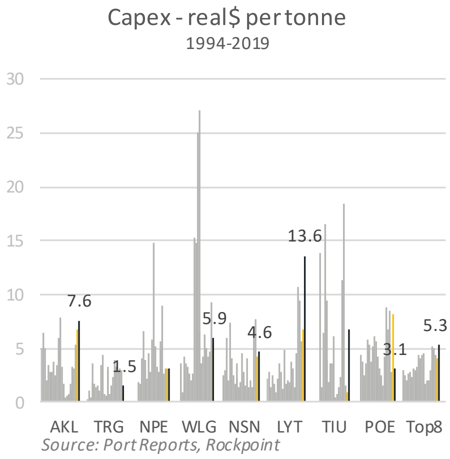


Figure E. 6



Port Tariffs

Ports periodically publish their tariff sheets, each adopting their preferred charging structure. These have been simplified in the following 2018/19 summaries. Ports may offer bespoke tariff sheets to key customers. Wet charges are those which apply to the ship (pilotage, towage, navigation and berthage), while dry charges apply to the cargo.

Table E. 5

Port Marine (Wet) Charges

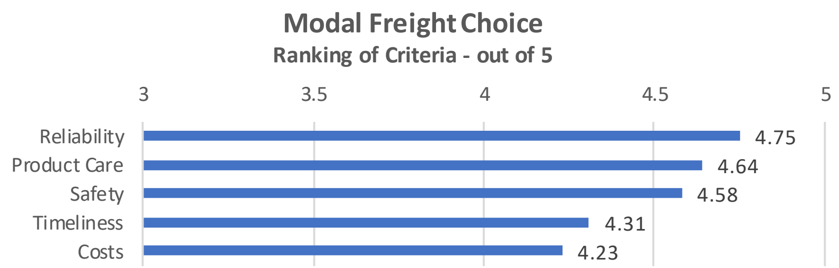
	AKL	TRG	NPE	WLG	NSN	LYT	TIU	POE	BLU
Marine									
Comprehensive $/GT	1.37	1.23	f^n(LOA)	f^n(GT)	0.35		1.39		f^n(GT)
Comprehensive Minimu	2595	1850			370		4310	per tug	2770
Towage $/GT					0.27	f^n(GT)		0.17	1.52
Towage minimum $					995	1650		1650	
Towage between berths	0.75				per tug	per tug		1725	
Towage btw berths Min	1482				900				
Towage Cancellation $		2040							
Pilotage $/GT					f^n(GT)			0.44	
Pilotage minimum $					700			3125	
Navigation ($/GT)						f^n(GT)			
Navigation minimum $						2219			
Shipping Lines A,B,C $					900				
Berthage									
Daily service $/m/day		11.35							
Berthage $/GT <7	0.11			0.10	0.15	0.20	0.20		
Berthage $/GT (7+)	1.37				0.24				
Berthage minimum					285				
Shift $/GT		0.19				0.20	0.40	0.13	
Shift minimum $/ship		1800	5500					124	
Security $/ship			275	306					
Insurance				510					
Shipping Lines					900				

Table E. 6

Appendix 8 : Mode Comparisons

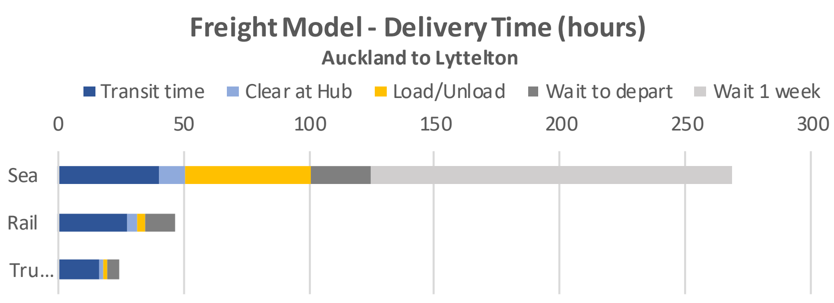
Rockpoint's 2009 report to NZTA and Te Manatū Waka , "Coastal Shipping and Modal Freight Choice", 120 shippers and industry stakeholders ranked the importance of several criteria for selecting transport mode. While the rankings are subjective, reliability ranked highest at 4.75 out of 5, followed by product care, safety, timeliness, and at fifth, cost scored 4.23. These rankings were in line with international studies, and are not expected to change materially through time.

