Chapter 2

Puerto de Gran Escala (PGE)

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The Government of Chile is developing a national ports development plan. The plan is outlined in this paper and its implications for strategic development of hinterland transport infrastructure capacity are discussed. The paper reviews port capacity and sets out the legal framework for competition between port terminal concessions and the assignment of responsibilities between port authorities and terminal concession holders for investment in new facilities. Forecast demand is compared with projected container terminal capacity and plans for development of a new large container port development, a Puerto de Gran Escala (PGE), are outlined.

1. Ministry of Transport and Telecommunications, Santiago, Chile

Chilean ports overview

Currently, there are 56 ports in Chile. They can be grouped in three categories:

- 10 state-owned, public use ports, distributed along the entire coastline, from Arica near the border with Perú to Puerto Natales and Punta Arenas in the vicinity of Cape Horn.
- 14 privately owned public use ports, with terminals developed by private companies. These ports transfer containers as well as bulk cargos, and are located in the bays of Mejillones (north of the country), Quintero (centre) and Concepción (centre-south).
- 32 privately owned, private use ports. These are terminals developed by private companies whose core business is not port operation (for example, coal power plant operators) or developed by companies under contract to large freight generators (for example, copper mines). Located in a variety of zones along the coast.

Figure 2.1 illustrates the geographic distribution of state-owned ports and the volume and composition of freight handled.

The state-owned sector was modernised in the late 1990s by means of Law 19 542, which divided the large national ports company (Empresa Portuaria de Chile, Emporchi) to create 10 independent port companies (Empresas Portuarias), each with its own board of directors, management, etc. These independent companies have a mandate to ensure efficient port operation and development whilst maintaining a sound financial status. The Law establishes a regulatory framework for freight transfer operations to be carried out by private companies, which can operate under two different regimes:

'Mono-operador': a single concessionaire operates an entire terminal, and

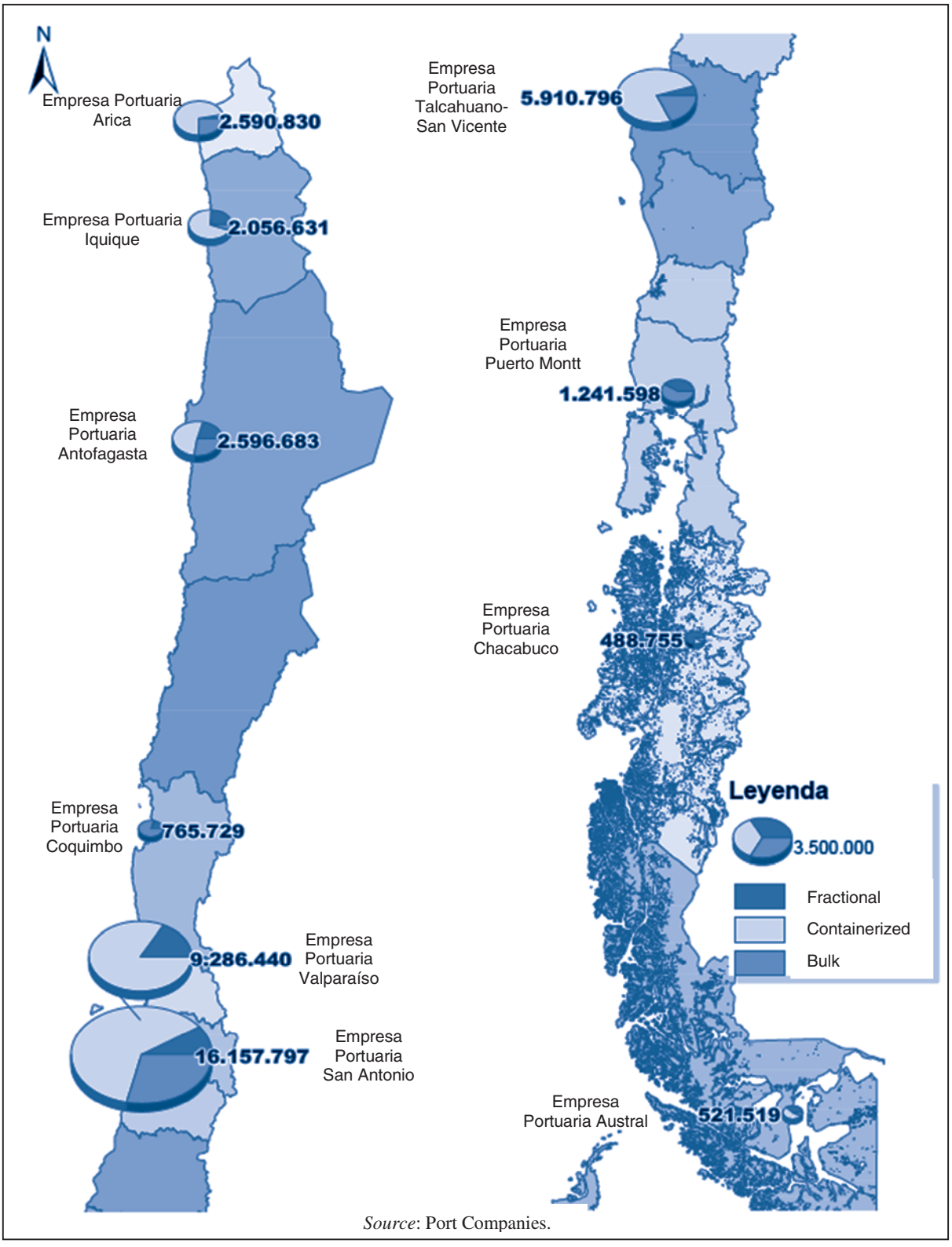
'Multi-operador': multiple agencies operate within a terminal administered by the respective port company.

