ENERGY DEMAND AND ASSOCIATED PLANNING FAILURE FOR HANDLING WET BULK CARGOES IN SOUTH AFRICAN PORTS

A Dissertation

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DECLARATION

I, BHEKISIPHO SIBUSISO NDEBELE, declare that

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ABSTRACT

Energy demand has intensified the debate on the capability (or lack of capability) of the South African port infrastructure to handle increasing wet bulk cargo. Coupled with this debate are numerous questions about whether the port system can address the planning failure for wet bulk cargoes associated with such demand and supply. Energy demand consists of demand for gas, crude oil and electricity and other forms of energy, while wet bulk cargo is liquid cargo that is throughput via the port system. This research examines the relationship between increased energy demand and the port infrastructure to process, store and distribute such energy. It will also analyse the impact of liquid energy as strategic stock and how this affects port planning. The relationship between energy demand and port infrastructure is studied because it sheds some light on the debate that has been a subject of discussion for years between port planners and maritime economists.

The research looks at both short-term and long-term demand for energy in order to understand this relationship. In analysing energy demand it is critical that strategies for energy and resource security are examined to reveal how these have changed the traditional role of ports from being mere receivers of goods to being active participants in global logistics supply chains. The supply chains which need to be reformed and planned and which need to change in line with economic needs are also examined (van Niekerk 2002). Additionally, there is a need to look at crude oil versus refined product and how any change in quantities of either crude oil or refined product brought through the port system would possibly influence the region's seaborne trade. This will also necessitate an investigation of how such changes in quantum will affect the demand for port infrastructure.

This study in essence looks at liquid energy as strategic stock and tries to understand how it influences port development. It is also critical to present a narrative of both the changes in energy demand in South Africa and their effect on the planning, development and configuration of ports. Based on the relationship between energy demand and port development, the research attempts to analyse the debate around the economics of port expansion, with particular reference to the current discourse on the expansion of the port of Durban.

The research will show both sides of the argument about the criticality of this move as implied by several authors, including Graham Muller Associates (2009), Mather and Reddy (2008), Bracking (2013) and Maharaj, (2013). Since the research is on port economics, it is therefore imperative to discuss the applicable port tariffs affecting the energy supply chain because they have a bearing on the subject.

There are various reasons why energy demand, the planning failure concerning wet bulk cargoes and the linkage between the South African maritime and energy development need to be researched. First, the maritime sector, which is pivotal to development and has been deeply fragmented and under-resourced, is restricting its potential to play its part as the primary component of South Africa's global competitiveness. Second, the industry has not been competitive and has been underperforming.

This will also help develop and implement an integrated maritime industry that will enhance South Africa's competitiveness in the global economy. In addition, the research will help in positioning the maritime industry as a key enabler to energy development, thus placing the maritime industry as the "10^{th} province" which hosts many industries such as energy development (SAMIC, 2012). This also helps to capture earlier debates on the importance of the maritime sector to energy development and economic growth.

The focus of the study is an analysis of current energy demand and the available infrastructure in South African ports for liquid bulk. The ports covered in the study are Durban, Ngqura, Saldanha Bay, Mossel Bay and Richards Bay. This entails understanding the planning strategy in place to meet any changes in quantities of liquid bulk cargo handled by these ports. Emphasis is placed on the relationship between refining capacities (or lack of refining capacities) and sea-borne commerce, in particular the relationship between fuel demand and berthing space demand for wet bulk cargoes.

The study also poses fundamental questions including the following:

- Will limited capacity and concerns about sufficient capacity growth affect port infrastructure planning and availability, in particular infrastructure for wet bulk?
- Is there a need to build more refineries to address the problem of meeting fuel demand and what are the implications of such a move on the port infrastructure?
- If there is a need to build more refineries, is there a need for more berths because berthing space is constrained?

Together with looking at refining capacities and implications on port infrastructure, there is a need to look at alternatives for the storage of semi-/refined products. This introduces a discussion on locating landside links near port areas.

A further question is whether port planners are considering all these requirements in the South African port planning strategy for the next 30 years.

In particular, the study looks at whether growth in demand for refining capacities will change the port infrastructure and whether our ports are geared to handle such cargo that is, is the port configuration and demand strategy geared for such demand?

The need to build new refining capacities is essential in South Africa but there is also a need for more berths for wet bulk cargoes. Fundamental questions here include, *inter alia*, how to maintain the balance between wet bulk infrastructure and other cargoes, since ports by their nature are supposed to service a variety of clients and whether an increase in energy demand will lead to an increased demand for larger carriers calling into our ports and whether our ports are inclined to handle such bigger vessels?

In the event of increased demand for wet bulk cargo will such a surge in demand justify the required port infrastructure expenditure? All these questions indicate the need for an economic model to assist in exploring the increased liquid bulk demand/berth space relationship, as well as throwing light on who should control that space. Hence, studies such as this one are invaluable.

South Africa's liquid fuels are supplied by an association called SAPIA (South African Petroleum Industry Association) which comprises Sasol (owning two refineries in Sasolburg and Secunda), Engen (one refinery in Durban), BP and Shell (which co-own the SAPREF Refinery in Durban), Total (which co-owns the Sasolburg refinery with Sasol), Chevron (owning a refinery in Cape Town) and PetroSA, which owns a refinery in Mossel Bay.

These refineries also carry stock that is used by Eskom. Literature consulted indicates that an increasing demand for energy, particularly oil and gas, necessitates that port infrastructure is planned accordingly.

A basic research approach has been adopted to achieve this. The purpose of using a specific research methodology was to obtain information from a representative sample of individuals in the ports and energy sectors that would reflect the thinking on the different issues identified by the researcher. This approach employed an in-depth literature review process to gather theoretical data from energy demand policy/economics as well as port planning methodology and systems.

The researcher initially used interviews (structured, semi-structured, telephonic and face-to-face) as a means of gathering data. These data were then verified against textual information. The research used two research methodologies, namely, quantitative and/or qualitative research. Quantitative research is based on meanings derived from the use of numbers and depicted by means of diagrams and statistical comparisons.

Qualitative research is quite the opposite. It is based on meanings expressed through words. Such meanings may be categorised and analysed through the creation of a conceptual framework. The scope of qualitative research includes in-depth interviewing, which is usually conversational rather structured. Since the research is based on case studies, the use of the qualitative method is adopted.

The researcher used both qualitative and quantitative data and questionnaires to extract the views of the respondents. These views are captured and analysed and recommendations are made concerning energy and port development.

Keywords: Energy demand, planning failures, port infrastructure, refining capacities, wet bulk cargoes, strategic stock, infrastructure expenditure, sea-borne trade.

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LIST OF ABBREVIATIONS

BFP	Basic Fuel Price
BUSA	Business Unity South Africa
CALREF	Caltex Refinery
CAPEX	Capital Expenditure
CBM	Calm Buoy Mooring
CPI	Consumer Price Index
CTIA	Cape Town International Airport
CTL	Coal to Liquids
DIA	(OLD) Durban International Airport
DCT	Durban Container Terminal
DoT	Department of Transport
DWT	Deadweight Tonnage
FDM	Freight Demand Model
GDP	Gross Domestic Product
GTL	Gas to Liquid
GRT	Gross Registered Tonnage
IDZ	Industrial Development Zone
IRR	Internal Rate of Return
KL	Kilolitres
LPG	Liquefied Petroleum Gas
LNG	Liquefied Natural Gas
LTPF	Long Term Planning Framework
NPV	Net Present Value
PetroSA	Petroleum Oil & Gas Corporation of South Africa
PCC	Port Consultative Committee
PII	Positive Interest Index
RAB	Regulatory Asset Base
ROD	Regulator's Record of Decision
ROPS	Rail Operations Performance Standards

SAMSA	South African Maritime Safety Authority
SAPIA	South African Petroleum Industry Association
SFF	Strategic Fuel Fund
SBM	Single Buoy Mooring
SPM	Single Point Mooring
TMDS	Transnet's Market Demand Strategy
TNPA	Transnet National Ports Authority
TEU	Twenty-Foot equivalent
TOPS	Terminal Operator Performance Standards
TPT	Transnet Port Terminals
ULCC	Ultra Large Crude Carrier.
UNCTAD	United Nations Conference on Trade and Development
VLCC	Very Large Crude Carriers
VLGC	Very Large Gas Carriers

CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

The research is concerned with the area of study referred to as 'energy demand' and the planning failure, or gaps, for wet bulk cargoes associated with such demand and supply. Energy demand consists of demand for gas, crude oil and electricity and other forms of energy, while wet bulk cargo is the liquid form of cargo that constitutes a significant proportion of traffic via the port system. Throughput is defined as the average quantity of cargo and passengers that can pass through a port from arrival at the port to loading onto a ship or from discharge from a ship to the exit (clearance) from the port complex. Throughput is usually expressed in measurement tons, short tons, or passengers. It should be noted that for the purpose of this research, throughput refers to liquid cargo. The research examines the relationship between increased energy demand and the port infrastructure to process, store and distribute such energy cargoes. It will also analyse the impact of liquid energy as strategic stock and how this affects port planning. The relationship between energy demand and port infrastructure is studied because it sheds some light on the debate that has been ongoing for years among port planners and maritime economists.

In understanding such a relationship, the research investigates both short-term and long-term demand for energy. In analysing energy demand it is critical that strategies for energy and resource security are examined to reveal how these have changed the traditional role of ports from being mere receivers of goods to being active participants in global logistics supply chains that need to be reformed and planned and to change in line with economic needs (van Niekerk, 2002).

There is also a need to look at crude oil versus refined product and how any change in quantities of either crude oil or refined product brought through the port system might influence the region's seaborne trade. This also necessitates research into how such changes in quantum will affect the demand for port infrastructure.

This research attempts to give a narrative both of changes in energy demand and supply in South Africa and their effect on port planning, development and configuration of ports. Based on the relationship between energy demand and port development, the research attempts to give an analysis of the heated debate around the economics of ports expansion, with particular reference to the current debate on the expansion of the port of Durban. Both sides of the argument about the criticality of this move will be presented as noted by several authors, including Bracking (2013), Graham Muller Associates (2009), Maharaj (2013) and Mather and Reddy (2008). The study will also discuss the applicable port tariffs affecting the energy supply chain.

There are various reasons why energy demand, the planning failure for wet bulk cargoes and the linkage between South African maritime and energy development need to be researched. First, the maritime sector, which is pivotal to development, has been deeply fragmented and under-resourced and this is restricting its potential to play its part as the primary component of South Africa's global competitiveness. Second, the industry has not been competitive and has been underperforming. Third, liquid fuels account for 34% of final energy consumption in South Africa (DOE, 2009). In addition, South Africa has limited crude oil resources and thus imports most of the crude oil needed for liquid fuels production in the refineries that supply some two-thirds of liquid fuels needs. The remaining third is manufactured from coal (CTL) and a small and decreasing proportion is manufactured from natural gas (GTL). These issues were discussed at the Inaugural South Africa Maritime Industry Conference in July 2012 on the theme of 'Delivering on South Africa's Maritime Agenda – A Call for Action' (SAMSA, 2012).

This conference provided a platform for dialogue with public and private sector role players to share information as to discuss how to advance the maritime agenda as an economic sector of note, the need for the different sub-sectors of the maritime industry and government to work together to seek common solutions and to take note that the country's economy is driven by the availability of affordable energy and a viable port infrastructure to service such demand. Yet the problems inherent in energy demand and the associated planning failures for wet bulk cargoes still persist.

This research therefore attempts to broaden the scope of the discussion aimed at addressing the issues surrounding energy demand and the maritime industry in South Africa.

This would also help develop and implement an integrated maritime industry that will enhance South Africa's competitiveness in the global economy. In addition, the research may help in positioning the maritime industry as a key enabler in energy development, placing the maritime industry as the '10th Province' which hosts many industries, such as energy development (SAMSA, 2012). The study also captures earlier debates on the importance of the maritime sector to energy development and economic growth.

Debate on energy demand and supply is critical in this dynamic era of the African Renaissance (State of the Nation Address, Mbeki, 2004). According to the World Energy Council (2003), the debate on energy demand enhances the points that were deliberated at the World Summit on Sustainable Development hosted by South Africa in 2002 (World Energy Council, 2003). This was supported by Mbeki (2004) when he posited that the resolve of the debate on energy demand will see South Africa rethink its renewable energy to take its rightful place in the energy sector and to play a significant role in contributing towards sustainable development. It is because of this view and associated views that the whole issue of ports and energy is researched.

Skinner (2006) asserted that with rising energy prices and limited refining capacities, South Africa needs to define strategies of harnessing liquid energy that are not divorced from port infrastructure planning, because port costs play a significant role in ensuring energy supply and determining the costs that are borne by the consumer.

Furthermore, according to the liquid fuels industry, local refineries have been running at maximum capacity and increasing demand has to be met by imports (BP, 2007). This has reduced the security of the liquid fuels supply to the South African economy and to consumers and undermines energy security in the entire system. These views are supported by van Niekerk (2002), who argued that the complexities of the existing legislation on ports need to be resolved. The argument is that port reform is necessary in South Africa but such reform should ensure the competitiveness of our port system, encourage the completion of port restructuring and enhance global supply chains (van Niekerk and Fourie, 2002).

This rationalisation should ensure that planning inefficiencies are eliminated and bureaucratic intervention and breakdown of trade barriers, which hamper decision making, are relegated to the past. The argument presented here is that port planning should incorporate various aspects, for example, energy planning, planning for other commodities and aligning such planning with changing trade patterns. It should also incorporate the views of the users in order to extract and develop value (van Niekerk, 2002); hence the need for continuous research in this field of study.

Moreover, South Africa has provided an orderly process of liberalisation, which would allow an increased participation of black empowerment companies to consolidate their positions within this industry. This liberalisation is set to increase energy supply in the market but it is not clear whether there is commensurate port infrastructure to support such supply and whether the Transnet National Ports Authority (TNPA) is ready for such potential expansion in the liquid fuels market. There is also a need to examine how the TNPA intends financing such projects. If the answer is that it intends doing so through its capital budget fund, the question is how the recovery cost will be achieved, given the fact that the current multi-year tariff proposal by the TNPA does not address this. The authority proposed a multi-year tariff approach from financial years 2014/5 to 2018/19 (TNPA, 2012:32). The multi-year pricing methodology was submitted by TNPA in September 2012 for approval by the Ports Regulator. The proposed multi-year tariff methodology addressed the financial sustainability of the Authority and Transnet, taking due cognisance of the critical years of Transnet's Market Demand Strategy. It was considered that it would also provide certainty on all stakeholders. This meant that there would be reduced regulatory effect all affected parties; provide certainty to the funders of the Authority; and allow customers to plan their business accordingly during the control period (TNPA, 2014: 2-5).

The commercial realities and heavy demands on our limited fiscus dictate that our initial ventures into renewable energy should be accelerated. This means that any future infrastructure planning should focus on liquid fuels (DOE, 2013: Staatskoerant). This calls for the focus not only to be left to the Department of Energy, but it should be a joint effort by all stakeholders, including

Transnet National Ports Authority, the Department of Energy, the National Department of Transport, the oil majors and the Planning Commission (Integrated Energy Report, 2012).

With the Euro 4 fuel standards and the Cleaner Fuels Act coming into effect in 2017, there is a need to focus on liquid fuels in order to move away from coal-based energy (DOE, 2011, Petroleum and Fuels Charter, Final Audit). The vast potential for growth within Southern Africa necessitates strategic thinking and integrated planning. Accordingly, the need to reduce the cost of business in the economy over time through the provision of infrastructure ahead of demand is critical. Moreover, an average growth of GDP by 8% between 1985 and 2010 shows that demand for berthing services has also increased drastically.

In addition, container traffic has grown to leverage vital trade routes between Africa, Europe, Asia, Australia and South Africa, necessitating the need to plan ports accordingly. South African ports, like other African ports, have also seen an increase in container traffic as a result of the expansion of world trade and rapid economic growth in the developing world. This has resulted in a concentration on facilities for container handling, including transhipment hub capacity, leading to a relative neglect of facilities for wet bulk (Beare, 2008; AICD report, 2009).

Furthermore, it is critical to shift from an initial pattern of scattered and poorly-coordinated ports along the coastline to a concentrated mega-gateway port designed to service highly-densified trade routes as well as domestic and regional freight corridors, whilst concentrating industrial activities according to commodity demand. Therefore it becomes imperative that port users, together with the port authority, balance the conflicting demand between containers and energy cargoes. Generally, there has been an ever-broadening of the scope of the debate on the energy demand and the associated port planning problems. However, the debate has not as yet produced stopgap solutions let alone a sustained strategic response to the constantly expanding demand for crude oil and various refined products and the implications that this has on the economic planning of ports. Therefore it becomes essential to conduct research on energy demand in South Africa emphasising the relationship between increased energy demand and the need to expand the ports for the ultimate processing, storage and distribution of crude oil and its products.

1.2 THE PROBLEM AND ITS ENVIRONMENT

Energy demand and supply in South Africa has been associated with many changes, which have in one way or the other impacted on port planning, development and configuration. Increased energy demand and supply in the country has opened the debate on whether the port system is adequately prepared to handle increasing liquid cargoes.

This has generated an intense debate on the economics of port planning and expansion, but there is still no immediate solution to the planning failures. Therefore, this dissertation probes fundamental questions, which are in themselves based on broad themes or issues on energy demand and the planning failure, or gaps, for wet bulk cargoes associated with the demand for energy. In probing such questions, the researcher examines the relationship between increased energy demand, supply and the associated port infrastructure, as well as analysing the impact of liquid bulk cargoes on port planning. In doing so, the research also looks at energy planning, capacity and port readiness. Examining this relationship and analysing the impact thereof helps to better understand the problems inherent in the energy and the maritime industries. The broad themes which are presented as the research results in Chapter Five could be outlined as follows:

- Energy planning capacity and port readiness – South Africa's port infrastructure for wet bulk cargoes and the refining capacities that are reaching elastic limits. Liquid energy as strategic stock and how it affects port infrastructure planning and development.
- The limited berthing space for wet bulk cargoes and the possible expansion of berthing space for these cargoes.
- The implications of the lack of refining capacities on the port infrastructure.
- The current liquid energy demand and maritime infrastructure growth.
- South African port tariffs and liquid fuels demand.
- The likely impact of the demand for Liquefied Natural Gas (LNG) on crude import and port infrastructure.

1.3 RESEARCH QUESTION

The central theme of this research study is energy demand and the planning failure, or gaps, for wet bulk cargoes associated with such demand and supply. Arising from this central theme are the more specific sub-themes of examining the relationship between increased energy demand and the port infrastructure to process, store and distribute this energy as well as the analysis of the impact of increased liquid energy demand on port planning. Through these two sub-themes underpinning the study, the research project attempts to answer the following questions:

- To what extent will the need to expand refining capacities have an impact on port infrastructure to handle liquid bulk, break-bulk, dry bulk and general cargo?
- Has the TNPA demonstrated that they have a plan to match increasing energy demand with the required infrastructure to handle liquid bulk cargo?

Bulk cargo refers to cargo not in packages or containers that is shipped loose in the hold of a ship without mark and count. Break bulk cargo refers to generally palletised and skiptainer cargoes and minerals and agricultural products. Dry bulk cargo is normally coal, iron-ore, dedicated woodchip and manganese.

1.4 SUB-RESEARCH QUESTIONS

There are two sub-research questions addressed by the research project. These are:

- What is the impact of LNG as feedstock in refineries on the port infrastructure? This question encompasses how this changes the demand for berthing space for liquid cargo.
- What is the impact of port tariffs on liquid fuels demand and supply and provision of port infrastructure for wet bulk?

1.5 NATURE OF THE STUDY

The study focuses on an analysis of the current energy demand and the available infrastructure in South African ports for liquid bulk. The ports covered in the study are the ports of Durban, Ngqura, Saldanha Bay, Mossel Bay and Richards Bay. This entails understanding the planning strategy in place to meet any changes in quantities of liquid bulk cargo handled by these ports. There is particular focus on the relationship between refining capacities and seaborne commerce, especially the relationship between fuel demand and berthing space demand for wet bulk cargoes.

The research study also poses fundamental questions including the following:

- How have ports prepared for the provision of infrastructure for wet bulk, given limited refining capacity?
- Is there a need to build more refineries to address the problem of meeting fuel demand and what is the implication of such a move for the port infrastructure?
- If there is a need to build more refineries, is there a need for more berths because berthing space is constrained?

Together with investigating refining capacities and the implications on port infrastructure, there is a need to look at alternatives for the storage of semi-refined products. This introduces a discussion on having landside links near port areas.

A further question is whether port planners are considering all these requirements in the South African port planning strategy for the next thirty years; in particular, how the continued decline in refining capacities will change the port infrastructure and whether our ports have enough capacity to handle increased import volumes.

The drive to build new refining capacities is essential in South Africa but there is also a need for more berths for wet bulk cargoes. Fundamental questions here include, *inter alia,* how to maintain the balance between wet bulk infrastructure and other cargoes, since ports by their nature are supposed to service a variety of clients. A further question is whether an increase in energy demand will lead to an increased demand for larger carriers calling into our ports; and if our port equipment is able to handle the bigger vessels? Also, in the event of increased demand for wet bulk cargo will such a surge in demand justify the required port infrastructure expenditure? All these questions point to the need for an economic model to assist in exploring the increased liquid bulk demand/berth space relationship, as well as clarifying who should control that space. Hence, studies such as this one are inevitable.

1.6 FUEL SUPPLY AND DEMAND IN THE SOUTH AFRICAN CONTEXT

This section presents the fuel supply and demand in the South African context and is critical in understanding what volumes are produced. This will also help understand the infrastructure requirements to plan for such cargoes**.** South Africa accounts for 28% of the sub-Saharan Africa refined market and 53% of total oil consumption (Trollip, 1996). This figure includes the privately-operated liquid bulk terminals located in each port. The strategic crude stock held by South Africa has fallen dramatically since 1993, resulting in refineries holding an equivalent of 10 days' worth of stock if they are operating at maximum capacity (DOE, 2009). There are also about 10 million barrels of crude oil kept by the Strategic Fuel Fund as strategic stocks that would cover one month of imports at 20bn bl/year (DOE, 2012f). The refining capacities for liquid fuels between 1992 and 2014 are shown in Table 1.1. The declining refining capacities by the refineries shown in Table 1.1 are explained by the fact that most of the infrastructure in these refineries is old, with most having been built in the sixties and currently operating at less full capacity. This has had a net effect on the vessels carrying refined product calling at the port. Surely a reduction in refining capacity also lead to an increase in vessel arrivals to land additional volumes of refined products at the relevant discharge facilities. Refined products are carried by smaller and medium- sized product tankers that can be accommodated at these discharge facilities.

The imported crude oil is refined at South Africa's four crude oil refineries. Total volumes of liquid products are forecast to grow from 22 million cubic metres to 48 million cubic metres in the period 2018-2030. The supply of petroleum products falls under the oversight of the South African Petroleum Industry Association (SAPIA), formed in July 1994, although some members have been supplying products since the sixties. SAPIA members are responsible for refining, distribution and marketing of petroleum products. SAPIA has seven members (Sasol, NATREF, Engen, Caltex/Chevron, SAPREF, PetroSA and Total), each of which contribute to the fuel supply in South Africa. Sasol contributes about 30% of South Africa's liquid fuels requirement. SAPIA has historically imported approximately 1,50 million tonnes of crude oil from Iran and 8,4 million tonnes from Saudi Arabia in (2012); 3,35 million tonnes from Angola and 4,31 million tonnes from Nigeria in 2012 (SAPIA, 2009b: 34 and DME, 2009).

Table 1:1 South Africa's oil refining capacity (barrels per day) from 1992 to 2008

Refinery	1992	1997	2007	2008	2014
SAPREF	120 000	165 000	180 000	180 000	125 000
ENREF	70 000	105 000	125 000	125 000	122 000
CHEVREF	50 000	100 000	100 000	100 000	110 000
NATREF	78 000	86 000	108 000	92 000	108 500
Total crude oil refining capacity (bbl/d)	318 000	456 000	513 000	497 000	465 500
Sasol	150 000	150 000	150 000	150 000	125 000
PetroSA	45 000	45 000	45 000	45 000	36 000
Total crude oil refining capacity (bbl/d)	195 000	195 000	195 000	195 000	161 000
Total refining capacity	513 000	651 000	708 000	692 000	626 500

Source: Adapted from SAPIA, 2009: 9 & Mullins et al., 2014

The decline in refining capacity from 2007 to 2008 was due to NATREF downscaling for clean fuels and in 2008 for the required electricity consumption reduction and the decline in PetroSA production is a result of falling gas reserves at their production platform offshore in Mossel Bay (PetroSA, 2014; SAPIA, 2014). Although PetroSA embarked on Project Ikhwezi in 2011, the anticipated offshore gas volumes have not yet started to flow as yet to enable the state owned refinery to produce to its maximum. These refineries also carry stock that is used by Eskom.

1.6.1 Crude oil imports

South Africa has small oil reserves and only modest gas reserves (SAPIA, 2014: 35) and all these reserves are offshore in fields off the west and south coasts. The Oribi/Oryx fields supply enough crude for about 2% of South Africa's liquid fuel requirements, while the Sable field will supply enough for a further 7% to 10% (South African Energy Synopsis, 2010). From the 1950s, for political and economic reasons, the South African government began a programme to reduce dependence on crude oil imports by making liquid fuels from abundant coal resources and gas reserves. The idea resulted in the birth of synthetic fuel plants of Mossgas and Sasol, which together supply about 38% of the final liquid demand and the rest is refined from imported crude (SAPIA 2014: 35).

