



**Transportation Study on the Liquid
Bulk Market Segment and the
Panama Canal**

**Estudio del Transporte del Segmento
de Mercado de Graneles Líquidos y el
Canal de Panamá**

Fearnley Consultants A/S

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Resumen Ejecutivo

TRANSPORTATION STUDY ON THE
LIQUID BULK MARKET SEGMENT
AND THE PANAMA CANAL

Prepared for the Panama Canal Authority

by

Fearnley Consultants A/S

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EXECUTIVE SUMMARY

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Principal Methods

In executing the liquid bulk study we have attempted to draw on the Fearnley Group's profound knowledge of and experience in the liquid bulk market. We have applied this knowledge and experience to the task of creating a study where more classic macroeconomic methods are necessarily required in the production of 25-year forecasts of trading volumes by commodity and by area of origin and destination. Our knowledge and experience informed all phases of the project, and were essential to making judgements regarding the effects of such diverse elements as port restrictions, customs of the trade, characteristic behaviour of major players in the various markets, etc. We believe that our familiarity with the liquid bulk business lends a quality and depth to our work, which would be absent in a purely economic analysis.

Main Findings for Each Deliverable

All of the work which we have done on the deliverables listed below was predicated upon the premise that there would not be any lessening of the present Panama Canal's capacity caused either by physical restrictions unforeseen today or any other factor which may reduce the present capacity of the existing Canal, such as problems obtaining sufficient volumes of water to operate the lock systems, etc. Further, we have assumed that traffic will not be so voluminous as to prevent efficient operation and turnaround procedures. In creating our forecasts we have not made any assumptions of capacity or traffic limitations, which may result from the actual transit limitations posed by virtue of the Canal's capacity for traffic. Our findings indicate potential only and the value of this potential in the three cases imposed upon us by the terms of reference.

Further, we point out that all dollar figures in our value forecasts are based upon the toll structure, which went into effect in October of 2002. Even though we have used the tolls announced in October 2002 we have to point out that the pricing of Canal tolls in the future is subject to change, which is unknown to us, and these could alter the results provided by this study.

Determination of Canal's Potential Market

Our reference case sees total Canal transit cargo volumes for the existing Canal increasing over the period by approximately 35 % from 36.7 million tonnes to 49.6 mmt, whereof crude oil, oil products, LPG, LNG and Orimulsion account for the increase in volumes, whilst chemical traffic is expected to decrease slightly during the period.

When broken down by direction, it is expected that total volumes from the Atlantic to the Pacific will increase by about 12 % from 28.2 mmt to 31.7 mmt, whilst volumes in the other direction will more than double during the same interval, from 8.5 mmt to 17.9 mmt.

Our best case shows total transit cargo volumes in both directions for the unexpanded Canal increasing 67 % to 61.3 mmt, whilst in a worst case scenario we see total transit cargo volumes decreasing somewhat before recovering to a level down 3% to 35.5 mmt in 2025. For the expanded Canal we see an increase in transit cargo volumes of all liquid bulk commodities of 64% to 60.2 mmt in the most probable case, up 111% to 77.6 mmt in the best case, and up only 10% to 40.4 mmt in the worst case.

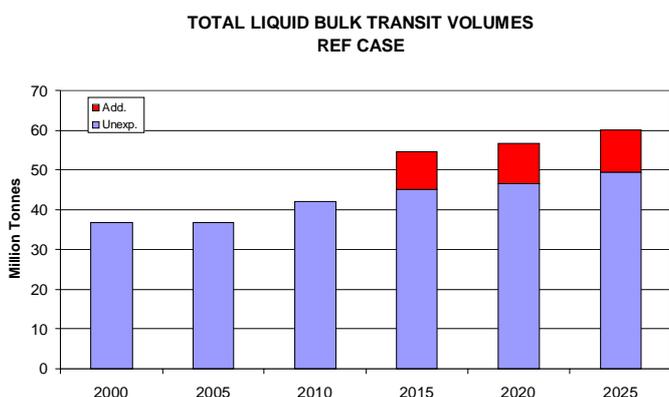
In the reference case for the unexpanded Canal, total transit cargo volumes of the various liquid bulk commodities will develop as follows over the 25-year period: crude oil from 7.2 mmt to 9.4 mmt, oil products from 15.5 mmt to 20.8 mmt, chemicals and vegoil from 12.5 mmt to 12.0 mmt, LPG from 1.2 mmt to 2.5 mmt, LNG from nil to 3.6 mmt, and Orimulsion from 0.2 mmt to 1.4 mmt.