The Law also establishes a general rule under which new pier infrastructure can only be developed by private companies and through public tendering. Only in the event of an unsuccessful tender can the port company itself invest.

Some of the smaller ports operate without a terminal concession, entirely under the multi-operador regime. Currently, 7 out of the 10 public companies have concessioned terminals under the 'mono-operador' regime, with at least two further companies planning tenders for terminals within the next year or so. Several of the companies in the group of 7 are developing plans to concession second terminals within a similar timeframe.

16 years after the reform of the public ports sector, the Chilean model is considered a largely successful experience, both because of the financial results that public and private companies involved have achieved, and because of the quality of the port facilities, services and rates on offer.

Figure 2.1. **Freight transferred in Chilean state-owned ports (tonne/year)**



Source: Port Companies.

Planning and development in the state ports sector

The Law also mandates that each company maintain an updated 'Master Plan' and 'Referential Investment Schedule' for its continuous and timely development. These instruments typically address issues such as expected demand levels in the respective hinterlands, pier infrastructure and equipment needs. With few exceptions, issues relating to the port's connectivity and the impact of freight movement on the road/railway network are not considered.

A case can be made for this to change. From an operational point of view, a terminal's effective capacity is not only determined by the transport stages that occur within the port boundaries, but also by those upstream: from port gate to linkroads, through the urban road network in the host city, to long-haul trunk roads and railway lines connecting the port with its clients. Efficient and sustainable development of these parts of the freight transport system depends on integration with port development plans and will benefit from engagement of the port companies in broader hinterland development strategies. Contributing to integrated strategic planning will help guarantee the long-term competitiveness of the terminals under their responsibility.

At a higher organisational level, the Law did not create a national ports authority but gave the Ministry of Transport and Telecommunications (MTT) a central role in overseeing, and in some cases powers to approve or reject, specific stages of the independent planning, development and management processes of port companies. Examples of the areas for such intervention are modifications to the physical area where each company has legal responsibility for developing port facilities (known as 'Recinto Portuario'); emitting non-binding opinions on tendering conditions; and setting the board of directors legally-binding yearly management goals (the 'Planes de Gestión Anual', PGAs).

Additionally, the Law sets the responsibility for MTT to propose 'strategic plans' for port development. Although the law does not specify exactly what such plans should cover, the ministry has taken a view that they should address all the aspects that independent port authorities do not have the mandate or incentive to take on themselves, for example with regard to coordination of plans for the long term development of ports which share large portions of hinterland.

Towards a national ports plan

The case for integrated planning, the historical criticism levied at the ministry for its abandonment of its infrastructure planning role in the freight sector in general, as well as other responsibilities that the Law establishes for MTT (e.g. safeguarding mutually beneficial port-city relationships), has guided the ministry in its current drive for developing a national-scale port planning instrument, the National Ports Development Plan (PNDP, by its initials in Spanish).

Work on the PNDP started in 2012, with the following objectives:

1. To complement the independent companies' mid and long term planning:
    - Harmonising company plans, and
    - Including aspects which might so far have been omitted.
2. To ensure the preparation of investment plans for the port system in its entirety, i.e. including:
    - Road and railway solutions, as applicable, within port cities,
    - Road and railway solutions, as applicable, to connect with each port's hinterland, and
    - Logistics support infrastructure, intermodal exchanges, etc.
3. To ensure that state-owned ports play their role as key link in the development of each of the country's regions to the full, catering for the needs of all relevant economic sectors.
4. To ensure the progressive building of local consensus and thus continuity in development plans, clearly identifying stakeholders and responsibilities in pushing forward such development.

The elaboration of the PNDP has been organised into three main stages:

Stage I: Review and critical analysis of current port planning instruments, i.e. port company Master Plans, with regard to four main aspects:

a) Demand forecasts for each freight type expected in the Region in the foreseeable future;

b) Port infrastructure necessary to meet such demand;

c) Coastal space needed for future development; and

d) Identification of road and rail needs.

Stage II: Update and standardisation of long term demand forecasts, modelling of freight distribution between ports with overlapping hinterlands, identification of requirements for coastal space reserves and sheltering works necessary for long term development, and identification of the freight transfer needs that the state-owned port system might not be able to fulfil.