Petroleum and other liquids production and consumption in South Africa between 2004 to 2013 show a decrease in production from 250 000 barrels per day in 2004 to less than 200 000 barrels per day in 2013, while consumption shows an increase from 500 000 bbl/d in 2004, hitting 550 000 bbl/d in 2007 and declining between 2007 and mid-2011, but slowly rising above 600 000 bbl/d in 2012 (SAPIA, 2014). This huge difference between production and consumption increased net imports of crude and other liquids from 250 000 bbl/d in 2004 to 410 000bbl/d in 2013. The increase in net imports was facilitated by the successful supply of fuel products during the FIFA World Cup in 2010 because the Competition Commission granted SAPIA, its members and affiliated companies and subsidiaries exemption covering all categories of agreements or practices in the petroleum industry until 31 August 2010.

Liquid fuels account for the largest share, at 34%, of final energy consumption in South Africa and make the country account for 28% of the sub-Saharan Africa refined market and 53% of total oil consumption (Trollip, 1996). This figure includes the privately-operated liquid bulk terminals located in each port (DOE, 2009, citing Trollip, 1996). The country has minimal crude oil resources and thus imports most of the crude oil needed for liquid fuels production in South African refineries, which supply some two-thirds of the liquid fuels needs with the remaining third manufactured from coal (CTL) and a small and decreasing proportion manufactured from natural gas (GTL). Demand exceeded domestic liquid fuels manufacturing (crude refining and CTL) capacity some years ago (Trollip, 1996). Local refineries have been running at maximum capacity and increasing demand is met by imports. This has decreased the security of liquid fuels supply to the South African economy and consumers and undermines energy security in the entire system (Trollip, *et al.*, 2014).

This situation has evolved over the last 20 years or so through poor governance of the sector and is further compounded by low strategic crude oil stocks. The other concern is that this shortage of crude oil stocks means that the country needs to increase its oil imports thereby overburdening the port system which cannot cope with current volumes (Trollip, 1996).
Literature consulted indicates that an increasing demand for energy, particularly oil and gas, necessitates that port infrastructure is planned accordingly. The literature further points out that this relative neglect of ports, particularly in sub-Saharan Africa, is exacerbated by the fact that ports are generally poorly equipped and operate at low levels of productivity (AICD report, 2009). Few of these ports are capable of handling the largest current generation of ships and they are generally unprepared for the dramatic changes in trade and shipping patterns (Beare, 2008).

As for the South African ports, the infrastructure, which was built in the 1960s, is aging. With increasing cargo volumes handled, the infrastructure has remained largely unchanged. This presents a whole new reason to re-examine port infrastructure demand and to reassess requirements based on changes on policy, shifts in economics and demand changes.

The study is also critical because South Africa, like the rest of the world, is looking at LNG as feedstock and as an energy source in addressing energy demand. This has an impact on global demand and supply and is bound to affect physical port planning and pricing. The growth of LNG demand to an estimated 350 million metric tonnes (mta) per year by 2025 (The Economist, Golden Rules for a Golden Age of Gas, June 2012), will see a massive alteration of port infrastructure and is likely to bring Very Large Gas Carriers (VLGCs) and Suezmax tankers to our ports. This is likely also to erode the capital infrastructure budget for the TNPA because new facilities will be required to handle large vessels coming into South African ports (Molefe, 2011).

Further questions asked by port authorities and other stakeholders that are critical for upstream and downstream logistics development, are whether the new demand growth for LNG, (estimated at 5% per year (IGU, 2012) and said to be motivated by politically charged themes underpinned by national energy security demand and supply requirements) will mean new pricing for wet bulk infrastructure. This new demand growth is aimed at ensuring supply diversity and flexibility and is driven by economic events in Asia. Currently, port infrastructure in South Africa, as in any developing country, is strained. This is compounded by huge increases in container traffic, pushing development of wet bulk infrastructure into the background.

The other question to be addressed is that, with the estimated world demand for LNG set to be over 5% till 2020, (IGU, 2012) there is a need for increased port infrastructure to cater for such demand. This is exacerbated by the fact that investment in global port infrastructure, which has generally lagged demand, has led to congestion and delays at major ports. These delays have a major knock-on effect of increasing demurrage costs, incurring higher fuel costs caused by the delays as well as having to account for re-adjusted schedules.

It is also important to consider the Energy Security Master Plan, as approved by cabinet in September 2007 and the Draft Strategic Stocks Petroleum Implementation Plan, 2013. These seek to facilitate making well-informed choices in respect of energy supply, energy carriers, demand sectors strategies as well as energy transformation approaches whilst being cognisant of the need to minimise negative impacts on the environment and economy (DME, 2007a; DOE, 2013a).

The short-term plan must also be considered. The Master Plan focuses on developing supply chain solutions to South Africa's liquid fuels supply challenges, management of liquid fuels demand and emergency response tactics. The Plan created a platform to integrate energy planning with port development (DME 2003; DME 2007a).The medium- to long-term approach is broader and begins to integrate supply, demand, macroeconomics, geopolitics and climate change.

The energy strategy lists thirteen options in the discussion of energy. These include, but are not limited to:

- integrating climate change in energy planning,
- alignment of fuels specification at least to those countries that trade with South Africa,

- procurement of at least 30% of crude consumed in South Africa through PetroSA,
- the need for some co-ordinated planning of infrastructure investment by linking energy projects with port development initiatives and
- remedying the challenges experienced in ports in order to allow optimum utilisation of petroleum handling facilities (Moerane, 2006; DME, 2007a).

1.7 PORTS' OPERATIONAL IMPROVEMENTS AND ENERGY DEMAND

It is also critical that the research discusses ports' operational requirements in a bid to link this with energy demand. Port operations are an integral part of the petroleum products logistical value chain (DOE, 2007a: 39).

The emphasis on port development initiatives seeks to understand the handling capacity of liquid bulk cargoes in various South African ports. For example, the port of Durban is used by a number of oil companies to ship finished products to markets in other parts of South Africa via coastal shipping or to the inland markets via pipelines, road or rail.

According to the study conducted by the TNPA in 2006, Durban port had enough capacity for liquid bulk but by 2010 this picture had changed, given the increasing liquid cargo volumes imported through the port of Durban. The study further shows the Durban port capacity profile, revealing that there is growth potential from 5000 vessels per year in 2006 to approximately 12000 by 2024 (DME, 2007a: 40) and that crude oil imports handled rose from 19,98 million kilolitres in 2011 to over 26,3 million kilolitres in 2012. The growth of vessel numbers is mainly due to imports coming into Durban port. Such an increase in terms of both the volume of cargo and the number of vessels has had implications for the Durban port facilities: this has since generated an intense debate as previously implied.

The results of the investigation by Moerane (2006) showed that there were challenges that created constraints within the harbour for the movement of petroleum products, namely:

- Long queuing times outside the harbour for petroleum ships that result in disruptions to the services of the terminal and the inadequacy of its access roads.
- Inadequate offloading and loading equipment (owned by oil companies) falls short of global best practice, causing delays in vessel handling and discharge, thus affecting port throughput (AICD Report, 2009).

The link between port planning and energy development looks beyond simple port engineering. This is supported by literature, which shows that no planning is complete without analysing demand for commodities and this is always related to port economics (Petit and Beresford 2009). It should be noted that although port engineering is mentioned, there will be no discussion of the subject in this dissertation. There is also a need to understand the maritime sector as a key industry in facilitating economic growth in South Africa.

An understanding of the maritime sector will assist government, port authorities and the public to understand infrastructure needs in ports and will assist private and public bodies to engage in a national debate on energy and minerals. This was missing from the debate on shipping that is a significant part of the value chain (Mokhele, 2013). This will further help reflect on how investment is linked with access to the markets: there is a gap requiring R300 billion in investments to support the maritime sector (Mokhele, 2013).

Although the refining capacities, storage and distribution networks in South Africa are currently utilised to full capacity (Adendorf *et al.,* 2012), there is nonetheless a need to expand current infrastructure facilities to handle the increasing volumes of crude oil imports. For example, the port of Durban handles about 75% of the country's crude oil and 40% of refined products and it is also utilised to its full capacity (AICD, 2009). One of the compounding problems with the limited storage of fuels that warrant this study is the fact that transport capacity available for distributing such products is insufficient (Adendorf *et al.,* 2012). The shortage of storage facilities in ports adds a constraint militating against adequate supply by the supply chain. Also, with transport rates higher, and transport routes longer, there is a need to look for an alternative. The alternative is to develop berthing facilities in ports so that larger vessels can enter and also be used as temporary storage facilities or alternatively have tank farms linked to quayside (Adendorf *et al.,* 2012). The impacts of increasing imported volumes to close the gap caused by declining refining capacities, matching demand for liquid bulk infrastructure with import supply and demand, energy planning demand, port capacity and port readiness and the impact of tariffs on liquid bulk demand are important research areas that need attention.

1.8 RESEARCH DESIGN

This sub-section outlines the methodological approach used in assessing the relationship between port development (facilities for wet bulk) and energy development, with particular emphasis on liquid energy volumes imported through our ports and existing port infrastructure. This is centred on research design, emphasising data collection techniques, data analysis and data presentation.

This research is a venture towards understanding the relationship between seaborne commerce and the development of port infrastructure in South Africa and emphasises selected ports in South Africa, namely the port of Durban's wet bulk facilities, the ports of Richards Bay (although this is mainly a dry bulk port), Cape Town and Mossel Bay (established mainly for crude and gas). Together with the case studies, the research will use interviews with representatives of the port authority, port users and port planning professionals to understand whether there is a link between port infrastructure, port development strategy and refining capacities in the development infrastructure for wet bulk.

The focus of the research design is on the methods used in identifying the dichotomy among port infrastructure development strategy, appraisal of port investments, policy and comparison of port development in relation to providing wet bulk facilities in the light of burgeoning energy demand in South Africa. It also emphasises understanding port planning policy considerations as well as planning of port investments.

The research was based on a literature review, which provided the context of the research as well as the theoretical framework and was also centred on an interview process, observations and questionnaires, which generated data necessary for making informed conclusions about the research topic. These expedited collection of the required information to address the problem.

1.9 RESEARCH METHODOLOGY

A basic research approach has been adopted to achieve this purpose. The reason for using a specific research methodology assisted in obtaining information from a representative sample of individuals in the ports and energy sectors that would reflect the thinking on the different issues identified by the researcher. This approach utilised an in-depth literature review process to gather theoretical data from the energy demand policy/economics as well as port planning methodology and systems.

The researcher initially used interviews (structured, semi-structured, telephonic and face-to-face) as a means of gathering data. These data were then verified against textual information. The research used two research methodologies, namely, quantitative and/or qualitative research. Quantitative research is based on meanings derived from the use of numbers and depicted by means of diagrams and statistical comparisons. Qualitative research is quite the opposite. It is based on meanings expressed through words. Such meanings may be categorised and the analysis of the categories is then carried out through the creation of a conceptual framework. The scope of qualitative research includes in-depth interviewing, which is usually conversational rather than structured. Since the research is based on case studies, the use of the qualitative method is adopted. In case studies an in-depth analysis of a few events or conditions is performed. Such an analysis depended to a large extent on the availability of information. For the purposes of this study, information was obtained from both primary and secondary data sources. Primary data was obtained by means of questionnaires and secondary data was obtained from documents from the various business units.

The research also used questionnaires to investigate to obtain direct answers on issues contained in the research objectives described in Section 1.5. The data were allocated to categories to assist with comprehension and identification of key themes and relationships. A more detailed methodology is presented in Chapter Four. This helped form the various views on the subject and helped understand how different actors in the port industry and energy sector understand the subject discussed.

1.10 ETHICAL CONSIDERATIONS

The research was conducted within the permitted rules and regulations of the University of KwaZulu Natal concerning research. For ethical reasons and out of respect for confidentiality the names of the respondents are not used in presenting the results of interviews and questionnaires.

1.11 THE DATA, THEIR TREATMENT AND THEIR INTERPRETATION

1.11.1 The data

It is important that the writer differentiates between pure and applied research. The difference between pure and applied research concerns the questions to be addressed rather than the approaches adopted (Fellows and Liu, 2003: 8). Pure research is undertaken to develop knowledge, to contribute to the body of theory that exists, while applied research seeks to address issues of applications in order to help solve practical problems with a contribution to knowledge as a secondary consideration. The research seeks to solve either closed-ended problems or open-ended problems.

The use of the complementary data-gathering methods of interviews, observations and questionnaires necessitated a multi-dimensional data presentation approach. Thus the data is presented in continuous prose, tables and flow charts.

1.12 LIMITATIONS OF THE STUDY

The study is limited to South African ports: Durban, Cape Town, Richards Bay, Ngqura, Saldanha and Mossel Bay. This is to allow the researcher to explore and review port development initiatives and development of wet bulk facilities as well as examining port planning development strategies.

1.13 OUTLINE OF THE DISSERTATION

The study is organised into six chapters that seek to address the main aim and objectives, in addition to providing answers to the research questions. The first three chapters provide a background and a theoretical framework to the study.

Chapter One: This chapter introduces the research work, which covers background to the study, as well as outlining the main aim and objectives of the study.

Chapter Two: This chapter outlines the theoretical framework of the research study and briefly introduces an economic analysis of ports and port infrastructure. The chapter focuses on the relationship between port infrastructure and seaborne commerce, looking particularly at the impact of inelastic refining capacities and energy demand on port infrastructure. This chapter is also centred on port planning methodology and gives an overview of how ports plan for various trades and the factors influencing such planning.

Chapter Three: This chapter gives a comprehensive overview of petroleum as strategic stock and unpacks the relationship between the South African oil industry and the ports. This involves looking at petroleum as strategic stock and how this affects port planning, focussing on wet bulk infrastructure. The chapter also unpacks the historical development of port tariffs and South African port structure post-2002 in relation to energy demand. A framework of evaluating the economics of required port investments for the oil and gas industry is developed. This means understanding the energy master plan and port requirements, thus introducing a discussion of how ports can plan effectively for liquid bulk cargo.

Chapter Four: This chapter deals with research design. It outlines the research methodology to be followed in gathering data, as well as data gathering techniques. The choice of research methods used (structured, semi-structured and unstructured interviews) together with observations and questionnaires is explained.

Chapter Five: This section of the dissertation presents and analyses the results forthcoming from the interviews and the follow-up questions that were used to gather data. The responses in the interviews are analysed and the meaning of these responses is recorded. It is through these responses that the planning initiatives to handle wet bulk cargoes are assessed, given the increasing energy demand. The analyses of results from the interviews and focus groups as well as other research methods used are discussed.

Chapter Six: This chapter presents the conclusions of the research and links these with findings from the literature review. In particular, the author's conclusion regarding whether there is a planning failure in creating adequate infrastructure to handle wet bulk cargoes by ports authority is present.

CHAPTER TWO

THE RELATIONSHIP BETWEEN PORT INFRASTRUCTURE AND ENERGY DEMAND: A THEORETICAL OVERVIEW

Ports are more than piers and more than just infrastructure
but a complex infrastructure. Winkelmans, 2002: 29

2.1 INTRODUCTION

This chapter provides an overview of the economics of ports and port infrastructure in relationship to energy demand. Particular reference is therefore made to the understanding of the relationship between port infrastructure and seaborne commerce in the context of port development theory. The impact of inelastic refining capacities and energy demand on port infrastructure is emphasised. This chapter is also centred on port planning methodology and will give an overview of how ports plan for various trades and the factors influencing planning.

Understanding port planning theory and economics and its relationship to energy demand is important because it provides evidence to support the research findings on energy demand and associated planning requirements. The management of traffic demand planning is central to the successful management of ports. Demand is one of the most important aspects of business economics.

Mismatch between supply and demand leads to a number of problems and therefore in the case of port operations, higher supply than demand leads to failure in the utilisation of port infrastructure and superstructure and brings in less cost-effectiveness. When demand for port services exceeds supply, an increase in costs for shipping and losses of time due to waiting are obvious consequences.

Supply in port infrastructure should be designed in accordance with anticipated demand. Therefore, in order to avoid the consequences of non-convergence of port supply and demand and to create a basis for appropriate capacity decisions, there is a need to forecast demand for port services.

2.2 ECONOMIC ANALYSIS OF PORTS AND PORT INFRASTRUCTURE

Ports are studied because they provide physical infrastructures in an ocean environment for berthing vessels, storage tanks and pumping diesel and other liquid bulk. The study of ports can be divided into port engineering and economics. Port engineering deals with the design, construction and layout of infrastructure and facilities in relation to the type of services offered by the port to its community. Port economics deals with the study of the economic decisions (and their consequences) of the users and providers of port services (Talley, 2009). A port is an 'engine' for economic development, providing employment, worker incomes, business earnings and taxes for its region (Talley, 2009; Heaver, 2006). It is important to understand why ports are studied in the discussion of energy development. Several authors, including Beresford (2004), Gaur (2005), Notteboom and Winkelmans (2002) and Oza and Oza (1999), have demonstrated the importance of studying ports.

Ports are studied because there is a need to understand the typology of port infrastructure and the strategic role ports play in the development of international and domestic trade of a country, whether the country is developing or developed (Gaur, 2005 citing Beresford, Gardner, Petit, Naniopoulos, & Wooldridge, 2004). Ports are also studied because in a globalised world, where distances are becoming virtually squeezed, ports play an active role in sustaining the economic growth of a country. In the modern technological era, ports are playing the role of an industry in their own right; they are not just passive actors in the transportation process, but they also participate actively in the entire supply chain management value chain. Hence ports are more than piers that are, more than just 'infrastructure but a complex infrastructure' (Notteboom & Winkelmans, 2002, cited by Gaur, 2005).

Ports not only function as part of a chain in transportation interchange, but they function as a self-sustaining industry linking ports with domestic and international trade. Ports are also studied because in some places they act as foreign exchange earners, not only in the form of transhipment or hub ports but as part of supply chain management by providing logistics services to the industry. That is why a port needs to be treated as an industry when it is being planned.

Such planning should extend to actual harbour planning. Harbour planning is important because it addresses port layout, berth space configuration, the length and width needed for movement of vessels and the cargo being carried (Oza & Oza, 1999). Since this research dissertation is not concerned with port engineering, only the economics of ports will be discussed, not the articulation of the engineering detail.

Ports need to be planned and such planning should not only be concerned with simple demand and supply of throughput but more than that, planning should be concerned with the institutional framework. As argued by Heaver (1995), Robinson (2002) cited by Heaver *et al.*, 2001 and Beresford *et al*. (2004), ports should be planned and managed and such planning should integrate the application of technology, marketing strategy and ultimately economic impact analysis for the development and implementation of a port development project. (The understanding of port economics helps in classifying port users and suppliers of port services in the context of economic demand and supply, the prices paid by users and considerations of port efficiency.)

2.3 DEFINITION OF A PORT

'A port (seaport) is a place at which the transfer of cargo and passengers to and from waterways and shores occurs and these transfers are made to and from vessels'. As defined by Talley (2009: 1), ports may be cargo ports (handling only transfer of cargo), or passenger ports (handling only transfer of passengers) or a combination of both cargo and passengers. Ports are typically cargo ports and this cargo could be general cargo (dry and neo-bulk) and bulk cargoes. General cargoes are either goods of various sizes and weights shipped as packaged cargo or goods of uniform sizes and weights. The former is either container or break-bulk cargo, while the latter is neo-bulk cargo. As stated earlier, this research will deal with liquid bulk cargo. Examples of liquid cargo that this dissertation will deal with are crude and refined petroleum products.

This definition of a port implies that it is an economic unit because it provides a transfer service as opposed to producing a product as in a manufacturing firm. The amount of this transfer service is called 'port throughput' which was defined earlier and is important in understanding the economic viability of ports, and is referred to throughout this research project. Measuring port throughput helps understands the efficiency of ports and planning.

2.4 STRATEGIC ROLE OF PORTS

As stated earlier, ports play a strategic role in the development of domestic and traditional trade of a country, whether it is a developing or developed country (Beresford, 2004, citing Goss, 1986). Ports act as a gateway to an intermodal transport system connecting sea and land transport and its functions essentially help the transfer of cargo and passengers (Port Regulator, 2010: 13). Ports also provide marine and cargo-working infrastructure facilities to port users who fall into two broad sets of economic actors – vessel owners whose assets utilise the former infrastructure; and cargo-owners whose goods pass through the latter infrastructure with the use of cargo distribution as well as cargo handling services (Port Regulator, 2010: 13).

Any discussion on the strategic role of ports should take into account the philosophy of port development and planning and should factor in the services that ports provide, that is, understanding the major role of such ports (whether such ports are neo-bulk, break bulk dry or liquid bulk). The discussion should also touch on port ownership models, port investment models and capacity planning for these assist in understanding whether ports have been planned correctly and in the measurement of port performance and productivity.

Port performance and efficiency are critical factors for port authorities. Port authorities need the data on port performance in order to improve port operations and to effect appropriate port planning. Port performance indicators should provide data on port facilities and operations, while the accounting system must provide data on port costs and revenues that also provide an analysis of a port's performance.

Port planning and economics should factor economic growth and changing requirements for ports (UNCTAD, 2002). Ports are assumed as 'properly planned' on the basis of whether ships carrying different cargoes and/or the adjacent hinterland are properly served. Thus a port, at least in theory, may offer very satisfactory services to vessel operations and at the same time be judged inadequate by cargo interests or by the support offered to the hinterland (or vice versa) (UNCTAD, 2002: 3). Inadequate port planning would be indicated by a port authority's failure to satisfy cargo owners, to balance the needs of port users against others or to take cognisance of the growing needs of economic dynamics in the economy (UNCTAD, 2002: 3). Poor port planning may be indicated by the overall port performance being lower than the forecasted one. Performance cannot be assessed on the basis of a single value or measure but on berthing efficiency, the quality of the cargo handling and/or the quality of port services to inland transport vehicles during their passage through the port. The complicating factor is the strong interrelationship that exists between the three sets and between the various performance measures in each. Thus it becomes virtually impossible and certainly inappropriate to study each of these variables in isolation.

Various port performance indicators must be satisfied in order to verify whether port planning for a particular port is adequate. But there is also a need to know why it is necessary to calculate port performance or present performance indicators. Port performance is critical in understanding whether or not there are gaps in the port system (Daniel, 1961: 113). Port performance indicators include, among others, the ability of the port to turn-around vessels, to manage the market demand system and port performance requirements (Daniel, 1961: 114).

These are used to compare performance against targets and to track trends in performance levels. The latter helps to understand whether there is a need to increase or change port space configuration in line with changing economic needs. These indicators can be used as inputs for negotiations on port congestion and the changing functionality of ports, surcharges, future port development needs, applicable baseline tariff considerations and investment decisions. Port performance indicators help to understand what capacity is required so that ports are adequately prepared to meet the set performance standards.

2.5 THE RELATIONSHIP BETWEEN PORTS AND SEABORNE COMMERCE

The relationship between ports and seaborne commerce is at the core of the discussion, which will help understand the nature of landside links required to accommodate different vessel sizes. This will also help answer the question whether port planners have considered the importance of this relationship in planning ports and whether planning has considered changing dynamics in seaborne commerce, for example, as shipyards build larger vessels, have port planners planned the provision of berthing facilities for such vessels? This discussion will also address the question of whether there is enough berthing space to accommodate the numbers and sizes of vessel transporting crude oil, and whether with increasing energy demand South African ports are geared to handle larger volumes of cargo.

Whether South African ports are geared to handle increased volumes of wet bulk cargo requires debate on port value chains. Maritime transportation has long been affected by major changes in trade systems that have resulted in a quest for ports to be integrated into supply chains and for consolidation of certain services. This is popularly referred to as 'port regionalisation' (Ferrari *et al.*, 2006 cited by Vitsounis & Pallis, 2013 and Notteboom & Rodrigue, 2005). International ports now concentrate on changing economic demands in order to attain such efficiencies and to maximise supply value chains. This view is supported by Leal, Notteboom & Sanchez (2009), who argued that ports exist because port users bring their business routines to such ports and these routines are governed by the market.

Ports are viewed as a place (macro-level) where 'firms' or 'terminal operators' (micro and meso-level) decide on allocating their routines. The characteristics of 'place' strengthen the position of the firm, but in addition the 'routines' of the firm can make the 'place' more attractive (Leal *et al.*, 2009). This port evolution process is guided by the market, hence a port exists because a market for certain cargo exists (Leal *et al.*, 2009) while the port process is guided by managers at a firm level, that is, managers decide on the routines and the resource allocation. Routines are not in a market under the evolutionary view, they are inside the firm. This means that port analysis needs to focus on firms.

A fuller understanding of the relationship between port infrastructure and seaborne commerce requires analysis of the emerging complex, diverse and extended scope interactions. It also looks at the interdependencies between port service providers and the users of these services. The understanding of this relationship also helps frame the ways and conditions within which port users extract (or at least are perceived to extract) value when using a particular port.

Ports need to be developed in the framework of 'efficient utilisation of space and resources' (Rodrigue, 2005).The efficient use of space helps in understanding the changing dynamics in the economy and complements the more traditional target of efficient use of available factors of production (Brooks & Pallis, 2008 and Pallis, Vitsounis, de Langen & Notteboom, 2011, cited by Vitsounis, 2013). However, in some instances, some port users complain even when efficiency is achieved (Farrell, 2009). This is because port efficiency is normally measured by price, while quality is generally not such a relevant issue. Furthermore, when port traffic increases and is not met by a commensurate upgrade of quality of service, there are bound to be inefficiencies that prevent industry players from internalising the whole value added derived from increased demand. This calls on the key actors in port development, especially port authorities or port service providers, to capture value by concentrating on strategies that are linked to economic demand (Magala, 2008).

This also means that when any port intends to serve its users both effectively and efficiently, it needs to know the type of interaction required in order to develop infrastructure that will enhance value. This will also help the ports create value, because by understanding user requirements, authorities can plan for the shifting demand for port space by port users. This understanding of the relationship between port users and the authorities' results in value creation but such requires an understanding of the network constellations.

Several writers including Chin *et al.,* (2009), Heaver (2006) and Krishna (2013) argue that a discussion of the relationship between port infrastructure and seaborne commerce is incomplete if no mention is made of the relationship between port costs and ship sizes and trade development, since ship sizes are influenced by trade development. Since 1973, the increase in the size of oil tankers (VLCCs and ULCCs), forced ports to design and construct infrastructure in order to accommodate such vessels.

