## Quality Management

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Berths 203 to 205 Expansion EIA - Port of Durban
Climate Change Specialist Study

07/03/2013

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# Table of Contents

Executive Summary............................................................................................................. 5  
1 Study Background ................................................................................................... 9  
2 Climate Change Vulnerability and Adaptation ......................................................... 9  
3 Climate Change Mitigation Policy and Framework .................................................. 10  
3.1 UNFCCC and Kyoto Protocol .............................................................................. 10  
3.2 National Climate Change Response White Paper, 2011 ....................................... 10  
3.3 Climate Change Policy Framework for State Owned Companies.......................... 11  
3.4 Carbon Taxation ................................................................................................... 12  
3.5 International Maritime Organisation Regulatory Framework ............................ 12  
4 Transnet Group Corporate Climate Change Policy ............................................... 13  
4.1 Overview ............................................................................................................. 13  
4.2 Transnet’s GHG Inventory ................................................................................... 14  
5 International Maritime Shipping Emissions ............................................................ 15  
6 Project GHG Emissions Modelling .......................................................................... 16  
6.1 Overview ............................................................................................................. 16  
6.2 Model Input Parameters ...................................................................................... 16  
6.3 Results and Discussion ....................................................................................... 23  
6.4 Mitigation Options ............................................................................................. 27  
6.5 GHG Emissions – Construction Activities ......................................................... 28  
7 Conclusions ........................................................................................................... 29  
8 References ............................................................................................................ 31  

Appendix A – Trends in Maritime Sector GHG Emissions and Model Assumptions
Executive Summary

Introduction

WSP Environmental Pty Ltd (WSP) has been requested by Nemai Consulting to undertake a specialist study on climate change related impacts associated with the Transnet National Port Authority (TNPA) plans to upgrade Berths 203 to 205, Pier 2, Container Terminal, Port of Durban. The study forms part of the Environmental Impact Assessment (EIA) for the proposed development. TNPA has proposed the deepening, lengthening and widening of Berth 203 to 205 in order to improve the safety of the berths as well as to improve the efficiency of the Port.

The present climate change impact study focuses primarily on climate change mitigation issues associated with the proposed development and, to a lesser extent, on climate change vulnerability and adaptation issues.

In order to assess the climate change mitigation aspects of the project, a carbon calculator model has been built for the freight logistics transport network associated with three distinct project development scenarios, namely:

- **Scenario A: No Development;**
- **Scenario B: Partial Development (deepening of berths but no extension);** and
- **Scenario C: Full Development (deepening and extension)**

The model covers greenhouse gas (GHG) emissions for the maritime freight, rail freight and road freight transport components associated with the project.

The carbon calculator provides for a theoretical calculation of GHG emissions (in tonnes of CO$_2$ equivalent emitted per annum), based upon a number of idealised assumptions, for each component on the freight logistics journey (ship, truck and rail) and for each of the three scenarios. Actual emissions will vary from theoretical calculations, however the analysis does allow for interrogation of impacts and mitigation options. The modelled period is for 2012 – 2024$^1$.

Results – GHG Modelling

The results for the GHG emissions associated with the freight anticipated to move across Berths 203 – 205 are summarised below:

- **Total (cumulative) GHG emissions are essentially the same for the period 2012 – 2024, regardless of the development scenario selected (i.e. Scenarios A – C).**
  
  “Scenario C: Full Development” comes out with the lowest cumulative GHG emissions of all the scenarios, but only by 0.2% less than the “Scenario A: No Development” option. “Scenario B: Partial Development” is the worst performer, due to the higher volume of freight diverted to Coega (under the model assumptions). However, once again, this is only a by a marginal difference (1.5% more than the No Development option).

- **International Maritime GHG emissions associated with the freight projected to land at the Berths (for all scenarios) is anticipated to increase by between 109% and 145% by 2024 compared to GHG emissions in 2012, deviating by between 4% and 18% below a Business as Usual projection.**

Maritime sector GHG emissions associated with the berths are projected to more than double between 2012 and 2024. These are substantial increases that are far in excess of the reductions that many Annex I countries have been pursuing (i.e. absolute reductions compared to a 1990 baseline).