Additional volumes in 2025 from an expanded Canal in the reference case totalling 10.6 mmt will be distributed as follows: crude oil about 1.4 mmt, oil products 3.8 mmt, chemicals nil, LPG 0.3 mmt, LNG 1.9 mmt, and Orimulsion 3.2 mmt.

In examining the Canal's potential market we have also made forecasts of numbers of transits through the Canal both in the case of the present Canal and in the case of an expanded Canal. During the forecast period we estimate that unexpanded Canal laden transits of liquid bulk carriers will increase by 53% from 1620 in the base year to 2475 in 2025. We note that in the reference case for an expanded Canal the number of total laden transits expected in 2025 is not much greater than in the case of the unexpanded Canal (2528). This is because it is expected that larger vessels will place a greater demand on Canal capacity, and even though volumes are expected to increase significantly, this will not be reflected in the number of transits in our reference case. However, in our best case scenario the number of laden transits in an expanded Canal

are expected to increase by 92% to 3105. In the best case scenario 3105 transits corresponds to 8.5 transits per day as compared to 4.5 transits per day in the base year.

Details for the three scenarios (unexpanded and expanded) are given in the Appendix section.



Summary Graphs.xls/Total Volumes

TOTAL LIQUID BULK TRANSIT VOLUMES

Million Tonnes

Year	Ref. Case		Best Case		Worst Case	
	Unexp.	Exp.	Unexp.	Exp.	Unexp.	Exp.
2000	36.7	-	36.7	-	36.7	-
2005	36.8	-	37.9	-	30.5	-
2010	42.0	41.2	45.6	44.6	32.4	32.5
2015	45.1	54.6	52.2	67.0	33.8	38.2
2020	46.6	56.6	55.9	71.5	34.8	39.6
2025	49.6	60.2	61.3	77.6	35.5	40.4

Summary Graphs.xls/Volumes 3Cases

Determination of Economic Values

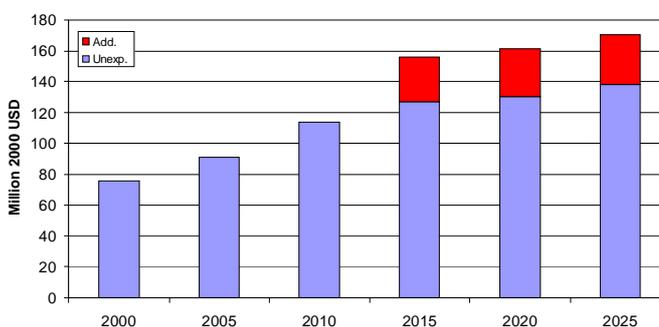
The general volume trends seen in the Canal's potential market are borne out by the figures contained in our determination of the value of Canal routes. In the most probable, or reference, case, calculations of future values of Canal transits based on the tariff structure of October 2002 show that the total value of liquid bulk routes in both directions, including ballast revenue, will increase from about usd 79.5 million to usd 138.1 million during the forecast period for the unexpanded Canal and to usd 170.8 million for the expanded Canal. This means additional income from the Canal expansion of usd 32.7 million in 2025. We observe that the value of routes by commodity increases in every category although only slightly in the case of chemicals. The value of the Atlantic/Pacific direction increases by 47 % from usd 45.4 million to usd 66.7 million for the unexpanded Canal and by 84% to usd 83.4 million for the expanded Canal, whilst the value of

Pacific/Atlantic more than doubles from usd 15.8 million to usd 37.9 million for the unexpanded Canal and usd 45.5 million for the expanded Canal. Estimated revenues from tankers in ballast show an increase from usd 18.3 million to usd 33.5 million in the reference case for the unexpanded Canal and to usd 42 million for the expanded Canal.