There has to be flexibility in port planning, particularly for energy, because the environment is demanding, given the fact that in South Africa in particular, demand exceeds domestic liquid fuels crude refining capacity, forcing the country to meet demand through imports. This places heavy demand for berthing facilities for wet bulk. The current economic conditions, particularly with increasing energy demand and recent trends in port and shipping sectors, are causing port planners to rethink their approach towards port planning, design and project evaluation (Taneja, Ligteringen & Walker, 2012). Attributes such as flexibility and adaptability can provide a port infrastructure system with the capacity to be useful under changing port requirements, making it robust in face of uncertainty, lengthening the economic lifetime of the port. This also guarantees payback on port investments.

South Africa consumed approximately 11,2 billion litres of petrol and 11,9 billion litres of diesel during 2013, showing a 4,8 % decrease in petrol and a 5,6 % decrease in diesel when compared to 2012 (SARS, 2014). There was also a 2,1% decrease in petrol consumption in 2013 and a 0,3% increase in diesel consumption from 2012 because of the delay in coming on line of Medupi and Kusile power stations. The increased figures in petrol and diesel consumption show that South Africa is more dependent on diesel and petrol imports. South Africa imported 4 billion litres of diesel and 1,2 billion litres of petrol in 2013. The Energy department argues that there is a need to increase imports because demand exceeds supply and that South Africa's strategic stocks of crude oil were currently low (Business Day, 9th February 2014). The demand for liquid fuels from neighbouring countries like Botswana, Lesotho, Namibia and Swaziland is also rising and set to reach 200,000 barrels per day before 2020 (DOE, 2014). With the exception of Namibia, these countries are wholly dependent on South Africa for their fuel, which means that there is a need to plan port development in line with such demand.

2.6 ECONOMIC IMPACTS OF PORTS

Ports function as gateways to an inter-modal transport system connecting sea and land. Ports provide marine and cargo-working infrastructure facilities to port users who fall into two broad sets of economic participants: vessel owners, whose assets utilise the former infrastructure; and cargo-owners, whose goods pass through the latter infrastructure with cargo handling and cargo-distribution services. Ports, like any other industry, affect local economies and they do this through employment, the facilitation of business between importers and exporters and their suppliers and customers. Thus, the focus of this section includes the analysis of economic impact of ports and how this is affected by energy demand.

This section will also look at port development and liquid energy demand and assess the extent of this relationship in shaping port development. Port demand is linked to the aggregate flow of goods that pass through the port system. It is possible that the demand for maritime transport port infrastructure services may rise when there is an increase in the supply of a particular commodity. This is what Stopford (1997), calls a derived demand. This derived demand makes ports important in the supply chain network, but it would be wrong to assume that investments in such transport infrastructure alone would lead to economic growth.

As posited by Goss (1990), ports have been seen as drivers of economic development as they increase competition through enlargement of the market areas of firms, thereby reducing prices for consumers. This has changed the maritime landscape, boosting seaborne trade in the process, increasing spatial relocation of production and increasing the importance of logistics. These changes have been effected by ship size, specialisation and changing demand for port facilities. This also has made port operations more capital intensive. Despite ports being capital intensive, there have been increasing calls for ports to lower tariffs, to decrease turnaround times and to accelerate trade and movement of goods.

According to de Langen, Nijdam & van der Lugt *(*2010), the demand for ports and port services is derived from the demand for transport services to enhance trade flows. Therefore ports do not influence the characteristics of demand but instead have to be able to adapt to changes in the port environment (de Langen *et al.* 2010). At times there are bottlenecks that hinder or slow the entire transport process and these should be addressed in order to improve the efficiency of the infrastructure. Examples of such bottlenecks are over-utilisation of infrastructure, mismatch between supply and demand and the quality of the infrastructure towards the hinterland (de Langen *et al.,* 2000).

There are relationships between patterns of social activity, economic progress and transport that make ports an economic unit. As argued by Taffe, E. Morril, R. & Gould, P. (1963) the development of transportation should be linked with infrastructure development and economic development. This view is emphasised by Bryan *et al.* (2006), in their study on the significance of the ports of South Wales. In this paper, Bryan *et al.*, described ports as economic units and posited that their expansion is an 'irregular or sporadic process' influenced by many specific economic, social or political forces. The importance of other industries that transport their inputs and finished goods through the port system influences the expansion of ports. As posited by Rodrigue (2008) 'the real matter behind potential future growth, is macroeconomic factors like energy growth and industrial development which tend to be overlooked'. This makes transportation a 'derived demand', meaning that transportation is dependent on other activities: an auxiliary function, much like a service (Rodrigue, 2006).

The link between energy and port development has been written about by many writers including Loo and Hook (2001) who identified the growing importance of railways, ports and energy. Port growth is influenced by this connectivity and the importance of this is critical in developing countries. This view is summarised by Pedersen (2003), who argued that the choice of ports is affected by a selection process that takes into consideration the economic activity and geographical advantages that make some ports lose out and others win, depending on the ease of access to the resources in the hinterland and increasingly on the investments in railway or road corridors linking the ports with their hinterlands.

Other factors considered are the port throughput, which measures the port's performance. Port throughput has been identified as critical to port expansion as ports by their nature seek to maximise throughput (Tongzon, 1994, cited by Rodrigue, 2006). Tongzon identified determinants of throughput that include, but are not limited to: geographical location of a port, economic activity and frequency of ship calls, port charges and terminal efficiency measured in terms of the number of containers loaded and unloaded per berth hour. Efficiency is linked to planning and as Rodrigue (2006) says 'any inefficiency which is a result of poor port planning of any of the determinants can become a constraining factor'.

Any inefficiency should be solved by holistic planning and engineering design (equipment), operations research and management. There have also been calls to look at port development plans to include not only improvement of the transportation infrastructure but also innovation in other sectors and to enhance economic development (Garrison and Souleyrette, 1996 and Casey, 1999). Pettit and Beresford (2009) pointed out that the development and promotion of the commercial port area is linked to the function of the port and the economic imperatives prevailing at the time. This places the port as a service centre (Beresford, 2009). At this level ports have dynamic, technological and developmental effects, because they stimulate growth and lower the costs of doing business.

In South Africa, port planning is a function of the Transnet National Ports Authority (TNPA), although detailed economic planning work is normally outsourced to development economists and infrastructure engineering consultants. This is critical in ensuring that an entity is responsible for providing the required port infrastructure. Port planning principles in South Africa are premised on:

- developing a complementary ports system with a regional grouping of old and new ports to provide a rational range of facilities to meet local and hinterland demand and to avoid duplication of investment;
- optimising capital investment across the port system to ensure capacity meets demand and to meet the requirements of Transnet, the National Ports Act and South Africa (although the requirements of South Africa are not properly explained);
- integrating and aligning port and rail capacity planning;
- ensuring a sustainable response to environmental opportunities and constraints;
- aligning with the planning initiatives of stakeholders, including local, provincial and national government, industry and other key role-players;
- improving infrastructural and operational inefficiencies and reducing transport and logistics costs;
- maintaining the flexibility to respond to changing technological conditions; and

- utilising available port space for berths, freight handling and back-of-port logistics to maximise freight capacity.

Source: TNPA Planning Document, 2012

2.7 PORT PLANNING PRINCIPLES ENERGY SECURITY AND LIQUID FUELS IN SOUTH AFRICA

This section provides an in-depth analysis of the implications of oil peak on port planning by addressing fundamental questions, such as whether the planning by the TNPA is adequate or not.

South Africa's port planning and liquid bulk planning methodology talks to the relationship between energy security and liquid fuels in South Africa. The country relies heavily on imported crude oil because domestic sources and available substitutes alone cannot satisfy the country's energy demand, resulting in imported crude oil accounting for over 90% of South Africa's requirements (Nkomo, 2009). This high dependency on imported crude oil exposes the potential events that impel Transnet to institute planning measures on ports to address this high energy demand. Also South African refineries '*are operating at full capacity; [the] road and rail transport systems for carrying fuel are stretched to the limit; pipelines are too expensive and too few and the roads are crumbling under weight of increased loads'. The truth is that [South Africa is] now at a point at which any unplanned break in the supply chain (for example, refinery breakdowns, pipeline interruption or shortage of rail tank-cars) will create shortages' (BP, 2007).*

Coupled with the energy interruptions of 2005 (details of which are discussed in Chapter Three), there is a need to widen the diversity of energy sources and supplies and to institute demand-side measures to maintain strategic inventories to strengthen energy security. However, this needs an integrated effort that includes planning ports accordingly (Wakeford, 2006, Nkomo, 2009 and Mokhele, 2013).

The importance of a relationship between port planning and the circumstances of the oil and gas industry was placed high on the agenda at the South Africa Maritime Industry Conference in July 2012. This emphasis was reinforced at the Ports and Maritime Conference in May 2013, in which the industry raised the problem of South Africa's dependence on imported fuels products and how this exposed the country to various economic and political risks, including security of supply risks and the continued use of foreign-owned vessels. It was also stated that existing infrastructure is unable to support the requirements for increased imports in the short time and will need to be upgraded (BP, 2007). Since then there have been shortages and disruptions in supply and South Africa has had to significantly increase imports of refined product (Energy Global, 2011 and Oil Review, 2013).

This security of supply risk demands that the government places new investment in local refining capacity by 2015, otherwise this country would have to import 8,5 billion litres of fuel a year (equivalent to 15000 barrels per day). This would pose a major threat to the country's foreign exchange reserves (SAMIC Report, 2012). South Africa was challenged to engage all stakeholders in the planning of infrastructure to address the problem of fragmented and uncoordinated roles in various state departments and state-owned enterprises in order to ensure that there is less red tape and that the bureaucratic cost of doing business is reduced. Also identified is the fact that the bunker caller market for South African ports remains largely untapped; it was argued that the Transnet National Ports Authority holds the key to this market, in terms of providing a reliable service as well as differentiating in terms of making it more attractive to potential vessels requiring bunkers.

The Conference also identified that despite South Africa's reliance on liquid energy as envisaged by Nkomo (2009), there is a lack of appropriate funding mechanisms for the industry's capital expenditure requirements, particularly infrastructure projects. During the Conference, questions were asked about whether South Africa had reviewed her port strategies in the wake of development of Liquefied Natural Gas (LNG).

Wakeford (2006) and Nkomo (2009) argue that there are major risks if energy planning does not take account of port infrastructure planning because energy security is linked to economic growth and social development. These writers also discuss issues linked to the demand for oil and the implication for other issues, such as infrastructure development. The argument that is advanced here is that development of port infrastructure is required to cater for imports brought by vessels since demand has exceeded domestic liquid fuels manufacturing.

2.8 ANALYSIS OF SOUTH AFRICA'S FUEL SUPPLY AND DEMAND

This section provides an in-depth account and analysis of the South African fuel demand and supply, focussing particularly on demand and supply of various products like LPG, bitumen, fuel oil, jet fuel, kerosene, diesel and petrol. The section also looks at the fuel demand and supply balance and petrol and diesel consumption and refining capacities required for the period 1988 to 2008 and period 2009 to 2025 as well as the refined fuel pipeline demand forecast for petrol, diesel and jet fuel for the period 2014 to 2043. It also attempts to show the effect of high volumes of liquid fuels on the port infrastructure demand.

2.8.1 Analysis of petroleum demand trends from 1988 to 2008

The demand for liquid fuels in South Africa rose from 18 billion litres in 1994 to 26 billion litres in 2008. Petrol and diesel make up by far the largest percentage of the market. In 2008, the consumption of petrol and diesel constituted 82,34% of the liquid fuels market. South Africa had a shortfall of refining capacity in 2008. According to SAPIA (2009a: 8), the demand for petrol exceeded refining capacity by 498 million litres and the demand for diesel exceeded refining capacity by 557 million litres. The product shortfall was imported. The increased reliance on imports means that there should be infrastructure improvements at South African ports to cater for the increased demand for port facilities for liquid bulk.

Table 2:1 The refining capacity and demand figures for petrol diesel and kerosene (including jet and illuminating paraffin) in 2008.

Product	Refining Capacity Actual	Demand Actual	Surplus/(shortfall) Actual
Petrol	10571	11069	(498)
Diesel	9205	9762	(557)
Kerosene	3261	2908	(353)

Source: SAPIA, 2009a: 8

Table 2.2 Petroleum demand trends from 1988 to 2009

	Average Annual growth % 1988 to 1999 (1998 base year)	Average Annual growth % 1999 to 2009 (1999 base year)
Petrol	2,4 %	0,4%
Diesel	0,9%	4,3%
Other Petroleum	2,7%	1,4%

Source Mullins & Viljoen, 2012

The demand for petrol grew much faster than that of diesel in the first period (1988 to 1999) because of increased inland demand for petrol. The figures changed drastically in the period 1999 to 2009, where diesel grew at 4,3% per annum and petrol only at 0,4% per annum, in all likelihood on account of the high petrol price effect and historically low growth rates in petrol as a result of a relative high increase in petrol prices over the period (Mullins and Viljoen, 2012).

The petrol consumption and refining capacity required show that the forecasted supply of petrol is steady at 10,000 million litres between 2009 and 2025, while future petrol demand is forecasted to increase from 10,000 million litres in 2009 to 22 500 litres in 2025, thus bringing about a (6000) litres balance between 2009 and 2025. Diesel supply is forecasted to be consistent at 9,000 million litres between 2009 and 2025, while diesel supply is forecasted to rise from 9,000 million litres in 2009 to 12,000 million litres in 2025, thus creating a balance of (5,500) million litres between 2009 and 2025 (SAPIA, 2014; Mullins and Viljoen, 2012).The negative balance as shown by the figures in brackets shows a shortfall between actual refining capacity and demand for both diesel and petrol.

The demand supply imbalance of petrol and diesel is yet to continue if the issue of liquid fuels is not attended to. Coupled with funding issues of critical projects which would probably alleviate the supply issues, the global economic crisis has affected certain projects causing planning to be difficult. For example, besides the delay in Umthombo by PetroSA, there were announcements made by the National Oil Company that the Project Umthombo capacity has been scaled down from 400 000 bbl/d to 200 000 bbl/d, thus adding strain to the fuel supply in the country. Sasol's growth programme in Secunda has also been delayed, forcing the country import two billion litres of petrol and seven billion litres of diesel by 2016, if no additional refining capacity is created. This delay in volume adds to the already existing problem of port capacity to handle liquid fuels in the country.

2.8.2 The national overview of the refined fuel pipeline demand 2014 to 2043

Further analysis of the forecasted refined pipeline demand and supply trends for petroleum between 2014 to 2043 show that the total liquid petroleum demand volumes for South African domestic consumption of petrol, diesel and jet fuel are projected to grow from 26 billion litres per annum in 2013 to 69 billion litres per annum by 2043 (Transnet LPTF, 2014).

The figures in the table below show that the growth in petrol consumption is expected to be less than 1% per annum over the period, while diesel growth is anticipated to be in the 4% to 5% range. Jet fuel growth remains lower than 2,5% for the period.

Table 2.3 South Africa refined fuel: Petrol, diesel and jet fuel demand 2014-2043

Liquid fuel products	2014	2015	2020	2025	2030	2035	2040	2043
Jet	2,51	2,57	2,86	3,19	3,57	3,99	4,48	4,81
Diesel	11,91	12,47	15,67	19,75	25,02	31,92	41,15	48,24
Petrol	12,27	12,36	12,86	13,38	13,93	14,52	15,55	15,55
Total	26,69	27,40	31,39	36,32	42,52	50,43	60,79	68,60
Annual growth	3,3%	2,7%	2,9%	3,1%	3,4%	3,7%	4,1%	4,3%

Source: Transnet LTPF 2014: 231

Declining refining capacities have been a problem in South Africa (Wright 2008). This is because refineries and synfuels plants are decades old and the cost of upgrading them to provide cleaner fuels cost effectively is estimated to be more than US$5 billion. The other compounding factor is that since refineries in Durban and Cape Town are located within residential areas, there have been cries of these refineries polluting the air forcing them to upgrade facilities.

Although it has not happened in South Africa, refineries could be forced to downscale refining capacities, increasing the dependence on imported products. This dependence could overburden the port system which is already struggling to handle current liquid bulk volumes.

The petrol and diesel demand balance for the period 2006 to 2020 show that that Sasol would increase its Secunda operations with 20% in 2010 and would also bring on stream its proposed Waterberg 80 000bpd coal-to-liquids plant in the Waterberg by 2014 and would bring on stream about 200 000 bpd Umthombo crude oil refinery at Ngqura in 2015 (although there have been delays in financial packaging the project) (Wright 2008: 9).

2.9 CONCLUSIONS

The literature consulted shows that ports are critical in planning for energy development. It is also evident from the literature consulted that demand and supply of petroleum products have a huge impact on demand for port infrastructure for liquid bulk cargoes. Mismatch between supply and demand causes problems in port planning and development because a lack of understanding of the liquid energy supply and demand trends will affect the provision of the required infrastructure therefore causing backlog which are bound to increase as demand for liquid fuels outpaces supply causing the country to meet the deficit through imports. There is also a need to ensure that provision of port infrastructure is tied up with cargo flows in various ports and in particular fuel demand and supply because the overall demand for petroleum products are linked to the general economic growth. Development of port infrastructure should seek to optimise the demand and supply of petroleum by ensuring that infrastructure development model looks at petroleum supply and demand and incorporates future sources of petroleum (in order to take care of crude oil imports and LNG products).

The port development framework should also address future economic growth targets that include liquid energy harnessing, consider future demand of petroleum products, incorporate future additional refineries and develop an iterative policy decision process that ensures a healthy ports sector to support the petroleum industry and to advance South Africa's economic objectives. The relationship between port planning and energy needs to be linked to liquid bulk commodity flows through the ports of South Africa. The liquid bulk is configured according to the geographical locations of refineries in South Africa. It is also clear from the discussion that there are four drivers of future energy supplies: demand growth, sustainable resources, environmental constraints and security of supply.

The shortfall between refining capacity and what needs to be imported creates a basis for planning port infrastructure development. This also calls for detailed understanding of the relationship between annual economic growth and percentage increase demand for petroleum products in order to provide infrastructure that meets the industry.

For example from 1989 to 2009, the demand for petroleum products increased by 2.3% on average per annum while the economy registered annual growth of 2,8% per annum. There is also a need to understand the petrol and diesel consumption that constitutes 80% of the market, as it would help in understanding the quantities to be throughput within the port system and will assist in the planning for the provision of the required infrastructure in South African ports. It is also important to move from international factors to domestic factors affecting the South African liquid fuels market in order to plan port infrastructure provision appropriately. The increasing supply/demand balance shows that South Africa has a shortfall of refining capacity and subsequently liquid fuels have to be imported to ensure supply and demand balance. There is also a need to look at the increasing dependence on petrol and diesel imports (imports of refined products, whose figures have been climbing in recent years), necessitating a re-look at the port infrastructure which will cope with increasing volumes. It also important to note that although there will be a surplus supply of diesel in South Africa between 2014 to 2017, there will be a shortage of diesel supply after 2017, prompting the liquid fuels industry to import more diesel. In the next 15 years the South African liquid fuels market will heavily impact port development, hence the need to look at port development and tariffs which are dealt with in the next chapter.

CHAPTER THREE

PORT DEVELOPMENT AND ENERGY AS STRATEGIC STOCK

3.1 INTRODUCTION

This chapter presents a discussion on port development in relation to management of energy as strategic stock. This will look at policy consideration regarding liquid fuel as strategic stock and liquid energy security strategy, with particular reference to imperatives of how port planning and policy affect planning for wet bulk infrastructure and cargoes. Energy security aims at ensuring adequate supplies of affordable energy for continued economic growth and development in the short term enabling policy and decision makers to make informed decisions on those complex, interdependent energy outcomes in the medium term. It will also ensure that strategic planning and subsequent growth and development are sustainable (Energy Security Master Plan Fuels, 2006: 6). The chapter will focus on strategic stock management and understanding the relationship between the South African oil industry and the ports. The chapter will also look at petroleum as strategic stock and how this affects port planning, focussing on the historical background of strategic stock policy, analysis of the applicable tariffs to the liquid cargoes, analysis of the liquid fuel environment in South Africa, logistical infrastructure constraints, oil movement infrastructure within ports and how energy development has affected the commercial port policy framework. Finally, the chapter focuses on developing a framework for evaluating the economics of port investment in infrastructure for the oil and gas industry.

3.2 THE SOUTH AFRICAN OIL INDUSTRY AND PORTS

The South African Government and the oil industry have a long history dating back from the apartheid era when the government faced international sanctions that impacted on mainstream trade with international partners on the trade of the oil. The government of the day exercised a very close control over all crude imports to a point where all purchases by South Africa were effected through the Strategic Fuel Fund (SFF) and Central Fund which were tasked from 1964 to co-ordinate all crude oil purchases and imports and to administer the country's crude oil stockpile. Oil facilities can be found in the ports of Durban, Port Elizabeth, Mossel Bay, Cape Town and Saldanha. Saldanha is a government facility built to stockpile strategic quantities of fuel and was established to counter the uncertainties resulting from sanctions and the oil embargo against South Africa. This facility also provides storage space for third parties. The Saldanha Bay terminal comprises a crude oil storage facility with an oil jetty to accommodate VLCCs.

3.3 PETROLEUM AS STRATEGIC STOCK

Oil and petroleum cargoes in the South African sea trade have been perceived as strategic cargoes over a long period of trading history, but for sharply different reasons. In the 'old' South Africa, most particularly in the latter days of Apartheid, when the previous South African state was the target of an international oil embargo and a wide range of trade sanctions, the entire oil trade was surrounded by a shroud of secrecy. Indeed, information about traded oil volumes were suppressed, and were not enumerated in the port traffic data. The quantum of strategic crude held by South Africa has been decreasing dramatically since 1993 after the lifting of the embargo by the United Nations. Previously, in response to sanctions, South Africa had stockpiled crude in dormant coal mines to meet demand requirements.

The government also invested in technology to extract oil from coal (coal to liquid technology) (CTL), which led to the birth of Sasol. There was also the search for a supply of crude oil through 'gas-to-liquids' technology (GTL), which saw a rapid exploration of the gas reserves offshore in Mossel Bay by Mossgas. Mossgas merged with Soekor in 2003 to form PetroSA, a national oil company. The exploration of the gas field off the coast of Mossel Bay saw the establishment of the GTL refinery in Mossel Bay, which is currently still being fed by gas exploration via pipeline to the refinery from the Offshore FA Platform. This development also led to the rapid development of the port of Mossel Bay, with the development of the Single Point Mooring Facility by PetroSA on a Build Operate and Transfer system. The Calm Buoy was established with the discovery of the Oribi Oryx field, which was found to have sizeable crude reserves and has been mined by PetroSA since 2006.

It is argued by writers Davidson and Winkler (2003) that each refinery in South Africa will hold on average crude oil stocks that equate to about 10 days of refinery operation at maximum capacity. This will force all stakeholders to relook at the energy situation in South Africa, particularly to look at how to meet the demand gap. It is also critical in looking at closing the demand gap that a holistic approach is used, which considers expanding the infrastructure enablers like the port system, since the current situation dictates that the shortfall must be filled by imports. This dependence on crude imports will increase, thus exposing the TNPA's liquid bulk infrastructure gap.

3.3.1 Drivers of the energy future in South Africa

There are more than four key drivers of the energy future in South Africa, including, among others, the need for socio-economic development, the need to deliver services that improve the lives of the majority, the need to have diverse sources of energy and the need to enhance economic growth, but also to progress towards some set of social goals and to create more jobs and more equal income distribution among different races in the country (Davidson and Winkler, 2003: 16-19). The others include the need to access modern affordable energy services and to achieve energy security through diversity of supply.

South African economic growth has increased energy demand forcing the country to import crude oil from Iran and Saudi Arabia, with imports constituting approximately 68% of crude oil in 2006 (Ports Regulator Liquid Fuels Cargo Volumes Monitoring Report, 2012). Nigeria and Angola have, however, become increasingly important sources of oil.

Furthermore, South African refineries have been operating at full capacity so that any unplanned break in the supply chain (for example, refinery breakdowns, pipeline interruption, shortage of rail tank-cars) will create shortages. The existing refining infrastructure is unable to support the requirements for increased imports in the short term and will need to be upgraded (BP, 2007). There have been shortages and disruptions in supply, forcing South Africa to increase imports of refined product (Energy Global, 2011; Oil Review Africa, 2013).

3.3.2 Liquid fuels production as a driver to port developments

In South Africa, petroleum is included as 'strategic stock' in the energy security master plan. It is important as an enabler for economic development because the country's level of development is heavily dependent on its availability. Hence, the strategic stock of petroleum products is defined as both crude and refined products (petrol, diesel, jet fuel and LPG), and they are physical in nature, kept for severe fuel disruptions or catastrophes (Staatskoerant, 2013: 7).

Strategic stocks exclude dead stock in tanks, pipelines fills, refined products in road and rail tankers and stocks held by operators in the petroleum infrastructure. Strategic stocks should only become available under declared emergencies and should therefore not be used for operational supply disruptions, short-term supply problems or bad planning by the operators in the oil industry. Petroleum strategic stock can only be called upon by the Minister of Energy. This is an important component of any government policy package aimed at coping with severe fuel supply disruption that exceeds the level of commercial stocks coverage.

The liquid energy sector has been faced with a failure in governance, despite the fact that stable policies for this sector were agreed by all stakeholders in an inclusive process, but in practice its non-implementation has led to a level of policy and regulatory uncertainty that has caused severe under-investment in the sector. In reality, the liquid fuels industry is overstressed and failing under pressure, with government having taken no substantial action to remedy the situation. The other factor is that the 40-year-old refineries have not had the required investment to keep up with demand and there have been no commitments from industry to invest in onshore tankage and cargo holding infrastructure to address this problem.