Stage III: Public discussion of the Stage II proposals with regional and national stakeholders and generation of the first formal version of the PNDP.

Stage I was completed in May 2013, with Stages II and III scheduled for the months of October and December, respectively. The design of the PNDP foresees regular updates, the first of which is due in December 2014; these updates should progressively broaden the scope of the development issues covered, moving on from an infrastructure-oriented effort to one which also comprises aspects such as the potential need for improvements to the institutional framework.

Work on the PNDP is being carried out in conjunction with individual port companies under the coordination of the ministry. MTT will also undertake specific components of the analysis and liaise with other state organisations; this, for example, is the case of trunk road analysis in the central region currently being carried out with the Ministry of Public Works.

Puerto de Gran Escala (PGE)

Within the general planning framework set out by the forthcoming PNDP, there is a project that, given the economic importance of the hinterland it will serve and the magnitude of the infrastructure involved, stands out as singular. Its working title is Puerto de Gran Escala or PGE (which can be translated as 'Large Scale Port').

The hinterland of interest is central Chile. It comprises five of the country's Regions[1], including Santiago, the national capital and the major cities of Rancagua, Valparaíso, Viña del Mar, La Serena and Coquimbo. The area is responsible for 60% of national GDP and is home to 66% of the country's population. Among other types of freight, it produces a significant volume of agricultural products for export and generates significant demand for imported retail goods. Most of the freight is transferred in containers, with average traffic in the last three years (2010-2012) totalling 1.9 million TEU/yr.

There are currently two container ports in the Valparaíso Region: San Antonio and Valparaíso. Their location is illustrated in Figure 2.2 overleaf, together with a general view of each.

Both are mainly import/export facilities, with figures of 94% and 98% foreign trade for Valparaiso and San Antonio[2] respectively. The remainder is a mixture of cabotage and freight in transit to/from Argentina. Each port currently has two terminals for freight transfer. Table 2.1 shows the total volume of containers transferred during 2012 by terminal.

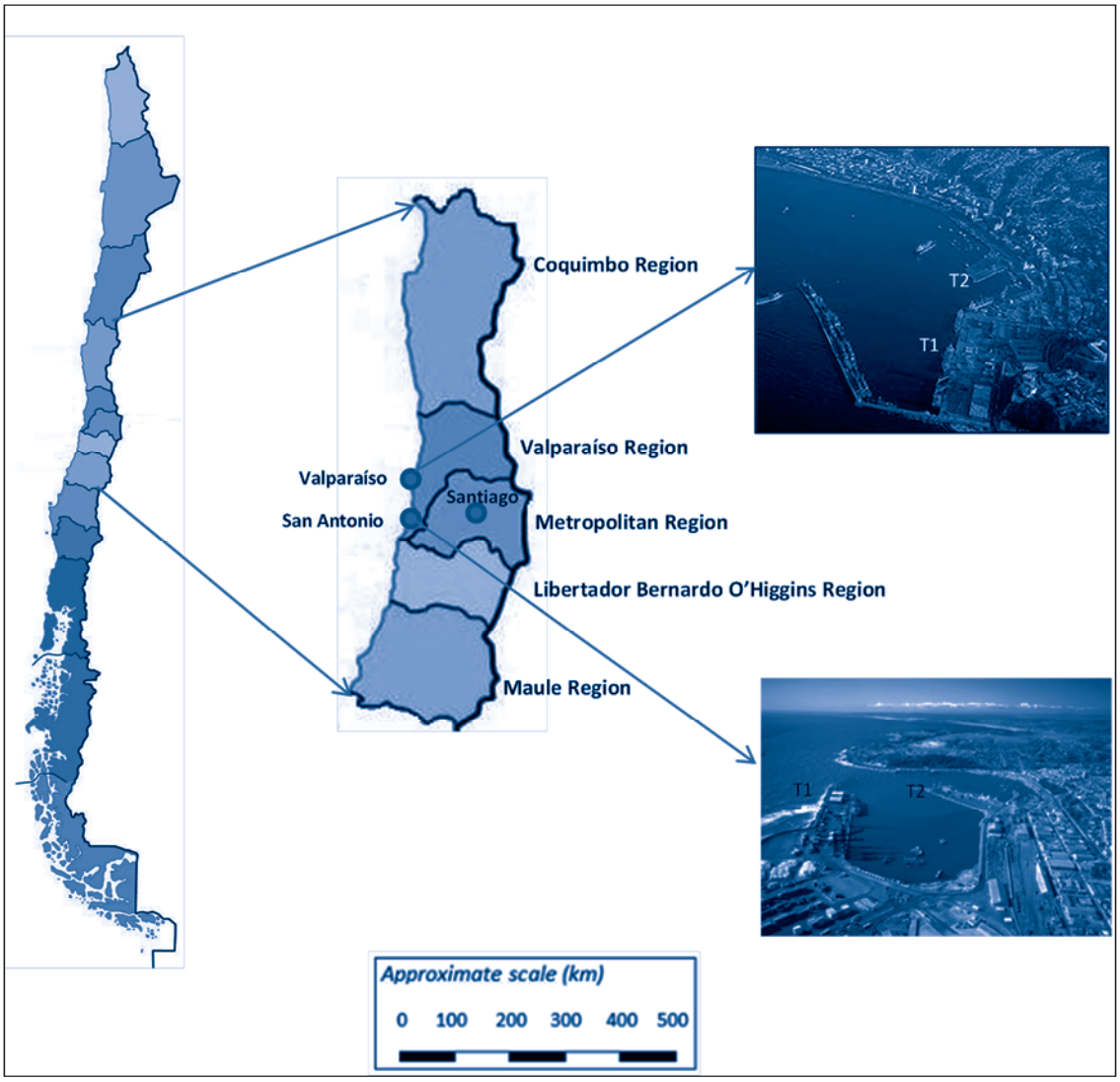
Table 2.1. **Containers transferred in the Valparaiso Region (TEU/year)**