In the best case, the total value of routes in both directions plus ballast increases by 119% to usd 174.4 million for the unexpanded Canal and by 184% to usd 226.1 million for the expanded Canal. In the worst case, total revenues from liquid bulk cargo transits plus tankers in ballast will increase by 19% to usd 94.6 million for the unexpanded Canal and by 40% to usd 111 million for the expanded Canal in 2025.

Detailed forecast volumes and value figures by direction of trade and routes for the three scenarios in the case of an unexpanded and an expanded Canal are provided in the Appendix section.

TOTAL LIQUID BULK TRANSIT REVENUES Incl Ballast REF CASE



Summary Graphs.xls//Total Revenues

TOTAL LIQUID BULK TRANSIT REVENUES Incl. Ballast

Year	Ref. Case		Best Case		Worst Case	
	Unexp.	Exp.	Unexp.	Exp.	Unexp.	Exp.
2000	79.5	-	79.5	-	79.5	-
2005	91.4	-	94.1	-	75.1	-
2010	113.8	108.8	127.1	121.5	81.5	82.4
2015	127.0	156.2	151.2	197.8	89.0	103.2
2020	130.3	161.1	161.6	210.9	93.4	109.6
2025	138.1	170.8	174.4	226.1	94.6	111.0

Summary Graphs.xls/Revenues 3Cases

Proposed Marketing Strategy

Our marketing strategy is informed by the provisions of the Neutrality Treaty, which in our opinion, gives the ACP ample opportunity to make changes in its pricing like those already implemented in October 2001, which will make transit fees paid by those who now pay least for transit more like those paid by those who now pay most. Our strategy proposes dividing the liquid bulk segment into sub segments each of which has particular needs and characteristics, which can be exploited by the ACP in order to maximize earnings. Specifically, with regard to crude oil and oil products, we point out that the Canal becomes particularly valuable in a good tanker market but is not very attractive to owners and shippers in a poor tanker market. We, therefore, consider the merits of a pricing system for these tankers, which follows the fluctuations of the tanker market. For Orimulsion, we see that price is all important and suggest providing a discount for guaranteed volumes over a prolonged period in exchange for lower prices. Each of the other market sub segments is treated in a similar manner whereby its particular characteristics are identified and exploited by the strategy.

Traffic, Transit Revenue Flows Forecasts

In our view these items are fully covered in our studies of the Canal's potential market and of the economic value, which provide a full reckoning of the Canal's potential market and of the value of routes through the Panama Canal. This reckoning covers the key Canal variables required by this deliverable.

Risk Analysis

Our risk analysis takes into consideration the three cases set out in the terms of reference, namely, most probable, best and worst cases. In all cases we have taken into consideration what we believe are unique elements of the tanker market, such as economic differences between shipbuilding and shipbuying nations, oil prices, pipeline competition, etc. We believe that these factors will have a strong influence on how events will unfold in the various markets and we use them as an important adjunct to many other, perhaps more standard, economic and political factors, which will influence liquid bulk scenarios. We have also given a number of concrete examples of how scenarios will play out in the various commodity markets.

Analytical Tools

Analytical tools and models are presented with reference to the tasks for which they were used in developing the study. A full description of analytical tools employed in the creation of the study, specifically for forecasting and calculation purposes is to be found in the 'Methodology' section of the chapter entitled 'Trading Volumes/Canal's Potential Market'. There is also a brief chapter in the study entitled 'Analytical Tools' in which the use of these as well as their purpose in the development of the study is explained.