Figure F. 1



Each transport mode presents a different proposition across these criteria. Notwithstanding their importance, all modes can demonstrate metrics for reliability, safety and product care. The material differences between the modes are in timeliness (especially delivery time) and cost. Shipping by sea is materially slower than road and rail. Delivery time comprises the time for actual transit, for aggregation (given ships and trains accommodate larger loads) and service frequency. Shipping a container from Auckland to Christchurch comprises a transit time of some 40hrs by ship (vs train 25hrs and a truck 16hrs). Ships need to aggregate many containers to warrant sailing – taking say 40hrs receive, process, aggregate and then load containers at a port. Finally, ships operate less frequent services (weekly) than trains or trucks (daily).

Figure F. 2



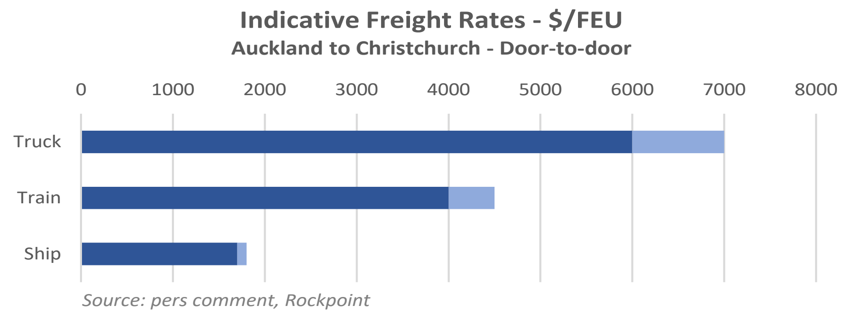
Source: Rockpoint

Our analysis is based on depot-to-depot freight task. Not considered is an additional transport task required to complete door-to-door services, that "last mile". Transport prices vary greatly with consignment type and priority. The prevailing supply chain orthodoxy seeks to minimise inventory costs, so valuing regular shipments and Just-In-Time delivery.

Freight pricing is a complex subject, given the range of variables which will apply to any consignment. Pricing reflects factors such as the route (distance, inter-island or not), priority for delivery, consignment characteristics (temperature controlled, fragility), last mile requirements (local collection and delivery), and other services required (such as packaging and storage).

Several sources have provided indicative rates for typical long-haul consignments which are represented by a 40' container (FEU) being delivered from AKL to LYT by ship, train and truck. We observe these price ranges are for door-to-door services of a dry container.

Figure F. 3



While we cannot question shippers' mode decisions, we do observe that faster delivery offered by trucks attracts a material price premium. Based on these indicative freight rates, the implied value of a 40' container-load of goods (ignoring any other criteria) is nominally $1200-2000 per day. Where the inventory costs for the goods are less than $1200/day, and where the reliability/product care/safety elements were provided, then the shipper would presumably choose moving by ship (or by train).

Recent natural events, such as the Christchurch and Kaikoura earthquakes, have materially disrupted transport networks, and renewed focus on network resilience – the ability to withstand, react and restore. Resilience has many dimensions and applies across all infrastructure. The NZTA's 2018 Resilience Framework states:

"Resilience is the transport system's ability to enable communities to withstand and absorb impacts of unplanned disruptive events, perform effectively during disruptions, and respond and recover functionality quickly. It requires minimising and managing the likelihood and consequences of small-scale and large-scale, frequent and infrequent, sudden and slow-onset disruptive events, caused by natural or manmade hazards".

This Framework is driven by more frequent natural hazard events, affecting more complex yet ageing networks, to meet rising public expectations to avert economic disruption. It seeks to enhance the government's responsiveness to emergencies with a "modal-neutral transport system strategy".