Terminal	2012
Valparaíso Terminal 1	930 174
Valparaíso Terminal 2	12 473
San Antonio Terminal 1	1 067 846
San Antonio Terminal 2	1 425
TEUs transferred in total	2 011 918

Source: Regional statistics provided by EPV for year 2012.

According to the Latin American and Caribbean ranking of container transference (CEPAL 2012), Valparaíso port ranks 15th with San Antonio port in 13th position. If they are considered as a single 'greater port' (both ports being close substitutes catering for largely overlapping hinterlands), they rank 5th, between the ports of Cartagena (Colombia) and Manzanillo (Mexico).

Figure 2.2. **Existing container seaports in central Chile**



Source: Port Companies.

Figure 2.3 illustrates the layout of main roads and railway lines connecting Santiago with the ports in the Valparaiso region.

Figure 2.3. **Trunk roads and railway lines connecting ports located in the Valparaiso region with Santiago**

Source: Ministry of Transport and Telecommunications, Chile.

The main roads connecting the inland with the coastal port cities in the Valparaíso Region are two concessioned motorways, i.e. Routes 68 and 78, both themselves connecting at Santiago with Route 5, the backbone of national north-south connectivity by road. Route 68 connects Santiago with Valparaíso port with 119 km of very good standard two carriage motorway, including two tunnels (Lo Prado and Zapata). Route 78 connects Santiago with San Antonio port over a distance of 110 km, another very good standard two carriage motorway and no tunnels. Two-way Annual Average Daily Traffic[3] (AADT) measured in 2012 on Route 68 (at the Zapata toll, located 59 km from Santiago) was 29 845 pcu/day and on Route 78 (at the Melipilla toll, located 66 km from Santiago) was 15 212 pcu/day.

There are also two railway lines connecting Santiago with the ports in the Valparaiso region. The railway connecting Valparaiso port with Santiago has a length of 187 km, operated by locomotives with a haulage capacity of 1 200 tons, with 15 car trains running 5 convoys per week. This accounts for less than 2% of Valparaiso port's total freight transfer.

In contrast, the railway line that connects San Antonio with Santiago, with a length of 110 km, moved over 710 000 tons in 2012, accounting for 22% of unpackaged freight and 3% of the containers transferred by San Antonio port.

The container transfer capacity currently available in the Region is estimated at 2.3 M TEU/yr., more or less evenly distributed between:

- Terminal 1 in the Port of Valparaíso, operated by concessionaire TPS; and
- Terminal 1 in the Port of San Antonio, operated by concessionaire STI.

The main characteristics of TPS and STI quays are displayed in Table 2:2:

Table 2.2. **TPS and STI quays main characteristics**

	TPS quays Valparaiso					STI quays San Antonio		
QUAY	1	2	3	4	5	1	2	3
Quay length (m)	188.5	200	231.5	230.5	152.2	263	253	253
Total linear length (m)	620			382.7		769		
Draft (m)	13.8	13.8	13.8	9.4	9.4 -8.5	13.50	11.34	11.34
LOA (m)	142	200	229.5	230.5	107.5	363	253	253
Year of investment / improvement	1998-1999	1998-1999	1998-1999	-	-	1995	1995	1995
Dock equipment	5 Gantry cranes + 2 Gottwald cranes			-	-	6 Gantry cranes		
YARD								
Total area (ha)	9.55			5.51		30.4		
Covered area	10 800	-	-	-	-	0.5		

Source: Regional statistics provided by EPV and EPSA for year 2013.

The respective state port companies, Empresa Portuaria San Antonio (EPSA) and Empresa Portuaria Valparaíso (EPV), have successfully tendered their second container terminals in recent times:

In 2011, EPSA awarded the 'Costanera-Espigón' project to the Puerto Central concession; and

In 2013, EPV awarded the 'Terminal 2' project to OHL Concessions.