Principal Conclusions

- **The world energy mix is changing, and oil, even though expected to increase in volume, is expected to lose market share to other means of energy generation.**
- **Both oil intensity and energy intensity are declining, the former due to increasing competition from either non-fossil alternatives or because of a greater interest in cleaner burning gas, and the latter due to more efficient use of energy supplies.**
- **Changes in the energy market may not necessarily mean a decrease in volumes through the Canal, but they could mean a change in commodities shipped, i.e. more methanol for fuel cells instead of gasoline for the internal combustion engine.**
- **Due to the size of the present Panama Canal much of the crude oil trade and some of the product trade have developed logistics which avoid the use of the Canal. These logistics, or 'customs of the trade' may be hard to break, even in the case of an expanded Canal.**
- **An expanded Canal will have a strong potential product trade, largely because U.S. refining capacity is expected to flatten out whilst demand for product imports will increase.**
- **An expanded Canal has a strong potential upside for Orimulsion volumes which are aggressively marketed towards the Asian**

market. The downside is that Orimulsion is a very cheap commodity, and even though it is a liquid, it competes with coal in the power generation market. Therefore, in order to be competitive, transportation costs for Orimulsion must look to freight rates in the bulk carrier market. In periods with a strong tanker market and a weak bulk carrier market, this can make the Canal an unattractive alternative in the Orimulsion trade.

- An expanded Canal will have little impact on the volume of chemical trade.
- A strong shift is expected in the direction of the chemical trade through the Canal, with the current dominance of the Atlantic/Pacific trade declining as trade Pacific/Atlantic increases. It is expected that the current ratio of approximately 25 percent Pacific/Atlantic and 75 percent Atlantic/Pacific will even out to about a 50/50 ratio during the period covered by this study. This is largely due to the strong growth in chemical plants expected in the Middle East and Asia and the slowing of growth in this sector in the West.
- LNG projects in Bolivia, Peru and Venezuela could have an important potential for the Panama Canal.
- Liquid bulk volumes through the Panama Canal face a serious threat from the re-activation of the already existing pipeline facility in Panama. This threat will become particularly acute should the pipeline company exercise its option to build an additional pipeline alongside the existing one, which could, for instance, be used to take oil products from the Atlantic to the Pacific side.
- Any Canal marketing strategy must seek to increase the tariffs paid by those vessels which now pay least but which still exploit the same facilities as their larger and higher revenue-producing counterparts.
- Further, a marketing strategy should seek out the different needs and characteristics of each sub sector of the liquid bulk market and seek to exploit these to maximize income.
- Providing a well-managed and relatively competitive bunkering service as well as other carefully selected, correctly priced, and well-run ancillary services will be a factor in attracting more business to the Panama Canal because these enroute services will accentuate the time saving character of the Canal and the 'one-stop-shopping' concept.