For freight transport, a practical measure of resilience is the frequency and duration of transport corridor disruption. Natural events are the predominant factor, be it weather (such as snow closing the Desert Road, or flooding), landslips (such as the 2012 washout closing the Napier-Wairoa rail line or regular road closures in the Manawatu Gorge) or earthquakes, although accidents are also a factor. Most road outages are small and quickly remediated, and almost invariably an alternative route is available. NZTA reports that 85% of unplanned road closures were resolved within 2hrs for urban roads and 12 hours for rural roads. While rail disruption may be quickly remediated, the lack of redundancy in the track network means rail operations cease until reinstated. For coastal shipping, ports have been disrupted by earthquakes (LYT in 2011, WLG 2017), while weather only briefly disrupts sailings. We observe that the 2016 Kaikoura earthquake, which affected WLG for a year, also closed SH1 and SIMT rail line through Kaikoura for 1 year.

Appendix 9 : Maritime Accidents

Introduction

This appendix is based on data originally drawn together in conjunction with DTCC working paper D1, “Costs of road transport crashes”, authored by Viastrada, a specialist transport planning and design consultancy.

Maritime NZ considers eight sectors, as shown below, of which the NZ International Safety Management (“NZ Coastal”) and Domestic Passenger / Non-Passenger (“NZ PAX/non-PAX”) sectors are considered to be primarily about transport in New Zealand.

Figure G. 1: Maritime sectors from Maritime NZ 2017/18 annual report

COMMERCIAL SECTORS							NON-COMMERCIAL BOATING
FOREIGN SHIPPING	NZ INTERNATIONAL SAFETY MANAGEMENT*	DOMESTIC FISHING	DOMESTIC PASSENGER/ NON-PASSENGER	DOMESTIC OUTDOOR AND ADVENTURE	OFFSHORE	PORTS AND HARBOURS	RECREATIONAL BOATING
EXAMPLE INDUSTRY TYPES:							Powered craft
Foreign Transport Services • cargo transport • passenger cruises	**Domestic Coastal Transport Services** • passenger/ freight • coastal (traders, tankers, research)	**Marine Fishing** • line fishing • fish trawling • aquaculture	**Intra-regional Transport Services** • charter services • water taxis	**Water-based Tourism** • rafting • jet boating • kayaking • river boarding	**Petroleum, Gas and Mineral** • exploration • extraction & production • decommissioning	**Commercial Port Services** • piloting • harbour master • stevedoring	Non-powered craft

Through time Maritime NZ has provided a range of disclosure on accidents. Broadly, accidents cover occurrences that involve a ship where a person is seriously harmed, the ship sustains damage or structural failure, there is damage to cargo or property, a dangerous substance is spilled, a person is lost at sea, or the ship founders. Incidents are occurrences that could affect safety of operations, while mishaps are events that have or could harm persons.