The Puerto Central and Terminal 2 projects, as they are commonly known, will add a total of 1 500 m of pier length through a total investment of US$ 830 M, increasing the nominal installed capacity in slightly over 2 M TEU/yr. This, plus small increases provided by minor infrastructure improvements to the existing terminals operated by TPS and STI (i.e. approximately 100 m pier extensions), should bring the total capacity in the region to approximately 4.9 M TEU/yr. by 2021.

Demand forecasting

As part of the preparatory work on PGE, in 2011 MTT commissioned a study with the aim among other things of reviewing and updating econometric modelling of demand. The study was finished in May 2012.

Using historical data up to 2010, the analysis sought to explore various model specifications, assess its statistical goodness-of-fit, and recommend a model on which to base further analysis regarding infrastructure needs, cost-benefit appraisal, etc.

The study tested the following explanatory variables, which were selected based on both the availability of historical data and the estimated feasibility of subsequently producing exogenous forecasts with which to forecast freight transfer:

- National and regional GDP (Valparaíso Region)
- GDP by economic sector and Region within hinterland

- GDP of foreign countries and/or economic zones to where Chilean exports are shipped
- Population
- GDP per capita
- Copper exported through the Valparaíso Region.
- Month and quarter dummies to represent seasonality

In terms of model structure, two main variants were tested:

- Linear Model

$$DemTon_{mont\ h,year} = a_0 + \sum_i a_i \times VE_{i,year} + \sum_{mont\ h} a_{mont\ h} \times d_{mont\ h}$$

- Multiplicative Model

$$\ln\left(DemTon_{mont\ h,year}\right) = a_0 + \sum_i a_i \times \ln(VE_{i,year}) + \sum_{mont\ h} a_{mont\ h} \times d_{mont\ h}$$

Where:

$DemTon_{mont\ h,year}$, represents the demand in tons for a specific month of a year

a_i, are the parameters determined by the regression for each variable

$VE_{i,year}$, is the value adopted by the predictor variable i, each year

$d_{mont\ h}$, dummy for the month or quarter

These two structures were used to generate both aggregate container traffic estimates and sector-specific ones (agricultural, copper and iron, wine and others).

Given the information available, several regressions were made considering the different valid combinations between the model structure (linear/multiplicative, month/quarter) and sets of predictor variables. Table 2.3 summarized the results for the three models that delivered a coefficient of determination over 90%.

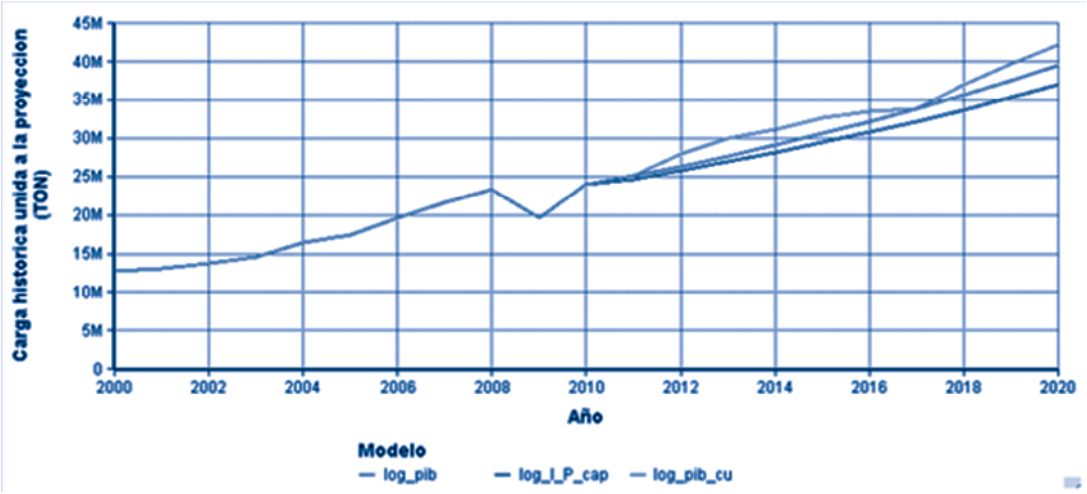
Table 2.3. **Analysed models**[4]

	Intercept Value	GDP Elasticity	GDP_per_Capita Elasticity	Copper Elasticity Region	R2
Model 1	-21.52 (-19.5)	1.98 (32.1)			91.23%
Model 2	10.56 (99.1)		2.68 (31.8)		91.06%
Model 3	-25.64 (-12.9)	1.90 (27.6)		0.4 (2.5)	91.66%

Source: Development of a Port Demand-Capacity Model for the Valparaíso Region", GreenLab for MTT, May 2012.

The demand forecasts arising from these three models are illustrated in Figure 2.4.

Figure 2.4. **Estimates from models 1, 2 and 3 (base: GDP growth 3%)**



Source: Ministry of Transport and Telecommunications, Chile.