Summary Matrix for Case Scenarios

Item	Best Case	Most Probable Case	Worst Case
Economic Assumptions	DRI-WEFA / Fearnley Consultants GDP Base Case adjusted for: OECD + 0.2% pa Non-OECD +0.4%	DRI-WEFA / FCons GDP Base case	DRI-WEFA / FCons GDP Base case adjusted for: OECD -0.4% p.a. Non-OECD -0.8% p.a.
Total Oil See General comments p.75			
Economic growth	High	Neutral	Low
Conservation	Low	Neutral	High
Alternative energy	Low	Neutral	High
Lat. Am. Investment climate	High	Neutral	Low
Crude oil			
US oil production	Low	Neutral	High
Lat. Am oil production	High	Neutral	Low
US refinery capacity	High	Neutral	Low
Lat Am. refinery capacity	Low	Neutral	High
Pipeline use	None	None / Low	High
Oil Products			
US refinery capacity	Low	Neutral	High
Lat Am. refinery capacity	High	Neutral	Low
Pipeline use	None	None / Low	High
LNG - Production	The LNG projects in Bolivia, Peru and Venezuela will be developed and according to current schedule and production is expanded during the period	Venezuela starts up as scheduled, but either Peru or Bolivia face delays in both start-up and expansion of the project.	Venezuela, Peru and Bolivia are developed, but with several years of delays. Limited expansions during the period. Large natural gas reservoirs found near consuming regions (US, Canada and Mexico) and Alaska gas piped to the US
LNG - Consumption	Strong interest in LNG from the U.S.A and Mexico in addition to several Caribbean Islands.	Strong interest in LNG from the U.S.A. and Mexico	Interest in LNG from U.S.A. and some interest from Mexico's Pacific Coast.
LNG - Trade	High degree of LNG trading and projects capable of securing long term agreements on both sides of the Panama Canal. Diversification/security of supply is an important element	A mixture of long term contracts and some trading from Pacific to Atlantic or vice versa.	Balanced markets on both sides of the Americas – limiting long term contract use of the Canal. Limited focus on diversification/ security of supply.
LNG - Cost	Reduced cost of producing and transporting LNG, Increased natural gas prices in consuming areas	Reduced cost of producing LNG, Increased natural gas prices in consuming areas	Falling natural gas prices in consuming areas. Stable production costs. New transport methods for natural gas (CNG/PNG)

Item	Best Case	Most Probable Case	Worst Case
LNG - Competition	High energy prices in general, but LNG still competitive as fuel for power production. Reduction in use of Nuclear power and coal fired power plants	Situation as is today	More use of nuclear fuel and coal, reducing demand for LNG as fuel for power plants
LPG - Production	High production growth from several areas, including Venezuela and Trinidad	Production growth from most areas inline with consumption growth	Production growth on both the Atl & Pacific Side of the Americas creating a balanced market. Limited new LPG production due to delays in LNG projects (LPG being a bi-product of LNG production)
LPG - Consumption	LPG consumption higher than GDP/Industrial production growth figures indicate – Strong demand for LPG from Asia/ Pacific side of the Americas	LPG consumption in line with GDP/Industrial production figures indicate	LPG consumption growth lower than GDP/Industrial production growth, but still positive. Consumption growth stronger in the US Gulf /Mexico region, reducing available cargoes for Canal traffic.
LPG - Trade	Trade increases more than consumption. More ballast transits due to more activity in the region	Trade growth in line with consumption. More ballast transits	More balanced markets in Atl and Pacific, limiting/reducing use of the Canal. Strong demand growth from Brazil/US Gulf. Ballast transit levels at present rate of laden
LPG - Cost	Competitive pricing of LPG.	LPG priced against other energy commodities	“Premium” LPG pricing and LPG losing market shares to LNG and other energy commodities
Ammonia	High level of regional trade as Venezuela and Trinidad increases production with the Pacific side of the Americas increasing their imports	Increases in production and trade, but demand from Pacific side competing with demand from US Gulf	More balanced supply/demand picture on both sides of the Americas, but with more import requirements to the US Gulf, reducing volumes for other markets. Limited ballast trade
Pet.chem	Strong economic growth in Asia and Pacific side of the Americas– increasing the US Gulf – west trade	Pet.chem trade follows general economic development	Increased regional production of pet.chem in Asia, reducing current trade from US Gulf – Asia trade. No ballast trade