The proposed 400 000 bbl/d new refinery planned by PetroSA in Ngqura is targeting to supply 25% of SA liquid fuels by 2020 in order to try and solve the fuel supply problems. The project dubbed 'Umthombo', the planned refinery is meant to help wean South Africa off imports of finished products and kick-start a manufacturing hub in the petrochemicals sector. The project's most important aim will be to ensure security of fuel supply in the face of ageing refining infrastructure and increasing demand. In addition to crude oil, SA imports about 20% of finished products as fuel demand exceeds its crude refining capacity of 513000 barrels per day. In addition, South Africa needs a new refinery to meet its fuel consumption of 24bn litres of petrol and diesel and its import of about 80000bb/d of finished product, which puts pressure on the balance of payments account (Financial Mail 16 January 2015). South Africa's balance of payments deficit has ballooned from 3.4% in 2010 to 6.1% in 2013 (Financial Mail 16 January 2015).

Given the level of uncertainty in the industry and large delays in projects such as the Umthombo refinery, stakeholders have been unwilling to invest in the refinery upgrade system. The crisis in governance in the liquid fuels sector has now led to a growing fissure in the liquid fuels system, which neither government nor the private sector has been able or inclined to fill.

Although the government has enacted a policy framework allowing oil majors and licensed manufacturers operating in South Africa to hold strategic stock, this has not happened because the latter have had no obligation to do so for economic reasons. It is therefore in the context of this discussion that petroleum as 'strategic stock' needs to be seen. It needs to be viewed in a wider context than just supply disruptions; hence it should be seen in context with infrastructure development, the enabler of energy movement. Strategic stocks include crude oil, refined products which are diesel (all grades), petrol (all grades) and Jet fuel (Jet A1, DPK), and LPG (DOE, 2013a). Strategic stocks are held in order to keep the country's fuel system 'wet' during severe fuel shortages and catastrophes. Strategic stocks exclude dead stock in tanks, pipelines fills, refined products in road tankers, stocks held on behalf of armed forces, commercial and safety stocks held by operators in the petroleum infrastructure (DOE, 2013a :7). Strategic stocks of petroleum are an important component of any government policy package aimed at coping with a severe fuel shortage that exceeds the level of commercial stocks coverage. This discussion of energy as 'strategic stock' is important in the context of development because crude oil stocks can tie up significant sums of money, which has a high opportunity cost in the context of today's new economic environment and the limited resources available to government.

The management of 'strategic stock' is very important given the fact that South Africa's strategic stocks of crude oil are currently very low, i.e. only about 10,5 million barrels of crude oil equivalent to just over three weeks' supply were stored (Business Day, 9 February, 2014). These figures are considered low because Department of Energy is aiming at having 42 days' worth of strategic stock instead. Apart from the supply disruptions due to unplanned shutdowns caused by, amongst others, fires at refineries and diminishing refining capacity in South Africa increase fuels supply risk of liquid fuels. The department is keenly waiting for the local economy to pick up before it starts upping the strategic stock level of crude oil. South Africa also faces other challenges in terms of implementing the strategic stocks policy. As a developing country, the economy is faced with many other competing priorities and this has an implication for the funding of strategic stocks and related infrastructure. Given all these problems, there is a need to manage the strategic petroleum reserve and to set a policy in a market setting that will holistically manage the enablers of petroleum movement as well. This calls on all stakeholders to facilitate a policy framework that looks at transportation of fuel as a 'strategic component'.

South Africa experienced fuel shortages during December 2005 which resulted in a number of fuel retailing sites running dry (DOE, 2013a). These shortages increased the disruption of refined products resulting in major industrial and societal loss including relative inconvenience to loss of business and reputational damage. The shortages resulted in stock-outs in many parts of the country, including shortages of jet fuel at Cape Town International Airport (CTIA), causing many airlines to postpone or cancel flights. The shortages also affected the agricultural sector where losses were incurred because farmers could not harvest at the optimal time. This also led to production losses in certain companies in the manufacturing sector. The problems caused by the fuel shortage of 2005 means that there should be a discussion on the volumes throughput at the single buoy mooring (SBM) later.

The planning of ports should take into consideration the need for storage of finished products because long lead times for receipts of imports landing on South African shores are problematic; for example, South Africa faces constraints of between 21-42 days for imports to reach our ports of entry and a further 10-14 days for off-loading, refining and transportation from coastal refineries to inland markets. The challenge here is that government would have to invest in storage facilities for refined products strategic stock as posited by Adendorf *et al.* (2012), or alternatively rent such facilities from private companies but there is a problem because even the licensed manufacturers and wholesalers have inadequate storage facilities to accommodate strategic stocks.

Although the current policy advocates that strategic stocks will be vested in the Strategic Fuel Fund Association it is not clear who will be responsible for the procurement and management of strategic stock volumes kept by government. There is also no clarity on how the enabling port infrastructure would be managed. The oil companies will still have a responsibility to procure and release, store and maintain strategic stocks held by them. Also, given all the challenges that this country faces, it means that South Africa needs to revise its current strategic stocks policy and to align it with the new port development framework. The other point worth noting is that the new policy should consider the storage of strategic stocks near the market and how they may be kept with other stocks, commercial stocks, for example. This also means that a separate tank farm, storage site or processing complex as well as some other facilities complying with technical and environmental conditions would be deemed to be a storage facility.

Port policy considerations should try and propose mitigation factors against major supply disruptions, given what happened in South Africa in 2005. It should also give clarity that the need for energy security is more urgent than ever in the light of the difficulties caused by energy supply shortages in in various countries (DOE, 2013a). There should also be diversification of supply, development of enough logistical infrastructures such as port facilities, pipeline capacity, depot storage and the provision of adequate strategic stocks products needs to be prioritised (DOE, 2009; Adendorf *et al*., 2012; DBSA, 2012).

3.3.3 The Moerane Commission: Solidifying the relationship between the oil industry, ports and government

The synergies between petroleum as a strategic stock and the required infrastructure reached its summit in 2005 with the appointment of the Moerane Commission by government to review submissions from all the major oil industry participants including the airlines, agriculture and other interested parties concerning energy shortages in 2005 as well as to develop a framework for managing energy and the related infrastructure.

The Moerane Commission proposed that oil industry participants should be obliged to hold 28 days of commercial stock to counter the effects of devastating interruptions to fuel supplies experienced in 2005, which resulted in stock-outs at many locations throughout the country, including shortages of jet fuel at Cape Town International Airport. As a result of these shortages, the country saw interruptions that negatively impacted many sectors of the economy with the severity of the hardship raging from relative inconvenience to loss of business and reputational damage (Moerane Report (2006: 1).

From the Moerane investigation, it is easy to understand how fuel energy has become strategic stock. The investigations placed emphasis on logistics infrastructure (pipelines, rail road and storage), refining capacity and state of repair, refinery shut-down planning, wholesale/retailer relationships, communications channels, handling of a phase-in period towards upgraded specifications (2010 specifications) and obligations of 'Basic Fuel Price' on holding products.

The Moerane investigation concluded that the fuel shortage resulted from a convergence of a number of events that included exposing underlying structural and regulatory weaknesses in the sector. The investigation also indicated the urgency of addressing petroleum supply shortages and ensuring that these do not become a feature of the future economic environment. The report also placed emphasis on planning energy supply in line with demand to counter the impacts of scheduled refinery shutdowns as happened in 2006.

The Moerane Report put forward a number of options, which included letting the market set the price and dealing with the fact that in South Africa participants are not, in fact, all state owned. The Master Plan sought to allow for the making of well-informed choices in respect of energy supply, energy carriers, demand sector strategies as well as energy transformation approaches with a view of nurturing supply chain solutions to South Africa's fuels supply challenges, management of liquid fuels demand and emergency response tactics as well as taking care of the impacts of energy demand and supply on climate change. A central planning, or coordination approach, was proposed to achieve energy security. This would require the maximum participation of a number of stakeholders in the design of energy demand and supply.

The energy security strategy aimed to ensure that adequate short-term supplies of affordable energy for continued economic growth and development are secured. It proposed splitting the strategic options into two distinct groups, namely, one focussing on the short- to medium-term interventions and the other focussing on the medium- to longer-term interventions. The short- to medium-term interventions are essentially infrastructural in nature (and largely security of supply driven). In the long term, the strategic plan should ensure sustainable growth and development while interventions are more policy and modelling oriented.

The following 13 strategic options were recommended in the Energy Security Master Plan to ensure future energy security:

- At least 30% of finished products should be manufactured from indigenous raw materials.
- Climate change should be taken into account when undertaking integrated energy planning and modelling.
- Global fuel specifications should be adopted. This would ensure compliance to the Euro 4 Standards on Cleaner Fuels which come into effect in 2015. This would help South Africa not to become a 'dumping ground' for all low grade fuels.
- To mitigate the risk of crude supply disruptions from Iran and Saudi Arabia, 30% of all crude consumed in South Africa should be procured through PetroSA. South Africa should also acquire its own crude vessel through its national oil company.
- A policy of limited imports is re-endorsed in order to support promotion of local fuels production.
- Energy efficiency and energy demand management should form an integral part of energy security. Industrial strategy and appropriate transport strategies will be required to make South Africa less dependent on oil.
- An independent energy planning coordinator should assist with the coordinated planning of infrastructure investments.
- Some level of redundancy through strategic reserve considerations should be built into the system to ensure security of energy supply. Significant petroleum stocks will resolve the problems by peak demand operation of open cycle gas turbines.
- Transnet Pipelines should build an appropriately sized, properly integrated pipeline that should be operational at the least in the second quarter of 2010 but this has not happened causing delays in the movement of liquid fuel products.

- An improvement in rail operations is required to keep the inland region wet by using 'block trains', which consist of 32 rail tanker cars. These should be used to improve Transnet turnaround times from an average of 14 days to a more acceptable global best practice of 4 days for equivalent distances.
- The management of the back-of-port operations should be consolidated under an independent contractor to allow optimal utilisation of petroleum handling facilities at South African ports.
- The policy on strategic stock was supposed to be revised in line with international best practice to ensure that such policies take care of the changing port management landscape.
- The ability to develop properly thought-out plans and a tool for evaluating proposed energy policies should be developed: something similar to the United States' approach of an Energy Information Administration (EIA) is proposed (DME, 2007: 7-10):
- Development of an integrated energy modelling capability that would assist in the development of energy plans, which will incorporate development of ports, rail and roads and storage at quayside.

The shortfall of refining capacity from 2008 and the analysis on the estimated shortfall between 2014 and 2025 by Mullins and Viljoen (Chapter 2), show that there would be increased imports of refined products. Increased imports of refined products mean that there should be a robust discussion about the provision of increased berthing capacities for liquid bulk cargoes. This means that the issue of improving the port infrastructure for liquid bulk cannot be left to the TNPA only but should involve other stakeholders who include government, oil industry and others.

This kind of robust thinking as presented in the cabinet 'Lekgotla' in January 2001 was summed up in 'Action Plans' for the 'Economic Cluster'. These plans highlight the transport sector as a key contributor to South Africa's competitiveness in global markets and also acknowledge various export sectors as a major thrust for growing the economy (White Paper on Commercial Ports Policy, 2001). The 'Action Plans' also included port infrastructure development with the White Paper on Commercial Ports of 2001 advocating the promotion of an effective transport and logistics system underpinned by strategic management of maritime ports and the entire logistics value chain.

There are two types of facilities that are provided by ports as infrastructure for oil: offshore and quayside facilities. Offshore facilities are the single buoy mooring structures; while within the port limits, these are not within the actual physical port structure. Quayside facilities are to be found within the actual physical port structure.

It is therefore from this background that a decisive ports policy is essential to regulate port development and governance in line with energy development.

3.4 CRUDE AND PETROLEUM PRODUCTS HANDLED IN SOUTH AFRICAN PORTS

The port of Durban, which is the major player in the oil and gas industry, handles the largest tonnages of crude oil and refined products in the South African port system and is the largest port in the southern hemisphere. The port provides port facilities for a variety of ship categories. Richards Bay is the largest port in terms of total tonnages of cargo handled; oil traffic is limited to modest volumes of petroleum products (Jones, 1988). Durban has only one berth available for handling marine fuel oils.

The volume of liquid fuels transported in South African ports between 2011 and 2012 is shown in the following table:

Table 3.1 Volume of liquid fuels transported in South African ports

Port		Cargo Shipped	Cargo Landed	Total
Durban	2011	778 780	23 657 891	24 436 671
	2012	1 355 11	24 977 634	26 332 745
Cape Town	2011	227 310	910 323	1137633
	2012	327 266	1358723	1685989
Richards Bay	2011	1 19971	291 993	1511964
	2012	1023227	336666	1359893
Port Elizabeth	2011	0	132035	132035
	2012	0	104920	104920
Saldanha	2011	3022745	4055707	7078452
	2012	1119215	4284221	5403436
Mossel Bay	2011	142612	713994	856606
	2012	143942	972868	1116810
East London	2011	0	16109	16109
	2012	0	18040	18040

Source: Ports Regulator 2013

The port traffic volume throughput given in Table 3.1 reflects the geographical location of South African refinery capacity with all refineries either located at Durban (SAPREF, ENREF), Cape Town (CHEVREF) or Mossel Bay (in the case of the PetroSA GTL Refinery), or linked to these ports by pipeline. Liquid bulk cargo that is mostly imported through the South African port system shows that liquid bulk cargo comprising imports accounted for 96% of the total cargo throughput in the commodity handling category in 2010/11, 97% in 2011/12, 94% in 2012/13 and 96% in 2014/15 (Ports Regulator, 2015). Tables 3.1 and 3.2 indicate that Durban remains the port that handles the largest petroleum volumes in the South African Port system.

Table 3.2 Liquid bulk volumes by port.

Port	2009/10	2010/11	2011/12	2012/13	2013/14
Durban	24512 283	23937584	25853276	26641358	24850417
Cape Town	1718193	2212387	2707105	2881176	2493133
Richards Bay	336865	474309	403027	466005	510990
Port Elizabeth	900822	941977	850280	936770	887465
Saldanha	14272349	9634834	3850454	4360494	4260761
Mossel Bay	1666964	1970	1893127	2483239	2118992
East London	946845	1012218	918688	840322	836844
Ngqura	0	86512	0	0	0
Total	44354322	38301790	36475958	38609364	35958601

Source: Ports Regulator 2015

The port of Durban has a single buoy mooring at Isipingo to cater for VLCCs (vessels of 330,000 Dwt 335m length and 22m draft). The SBM and immediate pipeline delivery systems were constructed by the oil industry and are operated by SAPREF. The SBM can also accommodate Suezmax vessels of 275m length and with a draft of 17m. The Durban SBM maintains continuity of supply because 85% of South Africa's crude import comes through the SBM. The SBM helps in resolving South Africa's crude supply issues by providing supply contingencies. The SBM is critical to the supply of crude in South Africa because there are no realistic alternative crude import capabilities to cover a protracted non-availability of crude should there be a delay in supplies.

The SBM is also critical because Durban refineries would shut down when their crude runs out, rendering them unable to hold 10 days' worth of stock. The SBM is also critical as it carried 15,5 million tonnes in 2012, to more than 16 million tonnes in 2013/14: it is estimated to land about 16,3 million tonnes and 16,8 million tonnes in 2016/17 (Staatskoerant, 2013). The volumes reached a high of 20 million tonnes in 2005 (because of fuel shortages in December 2005, as discussed earlier), remained flat between 2006-2008, fell sharply between 2008 and 2009 because of low consumption but rose steeply in 2010 because of fuel demand during the World Cup in 2010 (Staatskoerant, 2013: 10).

The Island View complex was developed principally to handle the oil and petro-chemical trade, although high-volume crude oil imports are now landed through an offshore single buoy mooring. The complex comprises a total of nine berths that are utilised for regional shipments of refined petroleum products, a substantial import-export trade in chemicals and other liquid-bulks. The area provides some of the deepest-draft berth space in the port, and is capable of accommodating vessels of Panamax size. The immediate berth hinterland contains an array of oil products and liquid-bulk terminals, all operated by private enterprise (EThekwini Transport Authority & Arup, 2004). The pipelines currently move 2,3 million tons of refined products and 4,6 million tons of crude oil per annum. The supply forecast of refined product from the Island View complex between 2014 to 2043 is estimated to rise from 6,6 million tons in 2014, reaching 20,4 million tons in 2020, 16,7 million tons in 2030 (because of decreased demand and the possibility of Umthombo having come on line by 2025), 20,9 million tons in 2035, 26,7 million tons in 2040 and an estimated 31,8 million tons by 2043 (TNPA, 2012).

The port of Durban handles 70% of all bunker ships that call at South African ports (Unical, Bunker Business, 2007). The bunker volumes from the port of Durban have decreased substantially, from a peak of 3.5 million tons in the late 1990s to around 2.5 million tons in the mid-2000s and now stand at only 1.2 to 1.4 million tons in 2012-2014 (Jones, 2014). (Table 3.3 shows the vessel numbers and delivered volumes falling between 2009 and 2014.) This is seen as a major problem by the bunker supply industry although Durban has the cheapest bunker prices in the southern hemisphere. The bunker market comprises terminal callers and pure bunker callers (Jones, 2014). Terminal callers, which are cargo-working ships, represent the largest bunker users and are in part 'captive' to the port cluster; as such, they are somewhat less price elastic (Jones, 2014). Bunkers-only callers consist of those vessels with no other links with SA sea-trade.

These bunkers-only callers are highly cost sensitive (price elastic demand). There is concern about the declining bunker activity in the Durban port cluster. It is critical to look at port and oil industry constraints to explain the decline in this bunkering activity. Various reasons have been given for falling vessel numbers and delivered volumes. These include lack of dedicated bunker berths (although barge delivery gives flexibility), cost and operational issues in the oil industry and high and costly vessel waiting time. For example, the average waiting time by bunker callers from

January to August 2014 has ranged from a peak of 10 hours to a low of 3.5 hours (TNPA, 2014). A further concern is that SA ports are, in general, high cost ports by international norms.

Table 3.3 Number of bunker callers in the Port of Durban, 2009/20-2013/14.

Year	Bunker ships
2009/10	1153
2010/11	999
2012/13	894
2013/14	629

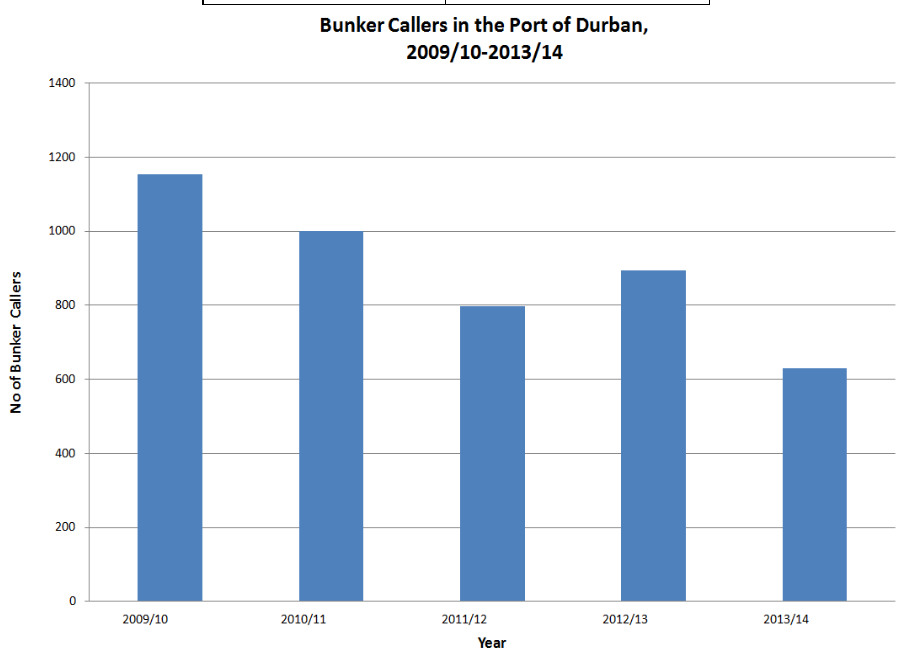

Figure 0.1 Graphical illustration of bunker callers in port of Durban, 2013/14.

Source: TNPA data, 2014

There are many reasons for South Africa's decline in the ship's refuelling market, which has dropped the volumes dispensed, particularly in Durban. One of the reasons noted by IBIA is that 'bunker vessels are just too low on the South African ports' list of priorities. There is currently limited port berthing for bunker vessels in all ports with vessels being dealt with on a first come first served basis' (IBIA, 2014). Other reasons for the decline in bunker volumes have been attributed to limited fuel storage facilities and inconsistent refinery turnarounds, which are unable to give the shipping market sufficient notice for refinery shutdowns. Aging refineries and their failure to produce ‘white oils’ have also been cited as reasons why bunker volumes have declined. In addition, these refineries have been unable to produce the low sulphur, low carbon, 380 centistoke (cst) fuel that operators require (IBIA, 2014). Adding to the problem is the fact that high port charges cannot be mitigated by offshore barge supplies, since these are prohibited: there is also little competition in the market with only four suppliers serving the sector.

The liquid bulk section of Cape Town has two berths at the Eastern Mole with a capacity of 3,4 million tons. The port of Cape Town handled an average of 1,5 million tons of imported refined products in 2013, compared to a figure of 1,2 million tons in 2010/11 (Chevron, 2014). The port of Cape Town handled 5,2 million tons of crude oil volumes per annum between 2010 and 2014 at its two handling facilities. The amount of crude handled in Cape Town declined slightly in 2011/12 because of increased imports supplied by Burgundy and made that more refined product than the market demand and any excess product was shipped to Durban and the Eastern Cape. This was done because import volumes were threatening to displace local production (Chevron, 2014). The Chevron refinery in Cape Town contributed 3.5 million tons per annum of refined product between 2010 and 2014, comprising diesel, jet fuel and petrol.

The port of Cape Town has 4 dedicated bunkering berths (Landing Wall 1 and 3/Eastern Mole 1 & 2) supplying marine fuel oil and gas. Bunkers are delivered by pipeline or by bunker barge but only inside the port. Bunkering in Cape Town is done by Joint Bunkering Services, a joint venture between BP South Africa, Caltex Oil, Shell South Africa and Engen Petroleum. The port of Cape Town handled below 800 bunker callers in 2010 with the figures shifting slightly to 1100 callers in 2013, but with a high proportion of these being small trawlers and offshore vessels taking small volumes.

Richards Bay handled approximately 2 million tons of liquid fuels. The TNPA has also planned new berths in Richards Bay in support of the expanded petrochemical cluster. All these factors show concerted efforts in planning of ports in relationship to energy. Liquid bulk planning has been on the increase at the port of Richards Bay because of the increase in energy demand.

The port of Saldanha, the port with the deepest natural harbour in South Africa and is sixty nautical miles northwest of Cape Town. Saldanha handled 5.7 million tons of liquid fuel cargo in 2011. Saldanha Bay's liquid-bulk berth is used principally by Caltex, which delivers the crude oil to the Caltex refinery through the Petronet pipeline and by PetroSA which operates tank storage facilities. With the demise of government stockpiling activities, Saldanha Bay has developed a crude transhipment business.

These transhipments are made up of two elements with a smaller, unspecified portion constituting genuine transhipment cargo, where a number of tanks are being used to store crude oil for various international oil companies in order to take advantage of the fluctuations in crude oil markets. This port accepts vessels of up to 20.25m draught although the harbour at times conditionally accepts vessels with a draught of 21.5m.

The port of Mossel Bay consists of two oil facilities, both of which are offshore but falling within the port limits. These comprise a Calm Buoy Mooring, used for the export of PetroSA products, and a Single Point Mooring (SPM), used for petroleum products. Both are owned by the TNPA, although the SPM was paid for by PetroSA and handed over to the TNPA (Portnet at that time) in 1992.

The port of Ngqura has three new berths for liquid bulk that each extend approximately 350m in length and are 50m wide. The estimated depth is 18m and is likely to be deepened to 21m in future. Smaller volumes of imported refined fuels were handled in Port Elizabeth and East London.

3.5 OWNERSHIP AND MANAGEMENT OF THE OIL INDUSTRY INFRASTRUCTURE

All the quayside berthing infrastructure of the facilities found within ports belongs to the National Ports Authority, whereas all cargo handling infrastructure as well as related superstructure belongs to and is maintained and operated by the various oil majors, except for the port of Mossel Bay, where the superstructure is owned by the TNPA, leased by PetroSA and maintained by a third party contractor on behalf of PetroSA. The offshore SBM facility in Durban was built and financed by the oil industry (excluding Total).

The quayside berthing facilities in the various South African ports comprise the concrete slab of the quayside itself, the mooring bollards, fire-fighting equipment, roads and rail links and rail trucks on the quayside.

In Durban, Island View berths are privately leased and the cargo handling infrastructure like the manifolds, pipes, valves and the superstructures that were built to facilitate cargo handling are owned by the various oil majors. Island View 6 was refurbished (including the quay wall) at the expense of the oil industry during 2000.

Oil majors also own and control the actual cargo handling facilities in the ports of Richards Bay, Cape Town, East London and Port Elizabeth. There are two pipeline systems set in the berth at Port Elizabeth. One is owned by Caltex, through which Caltex runs its own cargo and which Engen and Total utilise for a throughput fee. Shell owns the other, through which they run their cargo and for which BP is charged a throughput fee. There are two pipeline systems set in the berth at East London, one of which is owned by Engen, through which it runs its own cargo and which Caltex and Total utilise for a throughput fee. BP owns the other, through which they run their cargo and which Shell utilises for its cargo for a throughput fee.

3.6 PORT TARIFFS AND THE OIL INDUSTRY

This section outlines the legacy of port pricing and analysis of tariffs applicable to the liquid fuels throughput via the national port system in South Africa. The discussion provides a summary of the main charges levied at South African ports and moves on to give a brief history of tariffs in South Africa and the anomalies and issues of equity.