Figure 2.4 shows that Model 2 (GDP per capita as predictor variable) produces the lowest estimates, followed by Model 1 (pure GDP) and finally Model 3 (pure GDP & copper production). The non-smooth nature of the latter is explained by step changes in the explanatory variable derived from specific mining projects.

Analysing the demand forecasts for different scenarios, Model 2 turned out to be the one with the least dispersion in the results as shown in Table 2.4. Therefore Model 2 was selected for the following analysis.

Table 2.4. **Results for year 2020**

Scenario	Model 1	Model 2	Model 3
Low growth	33.3 Mton	33.0 MTon	35.7 Mton
Moderate growth	46.9 Mton	41.3 Mton	49.7 Mton
High growth	39.5 Mton	36.9 Mton	42.1 Mton

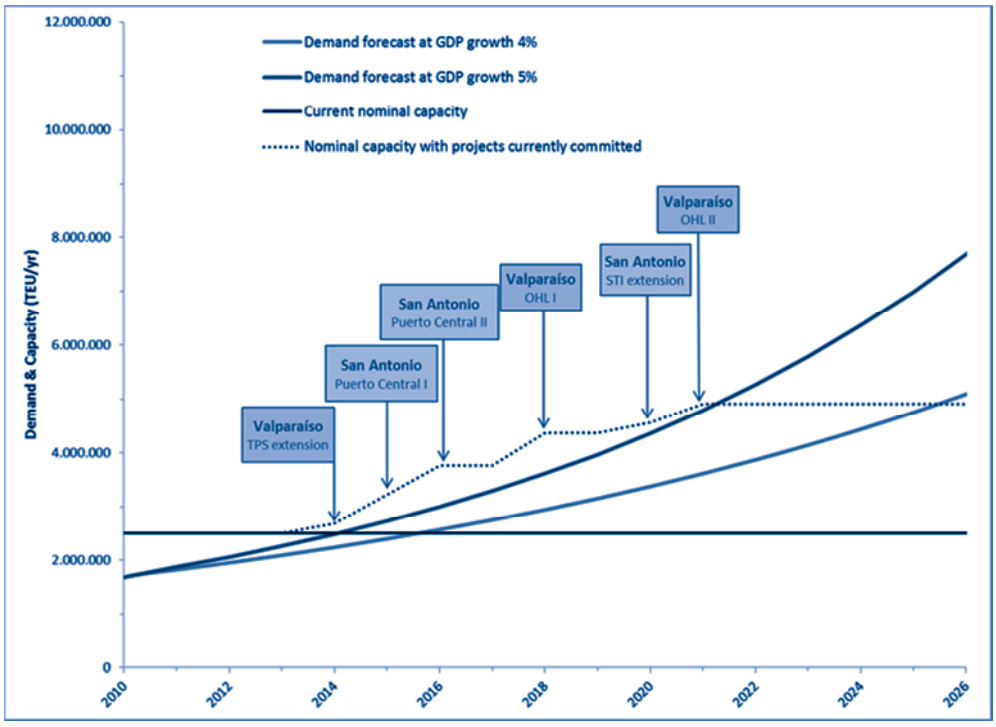
Source: Development of a Port Demand-Capacity Model for the Valparaíso Region, GreenLab for MTT, May 2012.

For the purpose of the policy implications under consideration, it is important to note that, even with these demand estimates, which could be considered to lie on low part of the spectrum, the argument in favour of swift action towards public tendering of new infrastructure seems strong. This is discussed in more detail in the following section.

Balance between demand and capacity

Figure 2.5 illustrates the balance between nominal capacity and projected demand as per Model 2.

Figure 2.5. **Demand and capacity: Existing and projected container terminals in the Valparaíso region**



Source: Ministry of Transport and Telecommunications, Chile.

According to these demand forecasts, at an average GDP growth[5] of 4%, the total nominal capacity in the port system would be exhausted around 2025, whilst at a rate of 5% this would happen in 2021[6]. The elasticity considered for both, blue and red line, was 1.98.

As part of subsequent analysis carried out by MTT in conjunction with EPSA and EPV, the demand estimates shown in Figure no. 5 were again revised; this time, the goal was to do some initial exploration as to the real capacity of the hinterland to generate the freight volumes predicted by the 'black box' of the econometric model. In summary[7], the results are slightly more conservative than those contained in Figure no.5, with a demand forecast lying between the red and blue lines, much closer to the blue one, with GDP growth of 4.5% and elasticity of 1.65. Under this scenario doubling of demand would occur a year later, i.e. while 10 years were needed to double demand in the previous analysis, 11 years are needed in the later analysis.

In any case, the main conclusion of this analysis is that, at some point in the first half of the 2020s, simply as a result of underlying demand growth, it is likely that Central Chile will need additional container transfer capacity.