Taking a South African perspective, it is perhaps more pertinent to ask how the GHG emissions for 2024/25 compare to a “Business as Usual” projection. The analysis suggests that the GHG emissions will deviate by

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$^1$ Actually the Transnet financial year 2012/13 – 2024/25.
between 4% and 18% beneath the BaU curve\(^2\) by 2024. This compares to the South African national government target of a 42% decrease below the BaU projection by 2025.

Notwithstanding the jurisdictional issue regarding international maritime emissions, and that these emissions are technically excluded from the national government targets, narrowing the gap between the projected deviation of 4% - 18% beneath the BaU projection and a South African target range of 42% decrease will require collaborative action from the International Maritime Organisation (IMO), the South African government, Transnet and Transnet’s shipping customers if it is to have any chance of being achieved. It would be hoped that further efficiency improvements related to new technologies and operational management procedures will help to close the gap further, especially in view of the mandatory energy efficiency requirements being implemented by the IMO. However it is also incumbent upon TNPA and South Africa to incentivise the adoption of these newer and more fuel efficient container ships utilising the Berths 203 – 205 and for the Africa trade routes in general. Similarly, it is incumbent upon Transnet and South Africa to ensure that the largest possible container vessels (with the lowest GHG emissions factor per TEU-km) are able to safely dock in South African ports, and to encourage the adoption of these large vessels on the Africa trade routes in general.

- **Assuming that the road to rail mix remains the same as at present, GHG emissions per annum associated with transporting the freight between Johannesburg and Durban is projected to increase by 156% by 2024.**

  The majority of this increase will be as a result of increased GHG emissions from freight trucks on long haul routes (i.e. between Durban and Johannesburg). The results suggest that a 50/50 mix between rail and truck haulage by 2024 should result in a deviation below the BaU projection of 25% (short of the national target of 42% below the BaU projection by 2025). Increasing the rail mix to 85% results in a deviation below the BaU projection by 49% (although this still represents an absolute increase in GHG emissions of 30% compared to 2012).

  While Transnet’s plans for the road and rail mix is yet to be finalised for the eThekwini-Johannesburg route, it is known that Transnet is looking at a rail mix of up to 85%, with a 50% target viewed as a lower but perhaps more pragmatic target. The results show that if a 50/50 road/rail mix is pursued, additional measures may be needed in order to bring GHG emissions in line with the national GHG reduction target. Examples of additional measures would include fuel efficiency improvements for the truck freight fleet, more fuel efficient diesel electric locomotives and decarbonisation of the electricity supply in respect of electric traction freight rail.

  The above also highlights the importance of ensuring that freight is directed to ports which have strong rail linkages through to Gauteng and the major inland centres. From a GHG emissions perspective, this favours development at Pier 2 and/or the proposed Durban Dig Out Port.

  It is also notable that in order to reduce the combined road and rail freight GHG emissions, Transnet would need to substantially increase its own freight rail carbon footprint (according to the model, an increase of 1,340% by 2024 for the Durban-Johannesburg rail freight route under an 85% rail 15% road mix).

**Conclusions**

**Climate Change Adaptation**

- At present, Transnet (and the TNPA) does not have a port wide approach or methodology to assessing and incorporating climate change risks such as sea level rise and coastal storm surge. Incorporation of these issues is undertaken at an individual project level, via Transnet’s project lifecycle planning process.

- There appears to be adequate scientific and technical data available for the Port of Durban area to allow the appointed design engineers to assess climate change risks associated with sea level rise and storm surge, and to incorporate mitigation measures into the design for the berth development. However, it remains the primary responsibility of the design engineers to properly evaluate this and to incorporate these risks into the design parameters.