Summarised, the main charges can be grouped as follows:

- ship-based charges: port dues (for use of the basic marine infrastructure), pilotage, towage, berthing services, Vessel Tracking Services charges (for orderly navigation safety) and a SAMSA levy, all levied on the basis of vessel size (gross tonnage);
- cargo-based charges: for the provision of port general infrastructure for handling cargo on the land side;

- stevedoring charges (though not a TNPA charge): handling charges for unloading cargo and its handling from receipt to dispatch and;
- landside charges: including customs duties fees to brokers, freight forwarders and other transport operators.

Ports and port infrastructure are constructed and maintained by the TNPA, which provides facilities at a cost that is recovered through a process of charging users a tariff for using port facilities and services. The tariff charged by the TNPA to port users is for using marine services, landlord services and cargo dues. South Africa's eight commercial ports are publicly owned and the decision on port tariffs is given by the Port Regular through a review process of submissions by the Transnet National Ports Authority and comments by port users. Even though both the Ports Regulator and Transnet are state-owned, they are independent of each other, which makes the decision on port tariffs interesting from the perspective of looking at revenue generation by the TNPA and for protection of port user interest as detailed in the Ports Act of 2005.The Port Regulator is a statutory and regulatory body within the Ports Act,2005 which is tasked to exercise economic regulation of the port system in line with government's strategic objectives and consider proposed tariffs of TNPA (National Ports Act, 2005:32). South Africa's eight commercial ports are publicly owned and the decision on port tariffs is given by the Authority with the approval of the Port Regulator through a review process of submissions by the Transnet National Ports Authority and comments by port users. South African port pricing conforms to principles of cost-based pricing for services although a unique and historically specific variant to strategic pricing is practised through wharfage, which was changed into cargo dues from 2001 (NEDLAC, 2008: 11).

It is also appropriate to give a brief history of South African port tariffs, where the current tariffs came from and what reforms have been made in the tariff structure. The history of port tariffs can be traced back to wharfage fees. South Africa introduced ad valorem wharfage in 1925 and these tariffs have shaped the transport system in the country (NEDLAC, 2008: 20). Wharfage is a category of general tariffs that are based on either the value of cargo or unit based (tons, TEUs, cubic metres) with the revenue generated by these tariffs used to pay for landside equipment, infrastructure, and administration (NEDLAC, 2008: 16). In South Africa, wharfage functioned as a key revenue contributor and central financing instrument for the rail and port system. Wharfage was levied to cover the costs associated with cargo handling infrastructure in the ports, such as the provision and maintenance of wharves, roads, rail tracks, cargo warehouses, storage sites and hardened surfaces.

The South African port system eliminated ad valorem wharfage charges in 2002 in order to achieve a more fair, efficient and competitive system and replaced it with a set of cargo dues that are cost related. The previous discrimination against high value cargo was removed to bring South Africa in line with international practices (Jones, 2002, cited by Gumede & Chasomeris, 2013). The change of wharfage into cargo dues attempted to close the extent of cross-subsidisation and cost-price irregularities across marine and cargo functions (Jones, 2002). In South Africa, wharfage functioned as a key revenue contributor and central financing instrument for the rail and port system. It is clear that South Africa needs to relook at its waterfront charges, which are high, in order to balance them with liquid oil imports needed by the country (Department of Transport, 1998, cited by Chasomeris, 2006: 108).

Table 3.4 Port authority tariff categories in 1980s.

FUNCTION	TARIFF	PRICES/COST SKEWNESS	% OF TOTAL REVENUE
Marine Infrastructure	Port, berth dues	Price well below Average Cost	# 3
Cargo-working Infrastructure	Ad Valorem Wharfage	Price substantially exceeds Average Cost	#55
Cargo Services	User Charges	Price-Average Cost	#30
Miscellaneous			#6

Source: Chasomeris, 2006

The ad valorem wharfage of cargo-working infrastructure was providing about 55% of the port authority's revenue, making up the bulk of Portnet revenue and making Portnet a major profit contributor to Transnet (NEDLAC, 2007: 21).

Ad valorem wharfage had two dimensions: it was value-based rather than cost-based and prices were set at high levels, which grossly skewed revenues in excess of costs. Wharfage had no bearing on the operational activities that took place before putting the shipment cargo on the ship and consequently wharfage charges had no bearing on operational activities prior to the placement of landed cargo on the quayside in respect of which landing and shipping charges were maintained (Chasomeris, 2006: 105). This, therefore, meant that wharfage excluded tangible items of superstructure such as gantries, wharf crane or cargo handling equipment and terminals for which explicit charges were raised (Chasomeris, 2006: 105).

Ad valorem wharfage also favoured low value export commodities as it was proportionally lower than wharfage for high value commodities while using the same infrastructure and port services. The import substituting regime was replaced by a manufacturing export-led economy in 1996 but even after this, pricing at the ports remained unchanged.

The other issue to be considered is that ad valorem wharfage was high because prior to 1994 there was strong support for investment in capital and energy intensive economy which continued after the inception of democracy in 1994, when there was a change in industrial policy. In the case of port charges in South Africa, all imports and non-mining exports subsidised mining port costs. The South African port tariff system faces the challenge that the system does not conform to the traditional landlord port model where the public sector/private sector interface would be allocated at the quayside edge.

3.6.1 Analysis of cargo and port dues as applied to the ports

This section deals with an analysis of port tariffs applicable to the ports, dealing in particular with cargo and port dues, providing insight into the views of the applicable charges to the ports and suggesting a way forward on how to deal with such anomalies and issues of equity raised by the application of the approved tariffs .

The TNPA charges marine and cargo fees against bulk movement of oil industry cargo in the form of cargo dues and marine charges comprising of pilotage, towage and mooring and provides assistance to ships to safely enter and leave ports and move around the harbour. This service in

South Africa has been provided by the port authority although private providers could give the same service. Cargo dues contribute about 70% of total revenue while marine services (pilotage, towage, berthing, safety services, repair facility hire) contribute about 17%. Lease income is about 13% (NEDLAC, 2008: 27).

The ports also charge pilotage, based on vessel size in gross tons. These costs will vary with distance of the pilotage service and the degree of navigation hazards found in each port and its approaches. Pilotage costs have had a substantial upward adjustment since 2005 in that they have increased in line with the Consumer Price Index (CPIX). This means that pilot charges for Durban and Richards Bay have risen by 66% and 78% respectively. This has caused a lot of concerns, particularly with the oil industry because ports have not justified the increase in expenses incurred by themselves in providing services based on gross tons of the vessel. Ports have however continued to levy such charges based on a less explained methodology.

South African ports also charge port and berth dues for mooring, protected water, channels and berths. Port and berth dues are uniform across all ports irrespective of infrastructure or maintenance expenditure at particular ports, which is problematic in certain ports where the infrastructure was built and is maintained by the oil industry.

The legacy of South African port pricing and freight system always reflected a system designed to support an import substitution economy, illustrated in the current port tariff structure, which is awash with distortions (Chasomeris, 2006: 103). The legacy of these distorted port tariffs is seen in the oil industry as well. Thus South African ports generally set prices well below full cost recovery for a number of port functions, including marine infrastructure and services. Port dues (payment by vessels for the use of marine infra-structural assets such as dredged approach channels, fairways and turning basins, tug charges and pilotage charges) generated revenues below associated costs (Chasomeris, 2006: 103).

The structure of port tariffs applicable to the oil industry is a clear indication that South African ports have inherited many performance and pricing problems. There are two distinct sets of port tariffs applicable to the oil industry as well as to major port users. These tariffs relate to the overarching marine infrastructure of the ports and to specific berthing infrastructure that are levied against the vessel and tariffs that relate to the cargo handling infrastructure are levied against cargo owners. The TNPA levies marine charges and cargo dues against the bulk movement in the oil industry. This is contrary to the time when the port structure fell under one umbrella, where landing and shipping charges were applicable and wharfage was raised thereunder. The split and transformation of wharfage into cargo dues attempts to close the extent of cross-subsidisation and cost-price irregularities across marine and cargo functions. This change also meant that the South African Ports Operator (SAPO) no longer had a role to play in the bulk oil industry movement through the ports.

Although the TNPA has tried to set port costs to align with the country's inflation, cargo dues still remain high because there is a source of revenue for the TNPA and also because the need for future investment in port infrastructure remains high, especially as the provision of appropriate capacity and infrastructure timeously is important to facilitating growth (Chasomeris, 2006).

Cargo dues form a substantial portion of the TNPA's revenue. Annual increases since 2003 have been kept well below CPIX but have started to rise since 2005 (NEDLAC, 2008: 31). Pricing of bulk materials handling like the handling of crude oil volumes, refined product and bunkers is based on volumes and material characteristics. The prices are usually commercially confidential between the TNPA and the port users.

As intimated in Section 3.6, ports infrastructure in South Africa is state-owned through the TNPA, while a majority of port operations are run by Transnet Port Terminals (TPT). Tariffs in South African ports still remain high compared to other international ports, thus driving efficiency levels. The current tariff system used by the ports aims at standardising port charges in all ports in the country. The system of ports also aims at creating ports that are seamlessly integrated in the transport network, which will also help increase efficiency for a growing customer base. This limits competition between ports for services within ports and reduces the incentive to invest in the port system, which has caused a backlog in port infrastructure delivery particularly for liquid bulk. Competition between ports remains weak largely because the TNPA is the only entity allowed to develop, manage and set tariffs for ports in South Africa. Additionally, intra-port competition is low, given the dominance of TPT in the cargo handling business (Chasomeris, 2011).

The South African port system then replaced ad valorem wharfage with cargo dues in 2002 in a bid to remove the previous discrimination against high value cargo and to achieve a more fair, efficient and competitive system to bring South African ports in line with international practice (Jones, 2002a; Jones 2003a). The NPA eliminated ad valorem wharfage as part of the port transformation process, acknowledging that South African ports have inherited many performance and pricing problems. This means, however, that there were clearly gainers and losers from the new dispensation (Chasomeris, 2006: 112). The NPA now acknowledges that there are pricing issues; more importantly, the NPA are willing and able to address many of these pricing anomalies. The old tariff setup was unbundled and repackaged to fit the new bipolar port structures. "The objectives of NPA tariff reform were clearly stated as being to create a transparent tariff structure based on user pay and cost coverage in relation to the provision and maintenance of basic port infrastructure" (Giladi, 2003: 102). These changes marked the first substantial reform of South African port tariffs in the last fifty years (Jones, 2002a).

In overall terms, then, cargo functions were thus used to subsidise marine functions and to close the extent of cross-subsidisation and cost-price irregularities across marine and cargo functions (Chasomeris, 2013, citing Jones, 1988b and Chasomeris, 2011). The TNPA uses the required revenue to calculate its proposed tariff increases and to charge tariffs for the various facilities in ports, including the ones used by the oil industry (Gumede & Chasomeris, 2013; TIPS, 2014: 65). The required revenue method seeks to ascertain the required capital including justified and guaranteed returns on any port investment made by the TNPA. This method ultimately entails that port users pay for all port investments and all port operating costs, whilst allowing the TNPA to make an agreed rate of return on its assets. This has been criticised by port users in that it means that port users would pay for all port investments, pay all port costs and pay for the TNPA to make a profit despite its inefficiencies (Gumede & Chasomeris, 2013: 8). Port users have also complained that the resultant revenues accruing to the TNPA are a clear indication of over-recovery by the TNPA (Gumede & Chasomeris, 2013). The stakeholders also argue that the tariff methodology does not provide any incentive for the TNPA to reduce costs or improve efficiency as it guarantees the TNPA full cost recovery and profit, even though some cost items may be higher than necessary due to inefficiencies. Port users also still feel that they are subsidising the TNPA, despite assurances by the TNPA that the approved tariff increases given by the Ports Regulator are far short of the requested increases. Table 3.5 shows tariff increases between 2009 and 2013.

Table 3.5 Selected products with different % increase: Proposed and actual tariff increases

Products	2009/10 Tariff	2010/11 Tariff	Actual % increase 2010/11	Prop. Tariff 2011/12	Prop.% increase 2011/12	Actual % increase 2011/12	Actual.% Increase 2011/12	Prop. Tariff 2012/13	Prop. % Increase 2012/13	Actual tariff 2012/13	Actual % increase 2012/13
Crude & Petroleum products	13,12	23,62	80,03	26,43	11,90	24,68	4,49	16.91	(31.48)	14,72	(40,36)
Molasses Products thereof	2,62	2,74	4,58	26,43	864,6	2,86	4,38	3,38	18,18	2,94	2,80
Chrome Ore	4,73	4,94	4,44	10,73	117,21	5,16	4,45	6,09	18,02	5,30	2,71
Coal	2,62	6,54	149,62	7,32	11,93	6,83	4,43	3,37	(50,66)	2,94	(56,95)
Ores & Minerals Magnetite	2,62	10,48	300,00	11,73	11,93	10,95	4,48	3,37	(69,22)	2,94	(73,15)
Vermiculite	12,86	13,43	4,43	40,89	204,47	14,03	4,47	16,56	18,03	14,42	2,78
Woodchips	5,50	5,74	4,36	40,89	612,37	6,00	4,53	7,08	18,00	6,17	2,83

Note: Prop = Proposed

Source: *(Gumede & Chasomeris, 2013: 13)*

There have been concerns about tariffs for cargo dues in South African ports despite the TNPA's proposed new strategy (to be effective in 2015/2016) aimed at enabling ongoing investment in the maintenance and extension of the South African port system, and ensuring effective cost recovery across all national ports. With this in mind, the proposal to have one basic rate for cargo dues for each different cargo handling type (for example, containers, dry bulk, break bulk, liquid bulk, automotive), which will replace the current differentiation of cargo dues by commodity, will be most welcome in the oil industry. Also, all the changes intimated by the TNPA, including deviations from these base rates for cargo dues, will be introduced in line with government priorities for promoting exports and beneficiation industries. However, there is concern about these reductions although there have been assurances that they would be determined on a fair basis and that they will have to be offset by increases in cargo dues for other types of cargo, for which there is no clear justification.

Cargo dues contribute the bulk of revenue the TNPA raises through tariffs. Cargo dues contribute about 60%, with liquid bulk contributing 5% thereof or a total of 9% of all cargo dues. The TNPA derives about 36% from marine charges (pilotage, towage, berthing, safety services, repair facility hire and miscellaneous charges). The TNPA (2012: 7) confirms that the current tariff structure is characterised by a lack of the following:

- ‘A clear set of principles and rules to be applied in determining the individual tariffs for the various services and facilities;
- Clarity and transparency regarding all operating costs, expenses and revenues incurred or generated from a specific service or facility, as well as the value of the capital stock related to such services or facilities;
- Explanation for differential tariffs for different commodities using the same handling classification;
- Information detail with respect to services or facilities pricing and cost relationships, making it possible to determine where and in which direction subsidisation takes place or if it does not;
- Information on how the tariff promotes access and efficient and effective management and operations of ports.’

3.7 A BRIEF ANALYSIS OF THE SOUTH AFRICAN PORT COST STRUCTURE AND THE OIL INDUSTRY

Petroleum infrastructure includes ports, wharves/berths, discharge facilities, pipelines, storage tanks at terminals and other remote locations, as well as facilities for loading petroleum products onto road and rail transport. Terminals are those storage facilities where refined petroleum products are received from either refineries or import facilities although crude oil terminals receive much larger volumes. Fuel is distributed from terminals by truck or rail or pipelines to bulk users. All terminals have loading gantries and storage and can be supplied by pipeline or by ship, which makes the construction and maintenance and management of liquid bulk facilities critical.

An understanding of the determinants of import capacity is vital in analysing the cost structure in South African ports. The determinants of fuel import capacity are the number of terminals around the ports and the capacity of each terminal and its associated infrastructure. In South Africa, the main terminals are in Durban (SAPREF, Engen), Cape Town (operated by Caltex) and Richards Bay, the SBM in Mossel Bay and Saldanha Bay (operated by Total). The existence of terminals is influenced by the fuel trade flows and the historical development of fuel distribution. Fuel trade flows determine import transportation as well as exports and infrastructure development in ports.

A fuel terminal's capacity should be measured as a flow or throughput over a period of time (such as a year) rather than the physical size of the terminal or the stock it holds at a given point in time. Beside the number of terminals around ports and their capacities, demand patterns, delivery infrastructure, shipping schedules, berth capacity, tank storage and load-out facilities are critical as determinants of import capacity. Interactions along the supply chain determine ultimate capacity and the capacity required has a bearing on costs. Capacity is not an absolute concept as it depends on operating conditions that apply at individual port terminals and in the supply network from time to time. In cases where there are no bottlenecks, it is usually possible to increase throughput above normal operating capacity but with increased costs (such as increased demurrage and shipping costs).

The South African port tariff system is problematic. As intimated in section 3.6.1, South Africa's port prices are skewed. The high port tariffs seem not to take cognisance of the fact that 96% of South Africa's exports (by volume) are by sea and that the competitiveness of the country's ports has a direct bearing on the competitiveness of its industrial and export activities. Port tariffs should take cognisance of South Africa's geographic location and size and ensure that port tariffs are fair and give access to efficient infrastructure. South African port tariffs should not be used to cross-subsidise other Transnet activities; instead they should promote industrial policy objectives and should be in line with international port rates.

Pricing for services within ports and port calls should, in principle, be proportional to the costs of a ship making the call and this covers four principal costs namely: general land and marine infrastructure (not attributable to a single user), time spent in the port, use of a berth (attributable to a single user), and the cost of handling goods (NEDLAC, 2007: 1).

The current structure has gaps and various concerns have been raised over the years by numerous private firms, in particular oil majors. Besides the high cost structure, which is still the main factor behind transport costs, the efficiency of ports is most important and can be most directly affected by government. The major complaints, amongst others, have been that the current South African port pricing system lacks a clear set of principles and rules for determining individual tariffs for the various services and facilities and a lack of information on how the tariff structure promotes access to ports and efficient and effective management of ports (TNPA, 2012). There have also been complaints that *'the South African ports, and indeed the transport sector as a whole, have a long history of getting prices wrong. Consequently it is little surprise that they also have a history of misallocating resources across and within modes'* (Jones, 2002). Complaints ranged from infrastructural charges in cases where users claim materially to provide their own infrastructure (in particular, the liquid bulk market) to concerns about efficiency relating to costs of vessel time due to poor infrastructure or lack of planning or poor pumping rates in terminals.

The nature of port tariffs charged by the TNPA for liquid bulk defines the relationship between the authority and the stakeholders. The oil industry in particular has always complained that the TNPA is abusing its monopolistic power, hindering global competitiveness, not taking cognisance the state of the country's economy, charging prices that are higher than inflation, is non-compliant with national policies, is not applying cost-based pricing principles, and is not following a justifiable pricing methodology (Gumede & Chasomeris, 2013: 2).

The South African port system is configured so that in some ports cargo handling infrastructure is owned, managed and maintained by the port, hence the authority reasonably raises marine charges against the vessel owner and cargo dues against the cargo owner. However, this arrangement might not reasonably work in cases where ownership, management and maintenance of cargo handling infrastructure lie in the hands of the oil industry. This configuration seeks to challenge the way the TNPA raises some tariffs particularly in the oil industry. Marine tariffs are charged for the rendering of marine infrastructure like pilotage, tug assistance and berthing. Port dues are raised

to cover the ‘wet’ infrastructure of the port, that is, breakwaters, turning basins, aids to navigation inside the port and maintenance dredging of the port. Cargo dues are raised to cover the ‘dry’ infrastructure of the port, that is the provision and maintenance of quay walls, roads, railways, building, fencing, security, lighting-outside terminal boundaries (Chasomeris, 2006). Cargo dues still remain a major revenue source as future investment in port infrastructure remains high, especially as the provision of appropriate capacity and infrastructure timeously is vital to facilitating growth in South Africa (Chasomeris, 2006).
In Durban, the SBM was built, owned, operated and maintained by the oil majors. Port authorities have no basis to charge cargo dues against cargo owners, since cargo owners themselves bear all the associated costs of ownership, management and operation of the entire cargo handling infrastructure–although they still pay cargo dues. The oil industry has always argued that the TNPA uses a good pricing structure and objectively in order to fulfil one of its most primary function as a trade facilitator (Giladi, 2003: 85). The TNPA should consider two distinct sets of principles when dealing with port pricing related to oil majors: consideration of cost and consideration of equity. Cost consideration relates to the marginal cost principle whereby the price of a service or function is equated with the marginal cost of provision of that same service or function, while equity consideration relates to principles of benefit and ability to pay.

The TNPA is using the benefit principle to the letter, in that those befitting from a service being provided to them should pay for it. The relationship between oil majors and the ports is an equitable one. Oil majors are paying cargo handling dues for the right to use facilities they created and own themselves and this has been problematic. The other important issue is the deteriorating port/oil industry relationship, which is a result of the pricing structure levied by ports.

The whole question of who pays for port facilities used by the oil industry has been at the heart of discussions between port users and the TNPA. This debate has brought in the Ports Regulator and has allowed port users like oil majors and other users to deliberate on the tariff submissions by the TNPA.

Although it was hoped by oil majors that the removal of the ad valorem wharfage charge to a per/kilolitre rate in October 1999 and the subsequent reduction over the years thereafter is evidence of tariff transformation although there is still dissatisfaction by the oil industry. The three different applicable charges for petroleum products–import, export and coastwise–are levied.

To be fair to the TNPA, the whole process of port tariffs application has been a transparent one, with the TNPA submitting a seven-year application and allowing comments by the users. These comments are deliberated on by the Ports Consultative Committees and submissions are made to Department of Transport and the Ports Regulator who then issues the 'Record of Decision' ruling on the percentage increase as requested by the TNPA, balancing that with the views of the port users.

South Africa also needs to correct the fact that the tariff structure has always been hugely weighted in favour of the export of raw mineral commodities at the expense of the manufacturing sector although this is addressed by the TNPA proposal. The skewness of South African port charges reflects that charges are substantially higher for cargo compared to marine/terminal charges, illustrating that cargo-based charges are cross-subsidising ship-based charges.

Inefficiency caused by these factors calls for urgent port reform in order to improve efficiency. Inefficiency is passed down to users in the form of delays and high opportunity costs, while improvements in efficiency will result in productive ports. The result is passed to end-users in the form of lower final distribution costs (Urban Econ, 2010).

It is important to explain that port costs are part of the entire logistics value chain (Bichou & Gray, 2004; Carbone & Martino, 2003). South African ports follow the same method described by Pettersen-Strandenes and Marlow (2000: 4), which is based on a cost-based pricing method for cost recovery, congestion pricing, strategic port pricing and commercial port pricing. South African port pricing conforms to principles of cost-based pricing for services except for wharfage, which was changed to cargo dues in 2002.

All these anomalies have led to calls for the TNPA to be separated from Transnet and established as an independent state-owned entity. This very process is fully in line with the precepts of the National Ports Act of 2005 (TIPS, 2014; National Development Plan, 2030). The anomalies have continued despite the fact that in 2002, the port infrastructure was separated from the services to form the National Ports Authority (NPA) and SAPO, which was later named Transnet Port Terminal (TPT) both still continuing to be owned by Transnet.

One of the major areas of concern has been that port tariffs were used to improve the income of Transnet as a whole, cross-subsidising other activities. This had serious negative consequences for investments in port infrastructure and competitiveness of tariffs and has been to the detriment of promoting industrial policy objectives. Tariffs in South Africa were higher than those internationally with lower efficiency and fewer, lower quality services provided by the ports. This led to Transnet not addressing past deficiencies, in particular, high tariffs. Although the government and the NPA have shown willingness to acknowledge and address many of the ills of the past, this has not convinced the oil industry because the industry still feels that not enough has been done to transform the ports. On the other hand, government and Transnet have allocated funds for the upgrading and maintenance of port infrastructure and superstructure. Improved pricing principles moving from value-based pricing principles towards a more cost-based (and user pays) pricing approach, while concurrently attempting to reduce the historical imbalances between port dues and cargo dues and the consequent intra-port cross-subsidisation. The oil industry has also lamented that the problems of the less favourable relationship between it and Transnet stem from a conflict of interests: Transnet owns both the landlord company (NPA) and the company that is the main user of the ports (TPT). Transnet's use of the profit generated by the ports operation to subsidise other operations in the group increased the underinvestment in port infrastructure, thus heightening the conflict between Transnet and port users. This has highlighted the short-sighted outlook on the development of facilities through investments, thus downplaying the importance of the required revenue approach proposed by NPA.

A further issue was to ensure that the challenges in the ports sector needed to be addressed and a regulation approach taken to ensure that ports operate in the best interests of the country in line with the mandate spelt out in the legislative framework rate entity. Those arguing for the unbundling of the NPA from Transnet argued that such a move would enhance competitive pricing within ports and would limit the narrow, profit-maximising interests of Transnet. The NPA would then report to the Department of Public Enterprise (DPE, 2000). It should be noted that by 2013, the separation of powers had still not taken place although significant progress has been made by the Ports Regulator in reducing tariffs; for example, distribution of revenues from cargo dues was at 11% in 2014 but future revenue contribution is estimated at 9%. Meanwhile, beneficiation rebates for liquid bulk exports produced through the beneficiation of South Africa's natural resources (which includes fuel) are estimated at 10% (DTI, 2013; TIPS, 2014). Because Transnet has recognised the complexity and financial implications of unbundling, separate institutions are being established to deal with this. The Ports Regulator, established in 2009, has played a key role in reducing key tariff lines as seen with the tariff decision of 2013 which limited key tariff lines to below or at-inflation levels (Das Nair & Roberts, 2014).