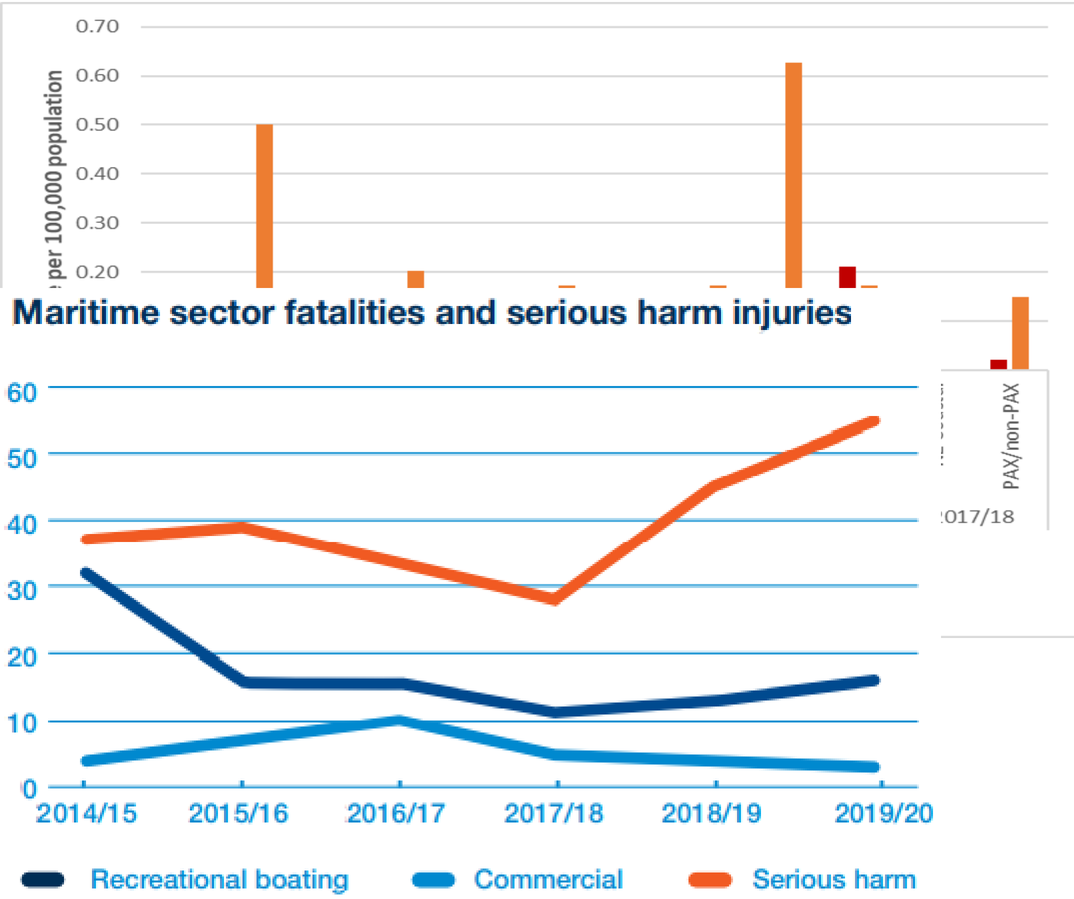
Maritime NZ requires self-reporting and notification from all shipping industry participants for all safety incidents, ranging from near-misses and non-injury incidents through injuries to fatalities, where the term ‘serious harm’ has been redefined under the Health and Safety at Work Act 2015 to refer to notifiable injury or illness.

Maritime NZ data

Historically (pre-2009) Maritime NZ presented full reports for each accident/ incidents for categories international vessels, non-passenger and passenger vessels (of interest to this report) and also fishing and recreational categories. More recently accident/incidents summaries are provided in its Lookout magazine, with monthly “Accident, incident, and mishap notification” summaries. Many entries cover minor incidents, both at sea and in port, including near misses and gear failure.

As the number of each accident severity are very low, Viastrada used longer analysis periods – maritime fatalities have been analysed for the period 2012/13 to 2018/19 and notifiable injuries / illnesses have been analysed from 2012/13 to 2017/18 (latest year with full data available). The graph below shows the rates of fatalities and notifiable injuries or illnesses per 100,000 population given in the Maritime NZ 2017/18 annual report for the NZ Coastal and PAX/non-PAX maritime sectors.

Figure G. 2 Yearly fatalities and notifiable injury/illness in maritime transport sectors per 100,000 population



Maritime NZ's interventions have led to improvements (in relative terms) across maritime safety areas, reflected in the statistics that cover not just regulation and compliance activities but lives saved through search and rescue coordination for New Zealand.

Figure G. 3

In its 2019/20 Annual Report, Maritime NZ reported 28 fatalities, of which 3 were in commercial sectors (while 17 were in recreational boating, so beyond the scope of the DTCC study), with 55 maritime sector serious harm injuries (an increase partly reflecting a broadened definition under the Health and Safety at Work Act 2015).

Port Data

Table G. 1 shows firstly the data available for accidents at individual ports from their annual reports for FY 2017-2019. It then gives an overall estimate for accidents occurring at ports and harbours in New Zealand, based on the data available for certain ports, factored according to the revenue of the 11 major ports, and with an additional 50% to conservatively account for other smaller ports throughout the country. Finally, the table attributes 31% of these accidents to the NZ Coastal and PAX/Non-PAX sectors and 69% to the other three main sectors (based on approximate proportions of accidents for the five sectors as presented in the Maritime NZ annual reports).