\(^2\) The assumptions underlying this “Business as Usual” projection may differ from those underlying the national government Climate Change Strategy “BaU” projection. However, for purposes of this assessment, these differences are not regarded as significant.
From a climate change adaptation perspective, the opportunity to develop the berths may be viewed as more favourable than the “No Development” option as it will allow for climate change adaptation criteria to be incorporated into the Berths 203 – 205 design parameters. The present structures were designed at a time when climate change adaptation criteria were not typically included in design parameters.

Climate Change Mitigation

The selection of development scenario (i.e. No Development, Partial Development or Full Development) does not meaningfully impact on the GHG projections (either cumulative total for 2012/13 – 2024/25 period or annual emissions by 2024/25). The primary reason for this is that GHG emissions that are dependent on the scenario selection are minor compared to GHG emissions associated with the overall growth in freight volumes for the modelled period.

While trade growth is assumed (for modelling purposes) to be independent of the three project development scenarios, in reality it cannot be ignored that these types of major port infrastructure projects facilitate both increased trade volumes and economic development. Hence initiatives that address GHG emissions associated with this increase in trade should be considered and integrated as part of these types of major infrastructure projects. This is critical if South Africa is to meet the GHG emissions reduction target as stated in the 2011 National Climate Change Response White Paper i.e. a 32% deviation below “Business as Usual” by 2020 and 42% deviation by 2025.

Recommended GHG mitigation initiatives during the construction phase include:

- Contractors to disclose their GHG Inventory, in terms of the CDP methodology for Scope 1, 2 and 3 emissions.
- Energy management plans to form part of the overall environmental management plan.
- The design teams to investigate low emission materials options for the project.

Key GHG mitigation initiatives targeting international maritime sector emissions include:

- Ensuring that the Berths 203 – 205 can readily accommodate the largest sized container vessels possible (assuming that this is acceptable from a broader environmental perspective).
- Adoption of an incentive programme to encourage the use of the most modern and low carbon container vessels at Berths 203 - 205, such as the WPCI’s ESI programme.
- Expanding TNPA’s GHG inventory to include reporting on international maritime vessels docking at Berths 203 – 205.
- Implementing measures to address GHG emissions not captured in this assessment i.e. cold ironing for vessels at Berths 203 – 205 (if not already implemented).

Key GHG mitigation initiatives targeting land-based freight transport emissions include:

- Massive expansion in the freight rail share of container transport flowing in and out of Pier 2 (i.e. Berths 203 – 205), as compared to truck freight. The current share for rail freight is estimated at 15% of TEUs. A minimum target of a 50% share should be aimed for by 2024 and, ideally, closer to 85%.
- Continued investment in lower emission diesel electric locomotives operating the container freight route to/from Pier 2 and a strategy of decarbonisation of the electric traction network in relation to the freight rail servicing Pier 2.
- Implementation of GHG data gathering systems that allows for the generation of freight rail corridor specific emission factors (i.e. kg CO\textsubscript{2} per tonne-km or TEU-km for specific freight rail corridors).
- Minimum standards and enforcement thereof for air emissions from freight trucks handling cargo at Berths 203 – 205.
- Establishment of a Clean Truck Programme aimed to encourage replacement of older trucks with newer and lower GHG emitting vehicles. This should not be implemented in a way that penalises marginal operators (who cannot necessarily afford new vehicles).
It is notable that many of the above initiatives will require close cooperation between the various Transnet Operating Divisions, namely TFR, TNPA and TPT. Furthermore, the present assignment raises the possibility and demonstrates the value of creating an integrated logistics network GHG model that can be used for evaluation of intervention measures in an integrated manner and on a national level.
1 Study Background

WSP Environmental Pty Ltd (WSP) has been requested by Nemai Consulting to undertake a specialist study on climate change related impacts associated with the Transnet National Port Authority (TNPA) plans to upgrade Berths 203 to 205, Pier 2, Container Terminal, Port of Durban. The study forms part of the Environmental Impact Assessment (EIA) for the proposed development. TNPA has proposed the deepening, lengthening and widening of Berth 203 to 205 in order to improve the safety of the berths as well as to improve the efficiency of the Port.