3.8 CONCLUSION

The energy situation in South Africa needs to be examined from the perspective of energy as strategic stock. The quantum of strategic crude held by South Africa has been decreasing dramatically since 1993 after the lifting of the embargo by the United Nations. In response to sanctions, South Africa stockpiled crude in dormant mines to meet demand requirements. The management of strategic stock is central in the discourse of developing port infrastructure required to hold, supply and deliver such stock. Liquid fuel has become more critical as strategic stock particularly because the liquid fuels industry is overstressed and failing under pressure and lack of governance in the sector. Also, South Africa's 40-year-old refineries have not had the required investment to keep up with increasing demand. Coupled with this is the increasing supply/demand imbalance in liquid fuels, which currently forces this country to import about 20% of refined products as fuel demand exceeds crude refining.

There is a need for robust thinking, given the mismatch between the need to increase port capacity to accommodate crude oil and refined products and providing bunkers and that of lowering port costs, which are seen to be high compared with global practice. The increase in demand for refined product landed at Island View in Durban, which is estimated to reach 31,8 million tons by 2043, calls on the port authority to forecast cargo dues and port dues in line with industrial policy. The ideal pricing structure of port infrastructure is still problematic because the current tariff structure lacks a clear set of principles and rules to be applied in determining the individual tariff for various services and facilities. The South African freight system and port pricing strategy, which always reflected a system designed to support an import substitution economy, was also discussed.

Analysis of the tariff rates shows that the South African port tariff system faces challenges such as the lack of conformity with the traditional landlord port model where the public sector-private sector interface would be allocated at the quayside edge. The analysis of tariff rates shows that there are still some flaws and that in order for South Africa's liquid fuel industry to be competitive our ports need be planned accordingly (Claasen, 2002; Phasiwe, 2004). High tariff rates that do not support industrial policy and fuel demand and supply outlook are concerning since these are likely to incur the risk of forcing the industry to absorb higher effective port costs. These imbalances are historical because the TNPA has always been a monopoly. Although some port infrastructure, like the SBM in Durban and Mossel Bay, was financed and built by the oil industry, the TNPA still charges the oil industry port dues on these infrastructures.

Finally, it has been seen that there is a need to integrate energy planning and for South Africa to review its mix of contemporary port systems and to address inefficiencies in port planning.

CHAPTER FOUR

RESEARCH METHODOLOGY

4.1 INTRODUCTION

This chapter seeks to outline the methodological approach used in assessing energy demand and associated planning failures by ports in view of burgeoning energy demand as identified in Chapters Two and Three. The data is presented and analysed in Chapter Five. This chapter centres on the research methodology and approach, emphasising the data collection techniques as well as giving a justification of the research methods used. The focus is on the methods used in understanding in the study which are explained in detail in this chapter.

The chapter also highlights aspects of the sample population and also discusses how ethical issues were handled. Since the research utilised questionnaires and interviews (structured, semi-structured and unstructured) to examine the themes, this chapter will set out the steps and processes whereby these research instruments were used. The steps in evaluating the interview design process, that is, defining the questions and designing follow-up questions to responses, will also be explained in considerable detail.

To interrogate the facts, the researcher only interviewed and sent questionnaires to a sample comprising port authority representatives (harbour masters and port managers), port planning professionals, port infrastructure economists, port users, representatives of oil majors who utilise ports, liquid bulk traders and operational representatives and shippers and supply chain professionals who deal with ports.

A significant number of respondents that form the key-focus group per port were interviewed in order to have an interactive process and to get appropriate information. The methods used also included site visits and observation that entailed collecting all the data through occurrences that can be observed visually. In these situations the researcher became a participant observer in order to formulate research questions for enquiry, as suggested by Mengwe (2010) and Treece and Treece (1986). All these are discussed in detail in the relevant sections of this chapter.

4.2 RESEARCH METHODOLOGY AND APPROACH

The research used a variety of methods including qualitative, quantitative and mixed methods. A justification of the methods used is made. The qualitative research method deals with words to describe course of events while the quantitative research approach deals with the collection and use of numbers to present information. Thus the use of the qualitative method was complemented by a quantitative method to uncover unique variances that might not have appeared with a single method investigation. The mixed method research, as suggested in section 4.1 of the study, includes one quantitative method design to collect numbers and one qualitative method to collect non-quantified views and interpretations (Ehige & Ehige, 2005). Leedy (1997: 106) and Ehige and Ehige (2005) have summarised the differences between the two major research approaches.

The research study selected ports in South Africa, namely the port of Durban's wet bulk facilities, the port of Richards Bay (although this is mainly a dry bulk port), the port of Cape Town, Saldanha, the port of Ngqura and the port of Mossel Bay. These ports were selected as they present useful information on the port planning and development strategies in relation to energy demand. This research has employed a multi-disciplinary methodology and approach requiring several kinds of expertise and sources of information. It thus lent itself to the use of a series of complementary methods in order to gain insight into the research problem.

A diverse range of methods has therefore been applied, with the advantage that the methods enhance capacities for interpreting meaning and behaviour as suggested by Hoggart, Lee & Davies (2002). The use of various methods eliminated the biases that are inherent in each of the methods used.

Table 4.1 is a summary of the differences between the qualitative and quantitative methods.

Table 4.1 Differences between qualitative and quantitative research approaches

Question	Quantitative	Qualitative
What is the purpose of the research?	To explain and predict. To confirm and validate and test theory. Outcome oriented	To describe and explain. To explore and interpret and to build theory. Process-oriented
What is the nature of the research process?	Focused Known variables Established guidelines Static design Context free Detached view	Holistic Flexible guidelines Emergent design Context bound Personal view
What are the methods of data collection?	Representative, large sample Standardised instruments	Informative, small sample Observation, interviews
What is the form of reasoning used in analysis?	Deductive analysis	Inductive analysis
How are the findings communicated	Numbers, statistics, aggregated data, formal voice, scientific style	Words, narratives, individual quote, personal voice, literary style

Source: Leedy (1997: 106)

All three approaches (mixed method, qualitative and quantitative) employ several techniques, including questionnaires, to collect data. Ehige and Ehige (2005) agree that although questionnaires form part of the qualitative approach, their use has been limited to quantitative methods, while Guba and Lincoln (1989) give a historical overview of the paradigm shift from quantitative to qualitative research designs. They argue that this has been fuelled by dissatisfaction or the inadequacy of using quantitative approaches alone in observing and measuring human behaviour.

Critiques on quantitative techniques have questioned the superiority of the technique for dealing with human behaviour. Quantitative analysis is full of ambiguity and vagueness, since it fails to tackle complex human problems. These issues are frequently subjective and intangible – and usually escape the quantitative research approach. Thus, for that reason, this research project used a variety of methods rather than only the quantitative approach.

Qualitative research methodology uses observation interviews, ethnography, questionnaires and documents. Although theory allows for the use of observations together with interviews, to conduct qualitative research, the researcher mainly used interviews, because observation requires that one should monitor the behaviour of the personnel and transform that into a transcript. Observations were used to a limited extent only in this research, to deal with biases inherent in interviews, particularly in the responses of the interviewees.

The research used interviews, because they provided an in-depth analysis of the issues that need to be addressed. Interviews also provided both the researcher and the interviewee with an opportunity to revisit questions and answers in order to get an in-depth understanding of these issues. Interviews also allowed further engagement on the questions in instances where both parties were not clear. The answers given by the interviewees were non-predictive or not anticipated: they provided the researcher with an opportunity to ask further questions. Interviews also allowed random samples to be drawn and for the standardisation of questions to be done. A full critique and analysis of the interviews follows in later sections of this chapter.

4.3 QUESTIONNAIRE SURVEYS

Questionnaires were used with interviews to extract information on the impact of energy demand on port infrastructure. Open- and closed-ended questionnaires were used to obtain quantifiable data on the impact of unit costs on port planning and the relationship between planning and energy demand.

Although designing open- and closed-ended questions was time consuming, it was nevertheless a valuable method in eliciting the interested and affected parties' views on port planning methodology, energy demand and tariffs. The open-ended questions also dealt with estimation of the port planning process, estimation of monetised benefits to the port planning process as well as estimation of non-monetised benefits that accrue because of the planning methodology. Port planning as a process has become an invaluable tool because it talks about the benefits accrued as a result of planning, such as to accommodate larger and deeper-draft vessels and to secure resultant economies of scale.

The same questions were applied to understand the relationship between ports and the hinterland transport operations. Questions on port planning methodology and evaluation of port projects were seen to be critical because this would provide flexibility and adaptability by a port and enhance provision of infrastructure. This will also give flexibility to ports to change capacity to meet changing trade requirements. This will also make them robust in the face of uncertainty; lengthen their economic lifetime, thereby guaranteeing payback on investments.

The qualitative components about the relationship between ports and energy demand included:

Energy Planning:

- Energy demand and liquid bulk cargo imported through the South African port system.
- Energy planning – understanding the link between port planning and energy planning.
- Energy planning policy in South Africa and its influence on the development of maritime development policy.
- The impact of energy demand on refined energy and port infrastructure demand.
- The relationship between crude oil demand and seaborne trade growth.
- The relationship between the TNPA and the oil industry.

Port Methodology:

- How do ports maximise their throughput?
- Port authority and tariffs.
- Capacity and port readiness.
- Understanding the port setting, for example, the creation of perceived value.

Energy supply side:

- Overview of cargo flows through the port system and the structure of cargo flows through specific ports.
- The link between energy supply and port handling capacity.
- The link between ports and capital investments.
- Liquid energy as capital stock.

Thus, this is an exploratory and descriptive research study of various ports in South Africa. The research approach used was therefore qualitative in nature centred on interactive structured and semi-structured interviews that were complemented by questionnaires and observations to uncover a unique variance that might not have appeared with a single method investigation.

The methods used were intended to interrogate and explore port planning methodology, the relationship between increased energy demands on the development of marine infrastructure, the value of shipping on the whole energy and mineral value chain debate and to understand whether there is disconnection with port planning.

4.4 DATA COLLECTION TECHNIQUES

As stated earlier, information in this research project is based on questionnaires, interviews with several key informants, including SAPIA members, the TNPA, the Ports Regulator, SARS, port planners, port economists, port management and port users, as well as on the information collected during site visits and observation.

The analysis of the effectiveness of the methods – questionnaires, interviews and observations – is dealt with below. It is also imperative to note the importance of the literature (reviewed in earlier chapters), as well as the survey, in answering questions and sub-questions posed by this study.

4.4.1 Interviews

The research study used informative interactive interviews to interrogate the issues in the value of shipping on the whole energy and mineral value chain debate. These interviews were both semi-structured (formal) and unstructured (informal) and furthermore, they were conducted with the primary purposes of examining the relationship between port infrastructure and seaborne commerce, energy demand and port planning, energy as strategic stock and how this affects demand for berthing space for liquid bulk in ports.

Interviews provided a personal interaction between the interviewer and the interviewees and afforded the opportunity to interview and interact with different groups within the ports industry.

A detailed interview guide (Appendix A) was used to generate responses and outcomes. The advantage of this is that it enabled the researcher to adapt the working and sequence of the questions to the kind of information received and also made it possible to pursue information that was raised during the interview – even if the questions were not among those originally specified.

The interviews were conducted in an open environment, with the participants being made aware of their voluntary participation in the interview process, as well as the length of the sessions. Participants were also made aware that these interviews were for academic purposes only, and that there was no financial gain when participating in these interviews.

The use of interviews enabled opinions, networks of relationships and ideas to be presented and qualified. The interactive informant interviews proved to be an essential data-gathering device, because once the researcher had gained rapport with the respondents, certain types of confidential information were obtained that the respondents had not been willing to disclose at the beginning of the interview process.

The use of interviews also allowed the author to observe the respondents' non-verbal gestures, which proved helpful and important in assessing the validity of the response and the intensity of feelings on controversial issues. As stated earlier in this chapter, follow-up questions were asked – especially in situations where the respondents indicated signs of not having understood the question.

The disadvantage of using this technique was that some of the respondents did not want to be seen as not understanding the questions asked, or else they simply did not trust the researcher, particularly when asked to give answers to controversial questions. The problem was further compounded by issues of loyalty on the part of the respondents who could not – or would not – answer certain questions or give opinions on the questions asked.

Thus the interviews proved important in acquiring the necessary data because they gave the researcher a chance to explain the investigation's purpose and just what information was sought more explicitly from the various groups of respondents. In addition, as earlier mentioned, they enabled opinions, networks of relationships and ideas to be presented and quantified wherever possible.

Therefore interviews proved an essential data-gathering device, because once the researcher had gained rapport with the interviewees, it became easy for respondents to even deal with certain information that they might have considered confidential and would have been reluctant to put into writing.

The researcher partly used structured questions in areas where there was a need to ask direct questions. In using interviews, the researcher became part of the measurement instrument. A general interview guide was used to collect specific information for the study. Even though the general interview guide was used, the respondent was still allowed a degree of freedom in answering the questions and the researcher could use follow-up questions to get more information from the interviewee.

The nature of the study also dealt with varied areas and a diverse group of port industry players, some of whom could not be reached in person, in order to conduct face-to-face interviews. This necessitated the use of telephonic and video conference interviews, the shortcomings of which are noted. These were that some of the respondents were uncomfortable about being called during office hours, while some were uncomfortable to be called at home, and some felt uncomfortable in giving their home phone numbers for the purpose of the interview.

Research interviews are normally divided into three categories: structured interviews, semi-structured interviews, and unstructured interviews (Fontana and Frey, 2005, cited by Zhang 2006). The difference between the interview types has been discussed in earlier sections of this chapter. It is important to note that the approach of using any interview type depends on what the interview is intended for, the relationship between the interviewer and the respondent, the conditions in which the interviewee finds himself or herself, as well as the sensitivity of the topic under investigation.

The following steps were followed during the interviews:

STEP 1.

1.1 The researcher drafted structured-specific questions on energy demand and port planning, energy master plan policy factors influencing development of maritime infrastructure, in particular for liquid bulk cargo and the impact of LNG as an energy source on port development and planning.

1.2 An application clearance with the questions was made to the Ethical Clearance Committee, explaining the requirements of the research project.

1.3 An explanation of the purpose of the research to all interviewed and requested to respond to questionnaires as a requirement by the university.

STEP 2. The time needed to conduct each interview is communicated in the Letter of Consent. The interview is scheduled to last for forty-five minutes only. A particular clause indicating that there is no financial gain is included in the letter.

STEP 3. An appointment was made with the respondents, and a sheet containing the questions to be asked during interview was enclosed. All the interviews and responses were detailed.

4.4.1.1 The interview process

As stated earlier, the nature of the research dictated that only specific respondents should be interviewed. Thus, specific ports and energy industry participants participated in the interview process (see Table 4.2).

The researcher forwarded the request for an interview, in which the background to the study was detailed. Some respondents even requested a letter/permission to undertake the research by their respective organisations before they would agree to be interviewed. The purposes for forwarding the formal request for an interview were the following:

To allow the interviewee to understand the background and purpose of the interview:

- to allow the respondents to prepare themselves to be interviewed and to set aside the requested time for the interview;
- to enable the respondents to understand that the interview was for academic purposes only; and
- confirmation of the respondents' availability and time.

4.4.2 Limitations in using interviews

Although the earlier discussions on the issue of interviews and their use in this study tends to depict them as effective methods for data collection, the researcher cautions on the excessive use of interviews, because of the limitations discussed herein. One of the limitations is that the researcher's epistemology and research objectives limited the formulation and testing of a hypothesis that could be used to benchmark because the answers provided by participants at the first instance did not provide a clear picture until they were probed with follow up questions.

The respondents' demographics could present some bias to the interviewer. For example, the interviewer may have some prejudice towards certain races, gender(s) or ages – leading to biased results. At times, the interviewer might approve or disapprove of the responses. The other limitation is that the interviewer might not have enough practical skills to obtain honest and detailed responses. Thus, the researcher had to guard against all these, something that was taxing in terms of time. The interviewer needed to be trained on how to take notes, to listen and to ask probing follow-up questions. Furthermore, the interviewer could not interview a large sample: the smaller the sample, the less representative it will be of the larger population. Nevertheless, the research had to use the interviews to generate data for the research project.
The selected participants were assumed to be representative of the larger population. The selected respondents included an assortment of people in order to avoid any bias by port planners, the TNPA, oil industry professionals, traders maritime and energy policy makers. For more details refer to the population sample.

The categorisation of participants ensured that all members representing the key-focus group were interviewed. As stated earlier, the researcher needed to understand the views of the diverse participants in the port/energy industry. These individuals were to be representative of the whole group and their views. For more details on the selection of respondents, see the population sample below.

It was noted that the whole debate about energy demand and its relationship with infrastructure development for ports deals with a wide number of participants, hence the need to categorise the interview process according to usage and interaction with the topic being researched. The researcher split the interviewees into smaller groups and avoided crowding everyone into one group: larger groups are often unmanageable, since the spread then becomes too wide. This also makes it difficult to undertake a study. It was also important that the size and composition of the participants could be accurately defined.

4.4.3 Observations

The researcher also utilised observations to a limited extent to collect data through occurrences that can be observed visually. This allowed the researcher to become a participant observer and establish a rapport in order to formulate research questions for further inquiry as suggested by Mac an Ghaill (1996). Observation was mainly used in ports – Cape Town, Mossel Bay, Ngqura and Port Elizabeth – to assess energy demand and to understand what port investment has been put in place to accommodate increased energy demand as well as extrapolating energy demand and port infrastructure development. This helped the researcher to gain an understanding of a phenomenon that could not be acquired through telephonic and other forms of interviews.

The strength of using observation was noted to contribute to an in-depth understanding of the research area, something suggested by Treece and Treece (1986). During the site visits and observations, the author used photographic and video coverage to facilitate a description of the visual layout of ports' liquid bulk capacities. The use of observation also helped the researcher to eliminate any bias given by the respondents during the interview process and in questionnaires.

Observations could therefore be said to have involved visiting liquid bulk terminals of ports included in the study. The observations served two purposes: (a) familiarisation with the general characteristics and port layout plans studied and (b) providing specific information about steps taken by ports to address energy demand and port planning. Hence, observation became a necessary tool to check what has been done to close any noted inefficiencies in port planning methodology.

The researcher used 'emic' and 'etic' approaches to observe behaviour. An 'emic' approach reinforces knowledge derived from the participants' understanding of their own culture and its relationship with particular patterns of behaviour. An 'etic' approach allows the researcher to place his perspective in understanding the culture of the participants by benchmarking it against the established norms of behaviour.

It is important that the researcher should justify the use of observations: the research instruments used such observations because the topic being studied was complex and required an understanding of complex behaviour of work teams. The observations made required the researcher to understand and focus on 'artefacts'. An artefact may be defined as 'a material object that is created by people specifically to facilitate culturally expressive activities' (Ehige & Ehige, 2005).

4.5 THE SAMPLE POPULATION AND SAMPLING PROCEDURES

The interactive informative interviews were centred on the interview guide questions provided in Appendix A, as well as the follow-up questions arising from the conversations between the author and the interviewees. To get a broad response that was representative of the views of various participants within the port industry the researcher interviewed respondents in the categories described above.

The people that were interviewed were grouped into six key-focus area groups. Table 4.2 illustrates the focus area groups and the total number of people involved in the interviews. From the key-focus areas groups, the researcher derived the sample population, which accordingly became the target group from where the researcher found information.

From these nine key-focus area groups, key informants or participants were identified and selected for the interview process. The various focus groups were selected through the positional and reputational approaches, which are based on formal leadership positions and a reputation for knowledgeability (Branch, Hopper, Thompson & Craghton, 1984 and Mengwe, 2010 cited by Ndebele 2012).

Table 4.2 The focus area groups for the sample population of the research study

Key informant focus area group	Description of representatives	No. of respondents
Port Authority	Harbour Masters/Port Planners/Engineers/port Managers	Twenty
Ports Regulator	Operations Manager/CEO/Researchers	Five
SAPIA	Port Users/Cargo Owners	Thirty
DOE	Energy Policy Planners	Four
DOT	Policy Researchers	Five
SAMSA	Regulatory Authority	Five
Others	Maritime Economists/Ships Agents	Eight
SARS	Customs officials	Four
Shippers	Owners/Brokers	Four

Source: Researcher

In order to avoid the deleterious effects of personal biases, the researcher employed the suggestion of Becker, Harris, Nielsen & McLaughlin (2004). Instead of hand picking the respondents in order to make a selection of respondents, the invited residents were selected using snowball sampling, in which the researcher used some of the key informants to name other people who could be interviewed.

4.6 DATA PRESENTATION AND ANALYSIS

Data presentation for the research project was based on descriptive information obtained through the questionnaires, interviews and observations. The data from the various key informants (respondents) were examined, compared and conceptualised as well as categorised in terms of properties and dimensions such as words, phrases, sentences and other expressions emanating from the data as suggested by Strauss and Corbin (1990: 61).

The data were then divided into manageable groupings or themes according to the questionnaires and interviewees (Appendix A). The data are thus basically presented in prose (continuous writing) according to the themes derived from both questionnaires and interview schedule. The use of a multi-disciplinary methodology and approach centred on the use of a series of complementary methods necessitated a multi-disciplinary data presentation approach.

4.7 ETHICAL CONSIDERATIONS

For ethical reasons and respect for confidentiality, in presenting the results of the interviews and questionnaires, the names of the key informants (respondents) are not used although the researcher has these names. For the same reason as above, the information is generalised to refer to a large population. The author thus protected the anonymity of the respondents since the respondents were assured that no physical or emotional damage would occur. Therefore, the research conforms to the ethical requirements of the University of KwaZulu Natal (See Appendix B).

4.8 CONCLUSION

The research project provided the researcher with the opportunity of discovering the personal experiences of persons associated with port planning processes and the possible inefficiencies that exist with the planning process. The research also provided a personal learning experience for the researcher and for the respondents, which will be shown in Chapter Five. The role of the respondents as representatives of a distinct population is acknowledged. The researcher also explains that the topic under research is ‘a single case-study’ evaluation; hence, the beneficial use of structured interviews and observations. The rigour that the qualitative approach brings gives meaning and form to the topic being studied. The results obtained – via this methodology described above – are presented in Chapter Five.

CHAPTER FIVE

RESEARCH OUTCOME AND ANALYSIS

5.1 INTRODUCTION

This chapter presents the research findings on energy demand and the planning failure or gaps for wet bulk cargoes associated with such demand and supply. The focus is to understand the liquid cargo traffic flow through the ports system, the structure of liquid cargo flows through specific ports, how ports have planned to receive and move liquid cargo and what ports have done to match energy demand with demand for berthing space for liquid bulk cargo in South African ports. The research results presented in this chapter are products of the methodology formulated in Chapter Four. The presentation of the results is centred on the broad questions presented in the interview guide (Appendix A) as well as questionnaires (Appendix B).

The presentation of the results of the research study is followed by the discussion of the findings. At the end of the presentations and the discussion, concluding statements for the whole chapter will be set out. The conclusions drawn from the case study are the researcher's and should not necessarily be associated with the various key informants involved in the research study.

5.2 PRESENTATION OF THE FINDINGS

This section is concerned with the presentation of the research study results. The results presented are based on the outcome of interviews with members of the focus groups as well as the observations and responses from the questionnaires. Although the results presented in this chapter are the outcome of applying the methodology discussed in Chapter Four, the researcher will reference the empirical work whenever the need to do so arises. Referencing is essential because the methodology used is multi-faceted. Therefore, for reference purposes, the researcher will refer to the interviews with the respondents as well as responses from questionnaires.

The results are presented following the sequence of questions used for the interviews (see Appendix A) and questionnaires (see Appendix B). Accordingly, the results were unpacked as follows:

- Energy demand and liquid bulk cargo imported through the South African port system. This provides the figures/volumes which will help to understand any structural changes in cargo flows through the ports of South Africa. The research also looks at the major petroleum products imported.
- The economic analysis of ports and port infrastructure.
- The relationship between the South African oil industry and the ports.
- The link between port infrastructure and seaborne commerce. This includes the analysis of the impact of limited refining capacities on the infrastructure for liquid bulk cargo. This attempts to address whether increased energy demand influences the need for development of marine infrastructure.
- The strategic role of ports. This includes unpacking the criticality of port planning in understanding the whole topic of energy development and ports.
- Port planning principles and energy security and liquid fuels in South Africa. This entails understanding port development theory and energy as strategic stock and how it has shaped future port planning and the linkages between port liquid bulk planning methodology and energy security.
- Liquid bulk planning and port readiness: Assessing the readiness of South African ports to handle increased liquid bulk as well as assessing port capacity. The research looks at energy demand planning and assesses whether there is a disconnection with port planning.
- The impact of Liquefied Natural Gas (LNG) supplies and bunkering on port infrastructure and how this affects port investment. Global LNG demand continues to grow in the short term and will need more vessels to supply the market.
- The analysis of the port tariffs for liquid bulk and how this affects energy infrastructure development.

5.2.1 Energy demand and liquid cargo volumes as a key driver for maritime infrastructure growth.

The key topic was to assess the impact of energy demand and liquid cargo volumes on maritime infrastructure planning and development. The essence of this was to assess short- and long-term demand for energy and how this has impacted on the pattern of development of maritime infrastructure. Hence this section attempts to provide answers to a number of questions as presented on Appendix A and questionnaires in Appendix B, including questions on the TNPA's readiness to handle the largest generation of ships in to order handle possible traffic generated by high energy demand. The other fundamental question was to find out whether there are strategic imperatives by government, the TNPA and other stakeholders to plan for liquid bulk infrastructure in the future, given the surging demand for energy.

The questions on the role of energy as enabler for marine infrastructure growth generated mixed responses amongst respondents. According to the respondents from the TNPA from all the ports, energy alone is not the key enabler to maritime infrastructure growth. They argued that infrastructure growth in ports is influenced by demand by shippers for commodities that dominate in the cargoes transported in that port and within the region. The TNPA's representatives from Ngqura argued differently by saying that they could not confirm whether '*liquid cargo volumes passing through South African ports influenced the development of maritime infrastructure'*.