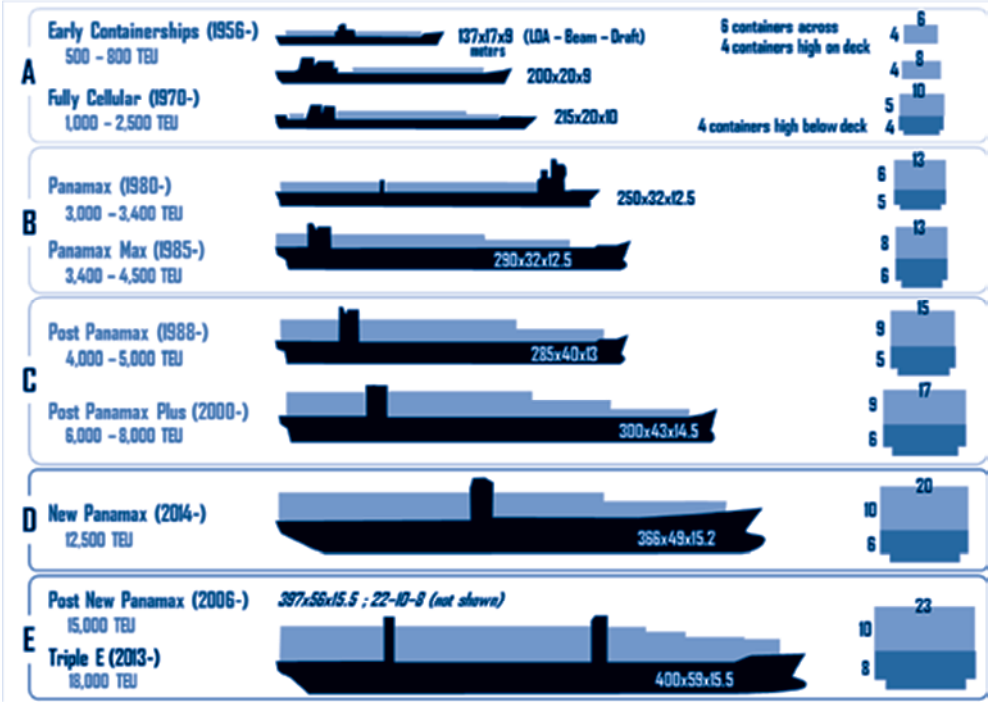
The need to advance rapidly

In the view of MTT, there are at least four main reasons which make advancement on the new PGE project a priority:

- The scale and complexity of issues posed by engineering challenges, environment permit approvals, port-city relationships, etc., imply long time spans between preparation of tenders and inauguration of the first terminals in the new port. This will be the first time since the early 1900s that new breakwaters will be built in the country, so there is no recent experience on a project of this nature, and certainly not within a systematic environmental approval process such as the one in force, introduced two decades ago.
- The fact that existing terminals could face some degree of obsolescence as a result of changes to the merchant fleet serving the region, i.e. the advent of large post-panamax vessels, which may require not only longer dock lengths but also deeper ports as shown in Figure No. 6 (Valparaíso currently has an authorised draft of 11.4 m whilst San Antonio has a draft of 12.4 m – see figure 2.6 for the evolution of container ship drafts).
- The potentially catastrophic consequences that severe port congestion could have on foreign commerce for a country that generates 38% of its GDP from exports (OECD average being 27%; all data from 2011). The exact effects of congestion in the Valparaíso region are uncertain but, for example, could include ships being diverted 500 km south to ports in the Concepción Region (thus imposing on freight the additional cost of longer journeys by heavy goods vehicle) and/or the introduction of 'congestion fees' such as that imposed in Chennai (India) in 2011, where charges between USD 75 and USD 145 per TEU were reported[8].
- The unknown economic and strategic consequences of a potentially significant fraction of Chilean exports being forced to rely on feeder services to Callao (Perú).

In turn, the costs of advancing swiftly are considered comparatively low; approximately US$ 2 M have so far been spent on studies, for a project than could cost as much as US$ 2 750 M, i.e. less than 0.1%. MTT is hence taking what can be considered a prudent stance: in the face of potentially serious consequences for the economy and relatively low costs for 'buying insurance', let us all just move as quickly as possible.

Figure 2.6. **Evolution of new generation container ships**



Source: Ashar and Rodrigue, 2012. All dimensions are in metres. LOA: Length overall.

Work so far

The ministry has actively pursued parallel progress by both port authorities on preparatory studies for public tendering of a single alternative; the choice between alternatives to be made at a later stage, based on the technical evidence produced by such studies. Work began in early 2011 with an analysis, carried out by MTT, to identify potential locations for a PGE-type project within a radius of approximately 150 km to the north and south of the existing ports. This produced three alternative locations.