Berth 203 to 205 are the key container berths in the Port, however, much of the physical structure (designed in the 1970s) is operating beyond original design limitations and no longer meets relevant safety standards. Vessel sizes have also increased since the original terminal was constructed and Berth 203 to 205 cannot safely accommodate fully-laden, new-generation, container vessels due to insufficient water depth at these berths. At present these vessels enter and exit the Port partially laden and during the high tide window. This creates unsafe operating conditions and the risk exists for vessels to run aground.

The present climate change impact study focuses primarily on climate change mitigation issues associated with the proposed development and, to a lesser extent, on climate change vulnerability and adaptation issues.

In order to assess the climate change mitigation aspects of the project, a carbon calculator model has been built for the freight logistics transport network associated with the “No Development”, “Partial Development” (i.e. berth deepening but no extension) and “Full Development” (i.e. berth deepening and extension) scenarios. The model covers greenhouse gas (GHG) emissions for the maritime freight, rail freight and road freight transport components associated with the project.

2 Climate Change Vulnerability and Adaptation

Ports and other coastal infrastructure assets are increasingly at risk from the projected impacts of climate change. Within South Africa, these risks relate primarily to permanent sea level rise projections as well as with temporary storm events (i.e. “storm surges”) which are anticipated to become both more frequent and more intense in many areas.

In terms of the proposed development, the impact of these phenomena will be on the design criteria used for the civil and costal engineering components. Permanent sea level rise projections and projected increases in coastal storm frequency and intensity will affect the flood line calculations which underlie many of the engineering design parameters.

The Department of Environmental Affairs (DEA) is mandated with leading the management and protection of South Africa’s coastline from climate change and is reportedly engaged in processes to this effect. In its 2nd Communication to the UNFCCC, the DEA reported that:

“Sea-level is rising around the South African coast, but there are regional differences. On the west coast, the sea level is rising by 1.87 mm per year; on the south coast by 1.47 mm per year; and on the east coast by 2.74 mm per year. Modelling has shown that some areas along the coastline will be more susceptible to sea level rise than others, but the understanding is incomplete” (DEA, 2011).

To date, there has been no national level study of sea level rise projections for the South African coastline. In the absence of such a national study, a number of local and provincial authorities have undertaken sea level rise studies, coastal set back line studies etc. to better address climate change risks and to inform the coastal development process. Notable examples include the City of Cape Town, the Western Cape Department of Environmental Affairs & Development Planning (DEA&DP) and eThekwini Municipality. Unfortunately, this approach has led to different models, methodologies and approaches being adopted for different areas of the coast, making comparison of the impacts at different geographic areas (i.e. Port of Cape Town and Port of

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3 Climate change vulnerability and adaptation issues are expected to be addressed primarily by other specialists i.e. coastal engineers.

4 It is noted that the National Ports Act governs the port zones, so the mandate of the DEA in the port areas is somewhat different to the rest of the national coastline.
Durban) difficult. Nevertheless, the eThekwini Municipality is widely regarded as leading the way in terms of local sea level rise studies within South Africa.

It is not the purpose of this report to review the sea level rise impact studies undertaken for the Port of Durban region; merely to note that, in the opinion of the consultant, sufficient sea level rise information and data is available for the Port of Durban area to allow for adequate inclusion of these risks within the design parameters for the proposed development at Berths 203 – 205. It remains the primary responsibility of the appointed coastal engineering consultants to assess the available data and to draw the correct conclusions in terms of mitigation of sea level rise and storm surge risks.