They argued that in the case of Ngqura, container volumes dictated infrastructure development and that the establishment of the port was politically motivated with a view to having transhipment influenced port infrastructure development'. They further argued '*that no economic study was done in Ngqura to justify the creation of a deeper port'*.

According to the TNPA representatives from the port of Durban, energy demand was not a driver to for maritime infrastructure growth. They argued that there was a need to expand the container terminal although others felt that maybe there was consideration of energy demand in the strategy of relocating the key loading facility to make way for the new Durban port. However the General Manager of Transnet Projects argued differently.

According to him, not only was energy responsible for the increase in marine infrastructure growth, but cargo dwell time in Durban port was also problematic, forcing authorities to look at alternative ways of reducing the congestion. When the researcher asked follow-up questions to clarify why the port of Durban emphasised solving problems of containerised cargo instead of liquid bulk, his response indicated that the congestion of the container terminal and the need to build Africa's largest deep water container terminal capable of handling 9.6 million TEUs through 16 berths by 2037, was also key in increasing maritime infrastructure. This view was supported by the comments of the manager responsible for planning when he asserted that '*in order to build a container terminal the current location of the SBM* (single buoy mooring) *had to be re-looked at and should be relocated since the current terminal is located precisely where the Durban-Dig-Out-Port's breakwater will be developed'*.

Representatives of SAPIA interviewed argued that the SBM is critical and that discussions about its relocation are not a Transnet issue alone but are critical for SAPREF, other oil majors and the whole country and that the vast majority of crude oil that is imported into South Africa comes ashore via the SBM. The researcher notes that the respondents considered the need to handle the increasing container cargo traffic as a driver for port infrastructure development, despite the fact that liquid cargo volumes imported and exported through the port of Durban had increased from 24,4 million litres in 2011 to 26,3 million litres in 2012.

Although the interviewees at the port of Durban did not vouch for energy as a driver for maritime infrastructure growth, the importance of energy should not be underestimated. From the results of the interviews, the port manager, port policy makers and other respondents from the port of Saldanha Bay claimed that energy contributed greatly to the development of port infrastructure. The TNPA representatives argued that although the volume of liquid fuels imports was decreasing from 7,07 million litres in 2011 to 5,4 million litres in 2012, there was optimism that volumes would increase, given the increasing demand for infrastructure by the oil and gas industry. They argued that the good depth of the port put it ahead to develop port infrastructure.

As put by the port planners and policy makers, '*energy development has a great influence on the future growth of the port of Saldanha maritime infrastructure development as seen from the* *number of crude oil carrying vessels docking in Saldanha, but was not the only cargo that influences the development of port infrastructure'*. They said that energy development has influenced development of the port infrastructure since the port is poised to become '*an oil and gas service complex of choice*'. The port manager in Saldanha showed the researcher plans of the proposed facilities for the oil and gas industry in the form of cargo handling facilities in anticipation of increased forecasted liquid fuels volumes. He also informed the researcher that an extra liquid bulk berth is planned for the end of the iron ore jetty, along with an LPG SPM facility in Big Bay. A privately funded development is providing additional berthing to the Mossgas facility in Saldanha to increase capacity for oil and gas activities. Although there are also plans to build a new liquid basin with outer breakwater on the Big Bay side of the jetty with bunker and LPG berths, there was no time frame put forward to construct such infrastructure.

The role of energy as key driver to port infrastructure development was intimated by respondents from the port of Mossel Bay. As posited by the harbour master, liquid cargo import volumes showed an increase from 800 000 kl in 2011 to above 1 000 000 kl in 2012, mainly coming to PetroSA and Eskom's Gourikwa power station. The positive influence of energy on the development of port infrastructure is reflected in the capital expenditure value allocated to energy development compared to other infrastructure needs, for example, the development of infrastructure for tourism and leisure. According to PetroSA representatives, demand for bunkers has increased, exposing the limitations of the infrastructure at the port.

In addition, key informants from PetroSA argued that increased drilling activities off the coast of Mossel Bay by Total and PetroSA meant that bunker demand had increased, putting pressure on the existing infrastructure. Increased drilling also exposed the aging infrastructure at the port which needs to be upgraded but there was no evidence that the TNPA had plans to upgrade the infrastructure. The lack of development of bunkering infrastructure had slowed down over the years because of declining gas reserves and there was no justification to spend capital on port development. Respondents from the TNPA could not demonstrate whether there was enough planning for energy demand increase at the port.

The key informants from PetroSA informed the researcher that plans were underway to design a solution to upgrade bunkering infrastructure at the SBM in Mossel Bay, given the energy demand increase in the area. The general consensus from all the key informants shows that energy demand increase is a catalyst for port infrastructure growth. The respondents, particularly the upstream engineers interviewed about energy demand at the port of Mossel Bay, indicated that the increase in off-shore drilling activities injected some momentum into the development of energy infrastructure, forcing the port authority to either dredge the port or to look at port expansion as an alternative to improving such infrastructure.

As put by one senior engineer working on the LNG project, '*the development of LNG as alternative feedstock will change the course of maritime infrastructure development in the port, thus forcing the TNPA to look at developing compatible infrastructure'* but he was not convinced that the TNPA had plans to look at upgrading the infrastructure.

It was intimated by the TNPA that forecasted volumes of liquid bulk imported through the port of Mossel Bay were a driver to infrastructure development. In particular, the NPA showed that although the founding principle of the port of Mossel Bay had been fishing, the initial exploration for oil and gas in 1987 and the establishment of the Gas to Liquid Refinery by Mossgas in 1990 saw an increase in the development of infrastructure for energy compared to that for fishing. This positive influence of energy as an enabler is shown in the current layout of the SPM. The SPM has eight berths, five of which have inbound petroleum products and outbound petroleum products.

5.2.2 The links between port infrastructure, seaborne commerce and limited refining capacity

Information presented in this section was derived from responses from interviews and questionnaires sent to all the respondents across the port system. The key question was to assess whether there is a link between port infrastructure and seaborne commerce, including the analysis of the impact of refining capacities on the infrastructure for liquid bulk.

All the respondents interviewed affirmed a link between port infrastructure and seaborne commerce; the growth of port infrastructure was shown to depend heavily on demand by various cargo owners. However, as expressed by some respondents, the supply of such port infrastructure in all the ports was skewed and did not take into account that liquid fuels account for 34% of final energy consumption in South Africa (DOE, 2009). The TNPA representatives at the ports of Durban, Cape Town, Richards Bay and Saldanha conceded that they were not aware of the fact that demand for crude oil exceeded capacity some years ago and that such demand had to be met with imports because local refineries have been running at maximum capacity.

They argued that information on refining capacities was kept by oil companies and was never shared with them to enable the TNPA to plan to accommodate such increased demand. They also said that they were not aware of the capacity of South African refineries, which made it difficult for ports to plan effectively for the increasing imports. The port manager in Durban argued that '*the lack of transparency of refining capacities and demand for liquid fuels was kept as a secret by oil majors who did not disclose such information because of fear of competition'*.

Crude shippers across the major ports like Durban and Cape Town revealed that although it was a known fact that increased demand as result of limited refining capacities had continued in the last 20 years, they were not aware of Transnet plans to provide the infrastructure to match the supply through refined imports. The respondents argued that South African seaborne commerce had increased in the last fifty years yet port infrastructure had mainly concentrated on containers, thus neglecting other cargoes. Further, the respondents felt that the relationship between seaborne commerce and infrastructure should be guided by cargo demand and trade requirements.

The above views were echoed by respondents from the port of Ngqura, who agreed that infrastructure needs to respond to the smallest trigger in trade flows, thus demonstrating the link between port infrastructure and seaborne commerce. This view was also confirmed by policy makers who argued that this linkage is demonstrated by the Transnet's market demand strategy and the Liquid fuels strategy of 2006 that shows that South Africa as a country faces constraints in refining capacities and this needs to be addressed via a holistic approach linking ports and seaborne commerce.

The two SARS representatives at the major ports revealed that liquid fuels imports through South African ports show an increase from 26,9 million litres in 2011 to 28,2 million litres in 2012, thus increasing seaborne commerce. They posited that seaborne commerce had increased rapidly because liquid bulk cargo imported through South African port system made 88% of total cargo throughput in 2011 and 92% of imports throughput in 2012. SARS also conceded that the structure of the volume flow through the port sector largely reflects the geographic structure of South Africa's refining capacities.

According to port planners at the port of Durban, linking port infrastructure development with seaborne commerce is critical, since it helps with planning and is reflected in their liquid fuels demand forecast which indicates a 30-year demand forecast. On prodding further, the researcher was told by port planners in Durban that although the port has invested heavily to address the container traffic, there were plans to improve the liquid bulk infrastructure at the port, although the extent of such investment could not be confirmed.

Further, as intimated by the harbour master at Saldanha, '*the port has the advantage of having an Industrial Development Zone which is seen as instrumental in developing deep water port facilities at the port'*. This, he argued, had the potential of creating twelve new berths and extensive quayside expansion, thus confirming that there is a linkage between port infrastructure and seaborne commerce. To articulate his position, the port manager in Saldanha presented a development plan that showed increased port limits and an expanded waterside infrastructure and plans to improve the liquid bulk basin with a breakwater and six berths and an expanded MPT.

The iterations on the port plan presented also revealed that liquid bulk volumes of both crude and refined products in Saldanha were likely to grow aggressively from 5.7 million cubic metres to 22 million cubic metres in a 30-year forecast period. Moreover, in response to the question on the linkage of port infrastructure with LNG development in Saldanha, the port planners argued that the Saldanha natural harbour layout with a draught of 23m made it a port of choice for building an LNG terminal in the short term and would increase seaborne commerce. This view was further confirmed by the PetroSA commercial manager on the LNG project.

The responses from Port Elizabeth confirmed the linkage between port infrastructure and seaborne commerce by pointing out, as shown by the TNPA's port planner, that demand for port infrastructure is showing some increase in line with energy demand. However, on follow-up questioning, the researcher was told that the demand for port infrastructure in Port Elizabeth was likely to change by 2019 when the liquid bulk is diverted to Ngqura. The respondents reasoned that this was because of the envisaged Umthombo refinery planned by PetroSA in Ngqura, which is scheduled to start producing in 2018.

The energy and infrastructure policy makers from the Department of Energy and Department of Transport who were interviewed on whether there is linkage between port infrastructure demand and seaborne commerce and limited refining capacities confirmed the linkage but two-thirds of those interviewed did not agree that Transnet and other stakeholders have fully addressed the imperatives of this linkage. According to them, '*although the total liquid fuel demand is on the rise in South Africa, there is no growth of port infrastructure, although there was a R300 billion investment proposed by Transnet'.*

Further, they pointed out that beside the linkages being known, there were concerns that if nothing is done in the short term this country would be unable to close the gap between seaborne commerce and limited refining capacities. South Africa needs a plan of action to address this gap, as total liquid volumes are set to double, reaching more than 60 billion litres, including crude oil, showing growing consumption of 114% (Energy Security South Africa, 2014).

5.2.3 Liquid energy as strategic stock and port development

The theme that was put forward to respondents was how the Energy Security Master Plan –Liquid, strategy on fuels, which states as a priority that South Africa develops the ability to construct 'properly thought-out' energy plans as a tool for evaluating proposed energy policies including infrastructure development influenced port development The respondents in all ports, particularly port users, lamented that '*although a stable policy for the liquid fuels sector was agreed by all in an inclusive process, in practice its (non)-implementation has led to a level of policy and regulatory uncertainty that has caused severe under-investment in the sector*'.

As a result of this, the liquid supply system, in all links of the chain, is overstressed and failing under pressure. Liquid bulk cargo owners complained that government had done nothing to solve the issue of infrastructure development. The ageing refineries which have not had the required investment to keep up demand were also cited as a failure to recognise energy as strategic stock.

According to the five respondents from the DOE, South Africa's refineries are experiencing reduced production levels that are a threat to liquid fuels security of supply but despite a solid plan on paper, the plan has not been implemented to date. Other respondents questioned the existence of such a plan. The failure to implement the plan puts a lot of pressure on the 40-year-old refineries which have not had the required investment to keep up with demand. All the informants called on government and stakeholders to finalise the liquid fuels infrastructure roadmap in order to improve energy security.

Port users from all the refineries lamented that despite the fact that the DOE assured Parliament regarding the liquid fuels and solutions required to address the issue, it has however not produced a policy or plans to update the out-dated 1998 policy. The researcher noted that the DOE has not made any actual commitments to invest at the scale required to effectively address the situation. On questioning further, TNPA respondents posited that '*of greater concern is the fact that the basic statistics required to develop such a plan are still not available, including the "real status" of refinery production capacities, which would make infrastructure planning possible'*.

It was noted by the researcher that although DOE policy researchers presented a policy framework on strategic stocks, there are a number of capacity constraints and challenges faced by the petroleum sector in meeting energy demand. The gaps identified by port users are lack of storage capacity and pipeline capacity. Energy policy makers' respondents posited that the DOE is likely to choose the least risky and most cost effective strategy of continuing to import a share of refined products until the country reaches a stage where it can absorb the output of either a new refinery or a major upgrade of an existing refinery. South Africa will therefore continue to import, taking a decision on the next step in 2016/17. This means that if a decision is taken to build a new refinery, it will only start producing between 2025 and 2028.

Cargo owners and three ship agents that deal with tankers at the port in Cape Town informed the researcher that even if such a decision was taken, port authorities still need to develop the infrastructure for liquid bulk. One third of policy makers argued that liquid bulk cargo contributed significantly to Cape Town port with 227,310 kilolitres exported in 2011 rising to 327,266 kilolitres in 2012. They also showed that liquid fuels cargo had increased from 910,323 kilolitres to 1,358,728 kilolitres imported at the port of Cape Town, arguing the fact there was a need to increase infrastructure to handle such liquid bulk cargo.

Ninety percent of the shippers of crude interviewed at the port of Cape Town reasoned that South Africa faced another problem besides declining refining capacities. South Africa has been requested by the US not to import its crude from Iran (South Africa imported about one-quarter of its crude from Iran). This place a burden on South African refineries as the country's refineries are configured to refine light crude – mainly sourced in Iran. Further, finding crude supplies with similar densities and sulphur content to that of Iranian crude, or changing refinery configurations to enable the refining of different kinds of crude feedstock, will also come at a financial cost to the local economy (Kotze, 2012). The other issue that was raised during the interviews as one of the constraints to achieving volumes to meet demand is the need to comply with the Clean Fuels 2 specifications by 2017, hence the need to increase refinery margins in order to decrease the cost of compliance.

The Clean Fuels 2 specifications outline the South African Government's direction in further improving the quality of transportation fuels. The researcher was informed by shippers of crude and refinery representatives that import volumes were set to increase because of the need to comply with Cleaner Fuels 2 specifications. The Cleaner Fuels 2 specifications aim to reduce the aromatic and benzene content of petrol to be in line with Euro 4 emission standards by 2017 and include the reduction of sulphur from 500 parts per million (ppm) to 10 ppm, the lowering of benzene from 5% to 1% of volume, the reduction of aromatics from 50% to 35% of volume and the specification of olefins at 18% of volume (Trollip, et al, 2014). SAPIA members who were interviewed argued that the already overburdened fiscus will be under pressure from this Cleaner Fuels initiative. Local refineries need about R25-R40 billion to convert to the specifications.

Further, South African refinery owners have indicated that local refineries would not be sustainable after 2017 at the current levels of production of about 515 000 bbl/d of cost recovery mechanism, which would enable the refineries to convert to Cleaner Fuels 2 specifications.

TNPA representatives from Ngqura suggested that the shift of liquid bulk commodities from East London and Port Elizabeth meant that the TNPA would shift the concentration of investment to Ngqura, thus solving the problems of energy demand and port infrastructure in this region, but not wider. Despite all this, respondents were not sure that the TNPA has prepared for increasing infrastructure demands.

5.2.4 Energy planning capacity and port readiness

This section presents information derived through interviews with the following key informants:

- representatives of oil majors and other liquid bulk owners in selected ports,
- ten port planners from across the port system,
- all four major ship brokers and
- liquid-bulk terminal operators.

All the respondents interviewed argued that although liquid fuels have been declared as strategic stock, there has been policy uncertainty and large planned prospective state investment in the sector and ports (Energy South Africa, 2014). Informants from SAPIA informed the researcher that oil companies and the private sector were unwilling to invest in improving the infrastructure. This lack of commitment by the private sector to invest in the infrastructure adds to the unreliability of the ports. Thus the crisis in governance in the liquid fuels sector has led to a growing fissure in the liquid fuels system, which neither government nor the private sector has been able to or inclined to fill. Port readiness to match with increasing imports has been slow. This was revealed by one of the SAPIA members, who informed the researcher that the oil industry had not been transparent about the import volumes forecasted, hence the lack of coordinated effort to provide infrastructure.

One of the SAPIA members even said that as '*early as in 2007, a question had been asked to look at a holistic approach to enable ports to be ready to meet increasing demand for crude oil imports'*. A holistic approach means that one should cater for the fact that South African refineries 'are operating at full capacity, [the] roads and rail transport systems for carrying fuel are stretched to the limit, that [South Africa is] now at a point at which any unplanned break in the supply chain (for example, refinery breakdowns, pipeline interruption, shortage of rail tank-cars) will create shortages'. These views by SAPIA cemented the report issued by BP in 2007 in which the oil major stated that the 'existing infrastructure is unable to support the requirements for increased imports in the short-term and will need to be upgraded'.

As intimated by port planners *'although (the) DOE had published a draft Strategic Stocks Policy and Implementation Plan in 2013, there was no supporting analysis given to the quantum of infrastructure required and there was no analysis given of the likelihood of disruption which would make ports prepare such infrastructure'.* The impacts of disruptions were not given to enable planning by the TNPA. Also noted by port planners is the contradiction by the Draft Policy of 2013 of the 2007 Energy Security Master Plan – Liquid Fuels as no explanation has been given. The lack of adequate policy analysis is of concern to informants from Terminal Operators.

In addition, because the policy is misaligned, investment is highly unlikely from the port authority as it has to justify such capital expenditure. The TNPA representatives argued, despite the misalignment between policy and need to invest in infrastructure, the TNPA planned to allocate approximately R4.5 billion to upgrade port infrastructure, although the category of goods to be invested in is not clear.

Key informants representing shippers informed the researcher that *'there were bound to be problems with increasing demand for fuels and limited refining capacities and large dependence on imports'.* One of the key informants from a bunkering company informed the researcher that bunkers-only calls increased due to piracy although daily deliveries limitations were limited to five vessels per barge per day, thus over-burdening the system.

On prodding further the researcher was informed that long waiting times for bunkering were problematic. '*At times there have been up to 50, causing vessels to wait up to two weeks backlog although at times additional delays have been due to bad weather and other vessel receiving rates'*. The lack of consultation by the TNPA in terms of their market demand strategy and capital expenditure plan was also an issue raised in all consultative meetings. At the port of Ngqura key informants from the TNPA said that the TNPA has planned to move the tank farm from PE to Ngqura in order to accommodate PetroSA's planned Umthombo refinery planned for 2018.

Key informants from port users in Cape Town advised that they were not aware of the TNPA's plans to develop long-term fuel loading facilities and argued that any plans to upgrade port facilities should consider who will invest in such facilities. To allay the fears of the oil industry the TNPA confirmed that they had extended their planning horizon to 30 years.

The key informants from the port of Ngqura informed the researcher that the TNPA had started the section 56 process in order to have land available for a liquid bulk terminal with new berths and a tank farm to be operational by 2017/18. These will replace the Port Elizabeth facility, which will be decommissioned once Ngqura is operational. The initial capacity will be around two million kl a year, doubling to four million by 2020/21 to meet forecasted demand for liquid fuels.

To ensure that the port of Ngqura is ready to meet the forecasted volumes, TNPA key informants posited that the port authority was finalising the selection process for a potential tank farm and liquid bulk terminal operators in anticipation of the relocation of liquid bulk facilities from Port Elizabeth after 2017, when the current lease expires. It became evident from the interviews that given the 'fuel crisis' similar to the energy problems currently facing Eskom, the construction of the proposed 400,000 bbl/d refinery by PetroSA was imminent and that concurrent with the construction of the Umthombo refinery, there was also an urgent need to build an offshore SPM with a capacity of 20 million kl when the facility comes online in 2019/20. It was not clear whether the TNPA has prepared for such a surge and whether the SPM will be sufficient to meet the 30-year demand forecast.

Key informants from the port of Richards Bay were not sure that the TNPA had created enough capacity to handle future liquid bulk, which is currently 3,5 million kl in 2012 and forecasted to 5,5 million kl in 2025/26, to meet the medium-term demand forecast (DOE, 2013). Liquid bulk volumes are expected to grow from 1,706,384 million kl to 6,9 million kl over a 30-year period. This is despite assurance by the TNPA that the port has a Capacity Expansion Project to build an additional two berth liquid bulk terminal.

5.2.5 LNG and how it affects port investments and how it is catered for in port planning

This section provides information derived from interviews with the following key informants regarding the impact of LNG on port investments and how LNG will affect port planning and capacity:

- SAPIA member (PetroSA's LNG project manager and energy development strategist),
- key informants representing the port authority at the port of Saldanha and
- policy planners responsible for the port of Richards Bay.

As intimated by key informants, LNG is recognised by the Department of Energy and the National Planning Commission as an important source of energy and that LNG as a source of gas would diversify South Africa's sources of energy supply, thereby reducing the country's carbon footprint. The key informants from SAPIA informed the researcher that LNG imports will add volumes which will add further burden on the system, already under pressure

The Port Manager in Saldanha concurred with this view by stating that LNG development would need dedicated infrastructure and would alter the port landscape in South Africa and that LNG infrastructure is listed as a strategic infrastructure. All the informants interviewed agreed that the development of LNG creates the option to secure gas supply and would lead to possible investment in port infrastructure.

The future forecasts indicate that LNG will add a burden to port infrastructure since it will add to volumes delivered through the port system. South Africa would be importing up to 20% of its total refined fuels by 2016, doubling by 2025 and then with volumes are set to increase further by 2030.

Port planners in Saldanha even stressed the fact that LNG is the enabler for investment in future port infrastructure since it is aligned with Department of Energy gas-fired IPP programme. This would balance renewable projects and create reserve capacity, hence the need to invest more on its infrastructure.

The PetroSA Energy Development strategist stressed the point that imported gas was the only option at this stage, hence the investment in LNG facilities. He further pointed out that although feasibility studies were conducted on piping gas from Mozambique to Richards Bay and beyond, this remained a future option and that it was better to develop LNG facilities since LNG is a well-developed industry and currently one of the possible ways to get gas into South Africa to meet demand timelines.

All the key informants argued that an increase in demand for LNG facilities in South African ports is likely because of constrained supply, which is outstripped by demand until 2015. This point was supported by the PetroSA energy strategist, who posited that increased demand for LNG facilities in ports in the Western Cape was due to the willingness to pay for LNG.

He added that with indigenous gas declining to feed the Gas to Liquid Refinery in Mossel Bay, there might be a need to relook at the issue of import cost, subsidies and pricing and in tandem with the tight supply of liquefied gas, the market may be willing to pay for LNG, leading to more facilities being made available, thus increasing port investments. With the likelihood of increased demand for gas, LNG could be the answer and markets could use this emerging tranche of demand to demonstrate willingness to pay high prices for a new supplier.

The position of the key informants at the port of Saldanha was that LNG would greatly affect the shipping market. They suggested that the draught of Saldanha port is conducive for increased investment in LNG port facilities and would bring increased demand for spot cargoes once LNG is imported. They also pointed out the possibility of increased investment to accommodate larger LNG vessels which may consist of Floating Storage and Regasification Unit vessels and Floating Production, Storage and Offloading vessels, which would help with floating liquefaction.

Nonetheless, they lamented that while market trends pointed in that direction, there was no solid plan to build such facilities by the TNPA. Port planners in both Richards Bay and Saldanha pointed out that although the TNPA had conducted comparative studies on the vessel capacity required for LNG and had found that the most common ones had a capacity of between 125,000-149,000 cubic metres, the TNPA had not budgeted enough Capex to develop facilities to accommodate such vessels.

5.2.6 South African port tariffs and liquid fuels demand.

This section presents the responses of key informants to questions on the impact of port tariffs on liquid fuels demand. Information is based on interviews and responses to questionnaires by the following key participants at the ports of Durban, Saldanha Bay, Richards Bay, Cape Town and Ngqura:

- thirty port users across five ports,
- four ship brokers and
- representatives from the Ports Regulator.

All the key informants concurred that South African transport costs are amongst the highest in the world and do affect port development. The researcher noted that the increasing tariffs for crude oil products are a concern.

This view of high tariffs, caused by the monopoly of Transnet, was also shared by the SAPIA who argued that government had tried to restructure ports to be competitive and play a significant role in accelerating economic growth through the National Commercial Ports Policy and National Ports Act. The aim was to ensure the low cost of doing business in South African ports.

Liquid Bulk cargo owners interviewed indicated that they would avoid the port of Durban if they had a choice because it is very costly and inefficient. They also told the researcher that they were making a concerted effort to avoid Durban and prefer Walvis Bay or Maputo and that despite the large crude oil facilities in Durban the port has clearly become a port of last resort.

They argued that the Durban port has the most expensive four barges supplying fuel to vessels at $9,90/mt. They lamented that although crude oil facilities were developed in the port of Durban, port tariffs still remained high. Port users argued that the TNPA has been charging them cargo dues yet the infrastructure was actually built and maintained by them. Thus they felt double-charged.

According to the bunker suppliers, the TNPA was asking them to pay for infrastructure that would then be included in the regulatory asset base for future port charge determination. They echoed the view that they should pay only if they were going to be the owners of this infrastructure and that their payment would encourage more port infrastructure investments.

According to SAPIA key informants, South Africa has high port costs, especially when considering cargo handling performance and service levels at the ports. One of the members suggested that ports should increase private participation in order to lower costs in line with the global trend.