Item	Best Case	Most Probable Case	Worst Case
Vegoil	<p>Strongly improved life expectancy</p> <p>Favourable economic growth</p> <p>Declining real term commodity prices</p> <p>No limitations in available land resources</p> <p>Favourable climate development</p> <p>Trade barriers reduced and incentives for the agricultural sector in major producing areas</p> <p>Great advances in biotechnology and widespread acceptance of genetically modified species.</p> <p>The growth rate in trade is set at 110% of the reference case.</p>	<p>Continued increased life expectancy, especially in the underdeveloped countries</p> <p>Reference scenario for economic growth</p> <p>Stable real term development in commodity prices</p> <p>Land resources growing at a pace in line with increasing demand</p> <p>“Normal climate”</p> <p>No major changes in agricultural policies</p> <p>Continued advances in biotechnology</p>	<p>Stagnating life expectancy</p> <p>Adverse economic conditions</p> <p>Rising real term commodity prices</p> <p>Reduced available land resources</p> <p>World climate becoming gradually adverse</p> <p>Agricultural policies restricting land use and trade barriers</p> <p>No major advances in biotechnology, and possibly bans on genetically modified species</p> <p>The growth rate in trade is set at 70% of the reference case</p>
Organic/Inorganic Chemicals	<p>Fuel cell scenario – major boost in demand for methanol following a successful introduction of fuel cells early in the forecast period</p> <p>The preferred fuel is methanol</p> <p>Limited expansion of Middle East and East Asian petrochemical capacity</p> <p>Fairly strong increase in European and U.S. output of petrochemicals</p> <p>Favourable economic conditions.</p> <p>Strong growth in financial markets</p> <p>Generally, world peace with little local/regional unrest</p>	<p>Business as usual scenario.</p> <p>Relative stability of financial markets.</p> <p>Limited growth in Asian output of petrochemicals.</p> <p>Continued, but levelled, growth in European and U.S. output of petrochemicals.</p> <p>Increased imbalance in North American / Latin American product mix.</p> <p>MTBE remains and holds its present position in the fuel market</p>	<p>Strong expansion in East Asian and Middle East petrochemical industries.</p> <p>Adverse economic conditions.</p> <p>Troubled financial markets.</p> <p>Increased environmental awareness in the U.S.A. and Europe, limiting future expansion of the petrochemical industry.</p> <p>Increased domestic demand in the U.S.A. and Europe limiting export potential of chemicals.</p> <p>War & unrest.</p> <p>The use of MTBE will decline following the ban in California. Fuel cells are not developed, or Fuels cells will not run on methanol.</p>

Item	Best Case	Most Probable Case	Worst Case
Methanol	<p>(The Fuel Cell Scenario)</p> <p>Fuel cells are successfully introduced in the market by 2004</p> <p>The preferred fuel is methanol</p> <p>Initially these "zero-emission" vehicles are introduced in the U.S.A. and Europe</p> <p>Future demand for methanol will increase drastically</p>	<p>(The Business-As-Usual Scenario)</p> <p>The use of chemicals continues to grow at GDP rates</p> <p>MTBE remains and holds its present position in the fuel market</p> <p>A "Probable case" GDP growth scenario (see economic development section)</p>	<p>(The MTBE Crash Scenario)</p> <p>The use of MTBE will decline following the ban in California</p> <p>Fuel cells are not being developed or will not run on methanol</p> <p>Worst case economic scenario</p>
Orimulsion	<p>Prolonged periods of a weak tanker market and a strong dry cargo market.</p> <p>Increased interest in Orimulsion if transport cheaper than coal, thus extending the limits of market saturation.</p> <p>Environmental improvements in the product or facilities for burning it allowing entry into the U.S. West Coast and other sensitive markets.</p>	<p>Continuing customer base in the Far East.</p> <p>Few customers in the U.S. market due environmental concerns.</p> <p>Differences between rates in the dry and wet markets will affect Orimulsion transportation because coal is its main competitor.</p> <p>Some Aframax and Suezmax movements through an expanded Canal.</p>	<p>Prolonged periods with a strong tanker market and a weak dry cargo market.</p> <p>Decreased interest due to consistently higher transport costs than coal, thus reducing limit of market saturation.</p>
Other Liquid Bulk Commodities	Limited/No use of the Panama Canal	Limited/No use of the Panama Canal	Limited/No use of the Panama Canal