In terms of Transnet’s approach to managing climate change related coastal risks, it is noted that Transnet Group identified sea level rise (and coastal storm surge) as a key risk in its voluntary submission to the Carbon Disclosure Project (CDP) Investor 2011 Response\(^5\) and has been gradually acting to integrate consideration of climate change risks within its systems and procedures for some time. It is also noted that the TNPA conducted a preliminary sea level rise risk assessment in January 2010, which included assessment of the Port if Durban (informed largely by the studies undertaken at the time by eThekwini Municipality). In terms of Transnet’s current risk mitigation procedure for coastal climate change risks, these are addressed on a project by project basis via Transnet’s project lifecycle planning process; no port-wide strategy exists in this regard.

Finally it is noted that in terms of climate change adaptation and improved resilience of South Africa’s port assets to coastal climate change risks, the proposed development could be seen in a positive light. The existing berths were designed at a time when sea level rise risks were not included in the basic design criteria. The proposed development will offer an opportunity for the TNPA to upgrade the structure to incorporate climate change projections, provided that the appropriate measures are carried through into the engineering design.

3 Climate Change Mitigation Policy and Framework

3.1 UNFCCC and Kyoto Protocol

The Kyoto Protocol, which came into force in 2005 under the United Nations Framework Convention on Climate Change (UNFCCC), committed signatories in developed countries (known as Annex I countries) to reduce their GHG emissions by 8-12% from 1990 levels in the period 2008-2012. Following the expiration of the Annex I countries’ GHG emissions reduction commitment period (at the end of 2012), the Kyoto Protocol has been the subject of ongoing negotiation for a follow-on commitment period, possibly to include certain non-Annex I countries such as South Africa, China, India and Brazil. South Africa is a signatory to the UNFCCC and the Protocol, although as a developing (i.e. non-Annex I) country, it has to date not been obliged to reduce its GHG emissions under international agreements. This is despite the fact that, on a global scale South Africa, is placed among the top 20 emitters in the world (United Nations, 2008 statistics\(^6\)).

3.2 National Climate Change Response White Paper, 2011

In 2009, and although not required to under international agreements, South Africa committed to conditionally reduce its GHG emissions by 34% below a “Business as Usual” (BaU) trajectory by 2020, and 42% by 2025. Actions that bring about this pathway would lead to the country’s GHG emissions peaking between 2020 and 2025, and plateauing for a decade before starting to decline in absolute terms. The national commitment was drawn primarily from the Long Term Mitigation Scenarios (LTMS) study, published in 2008. Stakeholder consultation in 2009 was used to identify policies and legislation required to realize these commitments, and was followed by the release of the National Climate Change Response Green Paper in 2010, turned white paper in late 2011.

\(^5\) Expected to eventuate within a 6 – 10 year timeframe according to Transnet’s submission.

The National Climate Change Response Paper outlines the approach that South Africa will take in order to reach these emissions reductions targets. Broadly, the approach will be balanced between adaptation and mitigation measures, primarily in energy, industry and transport sectors, through the utilisation of incentives (tax breaks and investment), as well as disincentives (carbon tax and legislation).

The response paper includes a call for detailed review and alignment of existing policies, strategies, legislation, regulations and plans falling within the jurisdiction of all government bodies in the next few years, leading to a determination of necessary legislative or regulatory measures required to meet the paper’s objectives. Legislative measures expected within the next 2-5 years will include:

- A national system of data collection will inform a greenhouse gas (GHG) inventory, while a monitoring and evaluation system will support an ongoing analysis of the impact of mitigation measures;
- Adopting a sectorial-based “carbon budget approach” to provide for flexibility and least-cost mechanisms for companies in each “relevant sector and/or sub-sectors”:
  - Where appropriate, translating carbon budgets into company-level desired emission reduction outcomes;
  - Requiring companies and economic sectors or sub-sectors for which desired emission reduction outcomes have been established to prepare and submit mitigation plans, setting out how they intend to achieve the desired emission reductions; and
  - Deploying a range of economic instruments to support the system of desired emission reduction outcomes.