The other issue raised was that the reform process was initiated later than the restructuring process in other infrastructure sectors in South Africa (Electricity White Paper, 1988 and Telecommunications White Paper, 1996) as exemplified by the issuing of a Ports White Paper (only in 2002), and of legislative change (only in 2005). Port users across the major ports also lamented that the implementation of reform also proceeded at a slow pace, as exemplified by port authority's failure to adjust prices, to eliminate the rent extraction across different segments of the economy such as from manufacturing to mining, to implement the landlord model, except on very small margins and to put in place an independent regulator with the mandate to set port prices. They also raised a concern that the TNPA was inefficient, resulting in huge annual demurrage costs, amounting to between R7 million and R9 million in Durban alone, which had huge increased costs in the liquid-bulk market.

5.3 DISCUSSION OF THE FINDINGS

The aim of this section is to provide an analysis and discussion of the findings achieved through interviews and questionnaires. This provides the researcher with an insight to compare the responses given by the respondents to the theoretical assumptions as intimated in Chapters Two and Three.

It is clear from the analysis of imported volumes that pass through South African ports that the country relies heavily on imported crude oil because domestic sources and available substitutes alone cannot satisfy the country's current demand, resulting in imported product accounting for over 90% of South Africa's requirements (Nkomo, 2009). It is clear from the responses from the port of Durban that the constraint on refining capacities meant that the bulk of volumes would be imported. Total imported volumes recorded by SARS show that imported volumes at the port of Durban rose from 19,9 million kilolitres in 2011 to 23,6 million kilolitres in 2012.

The volumes passing through the ports indicate that the port system has not planned adequately for such volumes; further demonstrating underinvestment in the future of liquid fuels in South African ports. The high dependence on imported liquid fuel exposes the backlog existing within the ports system to deal with such increasing volumes. The need to comply with Cleaner Fuels 2 and Euro 4 standards by 2017 increased the demand for liquid fuels in South Africa from 18 billion litres to 26 billion litres (Davidson and Winkler, 2003). Although in some ports (for example, Saldanha) volumes were decreasing, the overall picture of the refining capacities has been declining, forcing the country to experience a shortfall that had to be imported. The increased reliance on imported product means that there should be infrastructure improvements at our ports to cater for the increased demand for liquid bulk port facilities, since the existing infrastructure is unable to support the requirements for increased demand (BP, 2007; Energy Global, 2011; Oil Review Africa, 2013).The responses on the link between liquid energy as strategic stock and port development showed that the lack of policy direction contributed to the problem of ensuring that enough stock is kept by the refineries. The Liquid Fuels Master Plan existed on paper but the plan has not been implemented to date causing underinvestment in the enabling port sector. This again demonstrates that all stakeholders had done nothing to ensure that there is integrated planning: this includes the energy sector, the ports sector and government. The responses show that there is great uncertainty in the industry about investing in the required infrastructure, thus increasing the problems already faced by the port sector. The responses also show that there are crises in governance in the liquid fuels sector, which adds to the existing problems (Energy Security in South Africa, 2014).

Responses about energy planning capacity and port readiness revealed that there is policy uncertainty to lead the way for better capacity planning by the ports. The responses from SAPIA members show that because there has been no transparency on the planned volumes of imports required, this made it even more difficult for ports to plan effectively for increased volumes.

This view matches the one posited by Energy South Africa (2014), that the lack of transparency between government and the stakeholders led to '*a fissure in the liquid fuels system*' thus hampering port readiness to meet growing import volumes. Port readiness to meet the increasing import volumes has been hampered by the fact that there were contradictions between the outdated Energy Security Master Plan – Liquid Fuels of 2007 and the Draft Strategic Stocks Policy and Implementation of 2013. It is clear that the lack of policy analysis meant that the TNPA, who is charged with the responsibility for port planning is left in the dark – hence the failure to provide the required infrastructure.

The responses by port users about tariffs charged by the TNPA reveal a somewhat uneasy relationship between ports and the oil industry. The structure of the tariffs reveals that there is no agreement about who should pay cargo dues, especially in ports like Durban, given the fact that the SBM was built, owned, operated and maintained by the oil majors. The argument that was raised was that there was no basis to raise cargo dues against cargo owners since cargo owners themselves bear all the associated costs of ownership, management and operation of the entire cargo handling infrastructure.

The criticism of the current cargo and port dues charged to the oil industry challenges the idea that there is a need to close the extent of cross-subsidisation and cost-price irregularities across marine and cargo functions, similar to that posited by Jones (2002). This view supports arguments to relook at waterfront charges in order to balance that with liquid oil imports needed by the country as suggested by Department of Transport, 1998 cited by Chasomeris, (2006: 108). South Africa also needs to correct the fact that tariffs are highly favouring the export of raw mineral commodities at the expense of the manufacturing sector. The responses on tariffs shows that South African port prices are skewed, that is, charges are substantially higher for cargo compared to shipping/terminal charges, showing that cargo-based charges are cross subsidising ship-based charges. Also the responses reveal that subsidies for the capital intensive production is on-going in South African ports, even after the change in industrial policy, due to powerful interests that have banded around the capital- and energy-intensive growth path in South Africa.

5.4 CONCLUSION

This failure by the ports to cater for the changing demand of different cargoes as shown in the responses is consistent with the literature, which argues that ports should take into account the planning for all services provided and should be dynamic enough to factor demand for economic growth of the regions and the country as a whole. The increasing imported volumes passing through South Africa's port system need to attract careful planning, but such planning should focus on balancing energy demand with demand for infrastructure. Energy planning and assessment of port readiness should be guided by policy considerations, that is, the Draft Strategic Stocks Policy and Implementation Plan. The lack of consistency in implementing the policy is a concern as it affects planning for the required infrastructure. Also the lack of transparency regarding liquid volumes to be imported is of concern in planning infrastructure. Finally, responses on port tariffs show that the current method of RAB means that port users still pay more for all port investments and actually pay all port costs yet most of the infrastructure used by the oil industry was paid for and built by the oil industry.

CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

The purpose of the research was to study and explore energy demand and planning failure, or gaps, in providing berthing facilities in the light of a surge in demand and supply of liquid fuels. The research also examined the liquid cargo traffic flow in the port system, the structure of liquid flows through specific ports, port capacity and the readiness of ports to match energy demand and supply with the demand for berthing space for liquid bulk cargo in South African ports.

As intimated in Chapters Two and Three, the relationship between port infrastructure and energy demand needs to be understood on the premise of liquid cargo volumes throughput in the ports, refining capacities, energy as strategic stock, port tariffs and the short- and long-term demand for energy and how this has impacted on the development of maritime infrastructure. A summary of key findings will be provided, recommendations will be made as to how the study can be applied and further research areas will be highlighted.

6.2 SUMMARY OF THE KEY FINDINGS

Liquid fuels account for the largest share, at 34%, of final energy consumption in South Africa. The country's domestic resources and available substitutes are minimal, thus forcing the country to import most of the crude oil needed for fuels production in South African refineries.

The other issue is that South Africa's ageing refining infrastructure cannot cope with demand for fuels, leaving the fuels sector more vulnerable to potential events that either interrupt supplies or lead to higher prices, thereby making the country dependant on outside sources. The demand for liquid fuels in South Africa rose from 18 billion litres in 1994 to 26 billion litres in 2008 and the figures are set to continue to rise as the country strives to increase imports to power Eskom.

South Africa imports about two-thirds of crude oil required with one third manufactured from coal (CTL) and a small decreasing proportion manufactured from natural gas (GTL). Domestic demand for liquid fuels manufacturing capacity (crude refining and CTL) began to decline some years ago because local refineries have been running at maximum capacity and increasing demand has been met by imports. The decline in refining capacity which was intimated in Chapter 1 has decreased the security of liquid fuels in South Africa and undermines energy security in the entire system. It was also noted in section 2.8.1 that demand for petrol and diesel increased drastically revealing the shortfall in port infrastructure capacity. The petrol consumption and refining capacity required show that the forecasted supply of petrol is steady at 10 000 million litres in 2009 and 2025, while future petrol demand is forecasted to grow from 10 000 million in 2009 to 22 500 million litres in 2012, thus causing -6000 litres balance between 2009 and 2012. The liquid bulk volumes recorded show that imports have been increasing. For example in 2011, imports of 27.04 million kilolitres were recorded and 29.9 million kilolitres were recorded in 2012 respectively. Exports totalling 3.6 million and 2.6 million kilolitres respectively resulted in total liquid bulk throughput of 30.6 and 32.6 million kl in 2012.

The individual volumes throughput per port (Durban, Cape Town, Richards Bay, Saldanha and Mossel Bay) show that volumes are increasing. In Durban, South Africa's premier port, SARS and NPA both recorded an increase from 73% to 75% of volumes landed (crude oil landed and refined products), although there were discrepancies in Saldanha and Cape Town. There is a large under-recording by SARS in Saldanha that was offset by a higher volumes landed at the port of Cape Town for 2012. The TNPA has shown that there were attempts to develop liquid bulk infrastructure in Saldanha, despite the fact that the volumes seem to be decreasing.

The decision to develop such infrastructure comes from the optimism that the port has, given the increasing demand of infrastructure by the oil and gas industry. Recorded liquid cargo volumes at the port of Mossel Bay show that the port handled 3% of the South African port-wide liquid-bulk volumes, equivalent to 858,550 kilolitres of volume, in 2012. The increased demand in volumes came from PetroSA and Eskom's Gourikwa power station which required higher volumes. The increased demand in liquid fuels is a result of higher consumption which is supported by the study and is also a result of the delay in coming on line of Kusile and Medupi power stations.

In all the ports the TNPA has argued that there are plans to increase infrastructure for liquid bulk but no evidence has been produced by the port authority. Even their capital expenditure plans do not categorically show that part of the budgeted R300 billion is intended for a liquid bulk infrastructure upgrade.

The lack of understanding of the true energy demand in order to prepare adequate port facilities was seen in Durban, where responses received show that the need to reduce cargo dwell time at the port, particularly for containers, was the driver for infrastructure development, not energy although the port handled 75% of liquid volumes in 2012. Even the proposed Durban dig-out port is not planned to solve liquid bulk congestion but rather to solve container congestion, since there is a need to build Africa's largest water container terminal, capable of handling 9.6 million TEUs through 16 berths by 2037.

Energy security has been cited as one of the issues to be considered in full in the discourse of liquid energy supply and demand in South Africa. This is because the country relies heavily on imported crude oil and also because refining capacities have been declining while the demand for liquid fuels has long outpaced supply, with future demand balance of -6000 litres between 2009 and 2025, with a demand balance of -5 500 litres of diesel in the same period.

The discourse on energy security discussed the failure of the Liquid Fuels Master Plan of 2007, which has not been implemented, thus affecting port planning for the required infrastructure. In December 2005, due to the changeover to unleaded petrol, the country experienced fuel shortages, which were compounded by the strike in the petroleum sector in 2007. Both had a negative impact on fuel supplies to service stations forcing the country to import more volumes to close the fuel supply and demand balance. The fuel supply and demand balance focusses on petrol and diesel for the period 2006 to 2020 and exposes the impact of underinvestment in South African refineries.

The fuel supply and demand balance also exposes the fact that, despite the revised strategic stocks policy in 2013, the liquid supply system is still under pressure, given that the refineries were more than 40 years old and had no capacity to produce the required volumes. From a refining capacity perspective, it was assumed that Sasol would expand operations by 20% in 2010 but Sasol's proposed 80 000 bbl/d coal-to-liquids facility in the Waterberg in the Limpopo province, known as Project Mafutha was only expected to come on stream in 2014 but did not happen thus putting pressure on the need to bring in more refined products. In addition, the 400 000 bbl/d PetroSA's Umthombo refinery project in Ngqura seems to have been delayed, forcing the liquid bulk industry to continue to import more liquid fuels. The supply and demand balance shows that in the short term South Africa will continue to import petrol. The situation for diesel looks different. There will a surplus supply of diesel from 2014 to 2017 because of high volumes of biodiesel, which will add to volumes of diesel.

The global economic crisis has affected certain projects causing planning to be difficult. For example, besides the delay in Umthombo by PetroSA, there were announcements made by the National Oil Company that the Project Umthombo capacity has been scaled down from 400 000 bbl/d to 200 000 bbl/d, thus adding strain to the fuel supply in the country. Sasol's growth programme in Secunda has also been delayed, forcing the country to import two billion litres of petrol and seven billion litres of diesel by 2022, if no additional refining capacity is created. This delay in volume adds to the already existing problem of port capacity to handle liquid fuels in the country.

The need to comply with Cleaner Fuels 2 by November 2017 is also a challenge to both the fuel industry and ports as South Africa will have to make investment decisions in line with recommended specifications. On the supply side the aggregate of 692 000 bbl/d refining capacity in South Africa is not enough, forcing the country to import more volumes. In South Africa, any future decisions to import more volumes will have to be met with infrastructure considerations to upgrade ports.

Energy planning capacity and port readiness should address demand patterns, delivery infrastructure, berth capacity, storage facilities on the quayside and load out facilities. These determinants need to be looked at holistically by the TNPA, government and the oil industry. Capacity should determine port readiness and should clear any bottlenecks for ports to be ready.

Port readiness should also integrate planning of the entire logistics chain (incorporating volumes, capital expenditure planning and commitment by stakeholders on required infrastructure as well as having proper governance to interface both the liquid bulk industry and ports).

Fuel demand and supply is to a significant extent affected by port tariffs. The South African port tariffs have been problematic because oil majors who are directly affected by high port tariffs and have been complaining that they are being double-charged by the TNPA for infrastructure that they built years ago. It is therefore imperative that a review of the current pricing method is done because the cargo pricing method discriminates between imports and exports. The current practice is that cargo dues pricing discriminates between imports and exports, with imports being 100% higher than equivalent export dues.

6.3 RECOMMENDATIONS

While this study may hopefully be used by the TNPA and oil industry planning, it also offers government, the TNPA, oil majors, dealers and other stakeholders an opportunity to reflect on gaps that have been identified. The study may also be used to put recommendations on the way forward.

The study shows some need for strategic planning by both the TNPA and oil majors regarding import volumes and port infrastructure. One of the most important aspects revealed in the study is the need for both the TNPA and the oil industry to plan concertedly on required volumes in order to invest accordingly to improve the infrastructure. The lack of investment has been caused by lack of commitment by both the port authorities and the oil industry because of lack of transparency by all parties as to how much volume needs to be planned for. The lack of transparency by the oil industry needs to be improved to enable port capacity for liquid fuels to be provided on time. The study further allows all stakeholders to critique the Draft Strategic Stocks Policy and Implementation Plan, which is largely inadequate and does not provide the figures to cement the demand/supply issues of liquid fuels in the future that the country is facing and also no supporting analysis has been presented to the TNPA and other stakeholders to enable planning.

This is of concern for South Africa's energy security situation and indicates a lack of adequate policy alignment, which causes underinvestment. The lack of concrete direction regarding strategic stocks, a resource that could cripple the economy if an external disruption cut supply for a longer than a month, is a worrying fact that needs to be addressed urgently.

The kind of strategic planning, government regulation and investment, the TNPA and private sector buy-in is required to link strategic stocks build-up with the required infrastructure. As revealed by the responses, the planning of liquid bulk infrastructure is still problematic. This is exacerbated by a lack of governance in the sector, with no clear-cut policy on infrastructure investment. This lack of governance continues, despite the fact that the country's imported volumes increase. The other worrying factor is that, while it is known that refining capacity has been declining, port investment has been lagging for years and it seems that nothing is being done to solve the problem. As intimated in the study, although delayed, the proposed Durban dig-out-port is set to resolve container congestion and other cargo delay issues at the port of Durban which still leave the liquid bulk handling problematic.

Although the current actual delivery of liquid fuels to market looks adequate, there are warning signs from all quarters of the need to invest more in port infrastructure in order to meet future fuels demand. The increasing dependence on crude imports opens South Africa to shocks caused by external disruptions that can put huge stress on the whole energy and port system, undermining economic growth, social stability and development.

6.4 FUTURE RESEARCH

Although the study focussed on a broad spectrum of port planning and liquid fuels in South Africa, looking at the mismatch between supply and demand of fuel and port infrastructure, energy security, economic analysis of ports, there is still a need for future research which will look at a holistic picture of port planning in relation to liquid fuels, break-bulk, dry bulk, containers and automotive in order to assess the true reading of South African ports to be globally competitive and to support other industrial policy objectives.

6.5 CONCLUDING STATEMENTS

The research has sought to offer insight into the relationship between ports and energy infrastructure development. It has attempted to highlight the challenges faced by the South African liquid fuels industry and the lack of governance in both the ports and energy industries in developing solutions to the age-old problem of the shortage of berthing space for liquid bulk cargo in South Africa. The research has also demonstrated that the historical and current supply and demand affecting the liquid fuels in South Africa will continue but the TNPA, which is charged with port infrastructure, has not produced an adequate plan about the provision of port infrastructure which links limited refining capacities, future demand and supply of liquid fuels. This discussion on port infrastructure should not treated simplistically as an argument for regulation, but should be viewed as means to improve competitiveness of South African ports on the whole.

Hence, port planning needs to grow the ports to support the energy requirement as well as any macro requirement for South African business. Furthermore, the port's role in the movement of high value cargo through the port system should be enhanced.

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THESIS INTERVIEW SCHEDULE

The research has utilised a combination of focus group interviews, selected interviews, semi-structured interviews and questionnaires.

Table: A summary of objectives and data collection techniques

Research Question	Research Objective	Hypothesis	Data Collection technique
Does the increased energy demand influence the need for the development of marine infrastructure?	To assess the impact of energy demand on maritime infrastructure planning	Energy demand as key enabler for maritime infrastructure growth	Desk top study of energy planning reports Desk top study of statistics bulletin Interviews
What is the value of shipping on the whole energy and mineral value chain and debate?	To assess energy demand and to link port investment with energy demand	Energy demand has both a port planning and supply chain imperative	Interviews Observations Questionnaires Energy consumption statistics
What is the energy security strategy and how does this strategy affect port infrastructure planning?	To extrapolate energy demand and port infrastructure development	At a policy energy demand planning there is a disconnection with port planning	Interviews Questionnaires Studying energy demand and port planning policies

Question No:	Interview Question	Response
1.	Is there a link between port infrastructure and seaborne commerce on the elastic refining capacities?	
2.	2(a) Does the increase in the demand for energy in South Africa have an implication for port planning? 2(b) How has the concentration on the transhipments bubs led to relative neglect of facilities for wet bulk in South African ports?	
3.	Are South African ports generally equipped to handle the largest current generation of ships in order to handle possible traffic generalised by high energy demand?	
4.	Is South African port planning policy geared to handling these dynamics in shipping trends?	
5.	Does South Africa's energy outlook policy look at port planning capacity, storage and port investment as important variables?	
6.	6(a) How does base energy demand in South Africa affect the port system? 6(b) Has the shift between crude oil and refined product affected the port infrastructure?	

7.	If there is an increase in energy demand, which will result in huge imports of crude to be refined in South Africa, has TNPA planned for such facilities?	
8.	Even if TNPA has planned for these facilities: 8(a) Has TNPA provided clarity on how capital projects will be financed? 8(b) If the projects are financed through the capital budget fund, how will be cost recovery be done? 8(c) Has the recovery been factored into the current seven year tariff planning regime? 8(d) How will TNPA ensure that port tariffs do not stifle port development in the face of increasing base energy demand?	
9.	9(a) How does the base energy demand affect the supply side? 9(b) What does the balance between refining capacity and supply look like currently in relation to port information? 9(c) How will the expansion in port infrastructure as a result of the impact of supply-side affect port planning and will there will be a need to invest more on ports, that is, increasing capacity for wet bulk cargoes?	
10.	How do recently discovered drilling blocks in the southern continental shelf (currently being farmed) affect the demand for port infrastructure?	

11.	Is there a requirement to import crude and how will this affect demand for berthing space and hence trigger competition in the prioritisation of constructing facilities for wet bulk facilities ahead of break bulk facilities?	
12.	12(a) How is energy planning related to port planning? 12(b) Is the increase in energy capacity linked to the need to import crude which is likely to bring VLCCs and Suezmax to South African ports?	

13.	How might a global liquefied natural gas (LNG) bunkering infrastructure develop and what is the likelihood of LNG's effect on deep sea shipping and port infrastructure?	
14.	What is the likely scale of demand for LNG-fuelled construction and LNG as a fuel for deep sea shipping up to 2025 affect the energy demand model and change the classic port planning model?	
15.	How will LNG bunkering infrastructure affect shipping trade port infrastructure ships' types and size ranges?	
16.	How do LNG bunkering infrastructure facilities compare with current bunkering patterns?	
17.	How does LNG as fuel affect the whole: 17(a) infrastructure of supply chain? 17(b) How will LNG fuel demand influence port infrastructure?	
18.	What is the potential market size for LNG-fuelled deep sea ships?	
19.	How will LNG demand affect shore supply technology for LNG bunkering?	
20.	What will be the effect of the pricing mechanism of fuel on LNG demand and how will this translate to port infrastructure investment?	
21.	Is there a direct correlation between the location of primary bunkering hubs and the main shipping trade lines?	
22.	How will increased demand for LNG affect shipping trends, thus affecting/influencing a particular trend in port development strategy?	

23.	Is LNG a viable option for deep-sea shipping and what plans exist for LNG in the future?	
24.	What are the key drivers of change to LNG as fuel: 24(a) Pricing effect 24(b) Supply availability 24(c) Overcoming operational issues 24(d) Increased reliability of ships from LNG 24(e) Establishment of local regulations 24(f) Positive public perception	
25.	How does the increased demand for LNG affect traffic in the port?	
26.	What market volatility affect shipping trends, feeder vessels, vessel size?	
27.	27(a) How will be the use of LNG as bunker fuel affect the demand for LNG and ship construction and ship delivery and retrofitting? 27(b) How will increased LNG demand affect onshore LNG bunkering and port infrastructure standards?	
28.	How has the energy mix plan and the 20-year Integrated Resource Plan affect planning for energy and port infrastructure and downstream infrastructure?	
29.	How has South Africa joining the prestigious BRICS countries in 2011 affected the demand and supply of energy and are our ports ready to meet this envisaged demand increase?	

QUESTIONNAIRE SCHEDULE ON THE ENERGY DEMAND RELATED ISSUES

Instructions:

a) Pease tick the block where options are provided.
b) Where necessary, fill in your response.

c) Please make the comments where the questionnaire requests you to do so.

d) Please answer all the questions.

Statement	Response	Strongly agree … Strongly disagree				
Port Planning	**Unsure**	**1**	**2**	**3**	**4**	**5**
Availability of port planning mode is important in choosing for location of ports						
Rationalising port infrastructure could reduce the unit cost of shipping products						
The supply of refined petroleum products is supplemented by imports of refined petroleum products						
There is a need to expand current storage infrastructure to erect new storage facilities						
Port planning methodology is determined by type of product or goods passing through the port						
Planning for berthing space is required for energy growth						

Port Methodology	Response	Strongly agree … Strongly disagree				
Port Players and their Objectives	**Unsure**	**1**	**2**	**3**	**4**	**5**
1. aximise throughput						
2. ort Authority/Operator to operate at least cost						
3. ort Authority to maximise value addition						
4. ort authority/government to minimise required capital investment						
5. he physical and equipment related parameters of port methodology (stocking, surface berthing length, dock space) are important						

APPENDIX A: INTERVIEW QUESTIONS

Energy Supply Side	**Response**	**Strongly agree … Strongly disagree**				
Supply-side is linked to refining capacities	**Unsure**	**1**	**2**	**3**	**4**	**5**
South African port infrastructure is aging and needs to be improved to accommodate energy supply.						
Is there an energy exploration framework linking supply and port infrastructure?						
What would be the likely impact of increasing crude oil imports on port infrastructure demand?						
Is the increase in the supply of crude energy likely to lead to an increase in demand for berthing space?						
Will the increase in the supply of crude oil lead to a decrease in the prioritisation of facilities for break bulk?						
Is there a link between energy supply and port handling capacity?						
Are shippers and traders aware of the benefits of huge capital investments in ports?						
How will developments in port technology improve port operational efficiency?						

Energy planning, forecasting and port planning are linked and address the disengagement between the maritime sector and the energy development sector						
The construction proposed 400,000 barrels per day by PetroSA in the port of Coega will replace old and aging plants and help reduce the country's reliance on importation and increase energy supply						
The construction of the proposed 400,000 barrels per day by PetroSA in the port of Coega will replace old and aging plants and help reduce the country's reliance on importation and increase energy supply						
Energy supply component has a correlationship with the availability of affordable energy carriers?						
Should the government play a leading role in ensuring security of energy supply?						
Should the planning of energy supply be centralized?						
The proposed refinery should be connected to an inland pipeline network to ensure continuous supply of energy.						

The short to long-term interventions in energy supply are linked to port planning and development						
Should local production of finished products be encouraged in order to boost increase in supply?						

APPENDIX B: QUESTIONNAIRES

Liquid Cargo & Port Development	**Response**	**Strongly agree … Strongly disagree**				
Is liquid cargo traffic in South Africa dominated by oil and port infrastructure?	**Unsure**	**1**	**2**	**3**	**4**	**5**
Is this developed outside the main sphere of port operations?						
Should liquid cargo development be integrated within the energy supply chain?						
Has there been a significant shift towards handling large volumes of landed refined product in South Africa over the last ten years?						
Will port infrastructure have to change to suit the requirement for facilities alongside berthing facilities in order to reduce loss of operations time when unloading crude?						
Is the increased energy supply and demand present a case for dredging most port facilities in South Africa?						
There is a need for landside links to other refineries and ports						

LNG development will lead to a new demand trend for port facilities						
Pricing of LNG will be the most important driver for LNG facilities in ports						
Regulations compliance is a key driver in the provision of LNG facilities						
LNG bunkering in the port will have to be done alongside private investors and third party operators (bunker suppliers)						
Will the demand for LNG have to be driven by ship-owners?						