Table G. 1: Accidents at NZ ports and harbours

Port location	Alternative name	Average fatalities per year*	Average lost time injuries per year*	Average medical recordable injuries	Revenue (NZ$ million)
Auckland	Ports of Auckland	0.7	5.3	38.0	243.2
Tauranga		0.0	1.0	1.3	283.7
Napier		0.0	2.0		91.7
New Plymouth	Port Taranaki				45.6
Wellington	Centre Port				73.8
Nelson					67.2
Lyttelton		0.0	0.0	1.5	122.2
Timaru	Prime Port	0.0	3.0		22.2
Port Chalmers	Port Otago	0.0	6.0		111.1
Bluff	South Port				40.7
Marlborough		0.0	4.7		28.7
Total available sample		0.7	22.0	40.8	1130.1
Factored for all ports		0.8	27.5	71.1	
Increase by 50% to account for smaller NZ ports		1.3	41.3	106.6	
31% attributed to NZ Coastal and PAX/Non-PAX sectors		0.4	12.8	33.1	
69% attributed to other three main sectors		0.9	28.5	73.6	

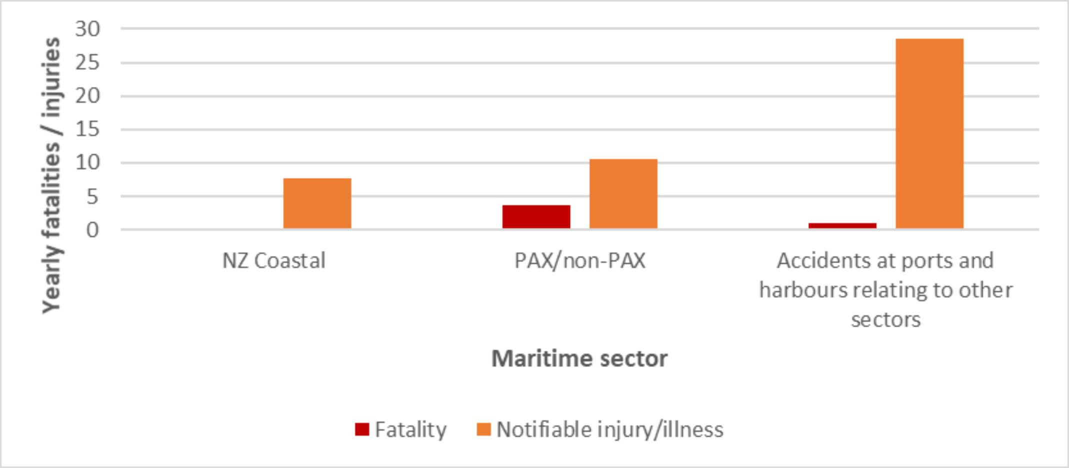
* Taken from data for FY2017-FY2019, where available

Thus, the additional component of the desired dataset as shown in Table 1 consists of 0.9 fatalities, 28.5 lost time injuries (considered to be comparable to notifiable i.e. serious injuries as per the Maritime NZ sector-based reports) and 73.6 medical recordable injuries (which do not involve any lost work time and are expected to involve only negligible first-aid expenses and therefore are disregarded in further analysis).

Maritime accident numbers

Figure 4 shows the average yearly fatalities and notifiable injuries/illnesses for the NZ Coastal and PAX/non-PAX sectors (based on Figure and taking into account population) plus the additional accidents at ports and harbours attributed to the other three sectors (based on Table G. 1).

Figure G. 4: Average yearly fatalities and notifiable injuries / illness in maritime transport sectors



As well as conducting Maritime Operator Safety System (MOSS) audits, which involves reviewing a maritime operator's risk profile including management of safety risks and harm prevention, Maritime NZ delivered several health and safety and focused inspection campaigns. Maritime NZ also worked with WorkSafe to improve its understanding of stakeholders' duties when operating as Persons Conducting a Business or Undertaking. This will allow Maritime NZ time to review and improve its health and safety arrangements.

Despite the relatively low number of fatalities in the commercial sector in 2018/19, serious harm incidents reported to Maritime NZ increased again in 2019/20. During the year, Maritime NZ was notified of 55 serious harm events, compared with 45 reported in the equivalent period last year. This increase was due to 22 incidents from the Domestic Passenger/Non-Passenger Outdoor Adventure category (an increase of 11 from 2018/19). Maritime NZ is also receiving more notifications than previously, so the 2018/19 year's result may reflect a change in reporting behaviours rather than an increase in incidents.

Domestic Transport Costs and Charges Study

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