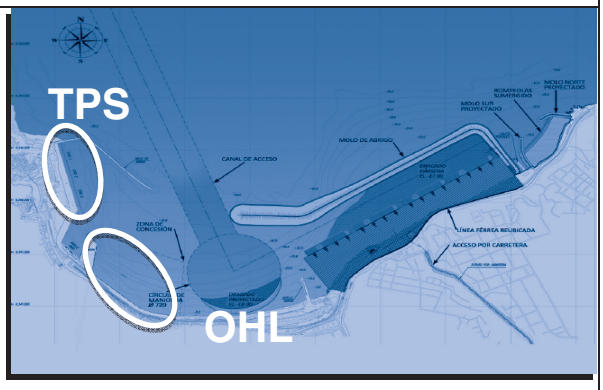
Based on this work, in January 2012, EPV and EPSA were formally commissioned by the Minister to produce by the month of December the first stage of the technical studies necessary for an objective comparison of alternatives. At EPV's request, a fourth alternative was added to the initial three identified by MTT.

In December 2012, studies were presented to the MTT and SEP[9] authorities, including basic engineering, design, cost estimations, road and rail requirements in the port vicinity, preliminary project appraisal and legal analysis. As a result of these analyses of the four potential locations identified, two front-runners appeared: one in San Antonio, located a few hundred meters to the south of the existing terminals, and one in Valparaíso, located approximately 2 km to the north of Terminal 2, in an area commonly known as Yolanda.

PGE profile

To provide an idea of the size and configuration of the project, Figure 2.7 illustrates two of the alternative designs currently being considered.

Figure 2.7. **PGE alternative designs and key figures** (values are indicative, designs preliminary)

San Antonio	Valparaíso
	
Design vessel: post-panamax of 400 m LOA Maximum total dock length: 3 560 m in two fronts Breakwater length: 3 700 m Backup area: 170 ha Nominal capacity: 6 MMTEU/yr. Estimated total investment: US$ 2 750 M	Design vessel: post-panamax of 400 m LOA Maximum total dock length: 1 770 m in one front Breakwater length: 2 300 m Backup area: 44 ha Nominal capacity: 3 M TEU/yr. Estimated total investment: US$1 420 M

Source: Ports of San Antonio and Valparaiso.

In summary, in its maximum size option and final development stage, the project would be equivalent to more than triple the capacity currently installed in the region and triple the investment committed by the two new concessionaires.

Work in 2013 and beyond

During 2013 work is progressing along two complementary lines: one technical (in an engineering/ transport planning sense) and one financial.

The first aims to produce definitive versions of basic engineering and project appraisal (both private and social), whilst the second is looking at the definition of a tendering model suitable for the type of port development that is PGE. This relates to the fact that the project considers providing artificial sheltering infrastructure, principally large breakwaters, which poses a number of questions. Could a 30 year concession provide efficient funding and financing for the breakwater, itself a large and potentially risky expenditure? Would it be it better to jointly tender the breakwater and port terminal, or to do it separately? Would the current bid-winning system, i.e. by lowest composite transfer rate offered (in US$), work well in this case?

In answering such questions, it will be crucial not to introduce distortions into a market which should, at that stage, have four independent operators. This is especially relevant in a scenario in which the government was committed to funding part or all of the breakwater cost.

The goal for 2013 is to finalise these analyses, so that government authorities can make a decision on the definitive location and instruct the selected port authority accordingly. If this is accomplished, an important step will have been taken towards publicly tendering the first terminal of the PGE by 2015. Delay beyond that would pose a serious risk to having the terminal operative in time.

Notes

1 The regions of Coquimbo (no. IV), Valparaíso (V), O'Higgins (VI), Maule (VII) and Metropolitana de Santiago.

2. Basis: tonnage

3. AADT is an indicator used in traffic analysis which measures the level of activity, in vehicles per day, of a given stretch of road. 'pcu' represents 'passenger car unit', an equivalence measure used to characterise a traffic stream composed of various vehicle types, using a common denominator.

4. Values in brackets are the t-statistic.

5. Reference Chilean GDP growth rates were 5.6% in 2012 and 4.5% on average in 2003-2012.

6. Ports in the Valparaíso region are already exhibiting some symptoms of congestion. For example, in 2011, a ratio of waiting time/service time of 16.8% was reported as average for the STI and TPS terminals, 10% being a broad 'best practice' reference figure. This translates into the conclusions drawn from Figure no. 5 being to some extent optimistic: the point where the capacity and demand curves intersect would possibly entail significant degrees of congestion.

7. For brevity a full account of the analysis has been omitted from this document but more details are available on request.

8. For illustration purposes, consider the case of a hypothetical 5 500 TEU ship on the route between Long Beach and Valparaíso, loading/unloading 1 200 TEU in the latter and currently facing total port costs of approximately 74 000 USD. A surcharge of 75 USD/TEU would result in an additional cost of 90 000 USD, thus more than doubling the total port cost of calling at Valparaíso. In the case of a hypothetical post-panamax vessel of 10 000 TEU capacity, assuming a transfer lot of 2 500 TEU, the 75 USD surcharge would result in an additional 187 500 USD per call.

9. The 'Sistema de Empresas Públicas', SEP, is an independent agency that monitors performance of state-owned companies, advises the Treasury on management decisions and sets financial goals for these companies. It is interesting to note that all 10 chilean port authorities have a sustained record of positive financial results.