Economic instruments proposed are likely to include a carbon tax (now anticipated for 2015), as well as a possible use of an emission reduction trading mechanisms for those relevant sectors, sub-sectors, companies or entities where a carbon budget approach has been selected. The definition of the scope of such carbon budgets has been committed to by October 2013.

As will be elaborated on below, international maritime sector emissions are not included in the above commitments on national greenhouse gas emission targets or proposed carbon budgets for the Transport Sector.

### 3.3 Climate Change Policy Framework for State Owned Companies

In 2011, the Department of Public Enterprises (DPE) released its climate change policy framework for state owned companies (SOCs), including Transnet. The framework is intended to “provide direction to the Boards and management of SOCs in relation to the accomplishment of the goals that have been articulated in the October 2011 National Climate Change Response White Paper”. It is also intended to guide longer term actions required to put South Africa on a low carbon development path and to ensure that SOCs are leading as agents of change in this process.

The overarching approach is based on four core principles which underline the design of the DPE policy:

- SOCs should focus on optimising the overlap between commercial, economic, developmental and environmental objectives whilst carefully managing areas where these objectives conflict.
- Climate change, broader environmental and green economy considerations must be integrated into the heart of SOC planning, procurement and operational processes (while acknowledging that this will be an on-going process of learning).
- Each SOC requires flexibility in the way it responds to the challenges of climate change given the diversity of sectors within which the SOC operates.
- The development of the green economy requires a high level of collaboration across SOCs and between SOCs and government.

While the Framework is perhaps short on detail, it clearly commits all SOCs to actively contribute to the national climate change response goals related to both adaptation and mitigation.
3.4 Carbon Taxation

The South African carbon tax discussion paper “The Carbon Tax Option” was published by National Treasury in December 2010. Based on public consultation and review the Treasury announced the proposed design for a carbon emissions tax in the 2012 budget speech. In line with in the Climate Change Response White Paper, it is proposed that a carbon tax will be implemented in 2013/2014 at a rate of R120 per ton of carbon dioxide equivalent (CO$_2$e) on direct emissions.

A basic tax-free threshold of 60% was proposed for the first phase (originally stated as 2013 – 2019). The maximum offset percentage allowance is 10%. In addition, the 2012 Budget also increased the electricity levy generated from non-renewable sources by 1 cent per kWh to 3.5 cents per kWh.

On 27 February 2013, the Minister of Finance, Pravin Gordon, delivered the 2013 Budget Speech. Government has proposed the implementation of a carbon tax (still at R120 per tCO$_2$e), effective from 1st January 2015. Mr Gordon announced that a tax-free exemption threshold would remain at 60% to soften the impact of the tax (i.e. an effective tax rate of R48 per tCO$_2$e), with additional allowances for “emissions intensive and trade-exposed industries”. The Minister further noted that an updated Carbon Tax Policy Paper would be published for further consultation by the end of March 2013.

At present, it is not entirely clear how the proposed carbon tax regime will be implemented in relation to marine bunker fuel, however in view of the special status enjoyed by the international maritime sector (described below) it is the opinion of the consultant that the carbon tax will not affect international bunker fuels or shipping operations in any material way for the present.

3.5 International Maritime Organisation Regulatory Framework

While emissions from aviation and maritime transport have been part of the UNFCCC agenda for some time, these emissions are not included under the Kyoto Protocol. Article 2.2 of the Kyoto Protocol reads:

“The Parties included in Annex I shall pursue limitation or reduction of emissions of greenhouse gases not controlled by the Montreal Protocol from aviation and marine bunker fuels, working through the International Civil Aviation Organization [ICAO] and the International Maritime Organization [IMO], respectively.”

In other words, GHG emissions associated with the maritime sector are not included in GHG reduction targets agreed to by Annex I countries (IMO, 2009). Similarly, the 2006 Intergovernmental Panel for Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories excludes GHG emissions associated with the international aviation and maritime sectors from national GHG inventories. The GHG Inventory South Africa 1990 to 2000, compiled in accordance with the IPCC 2006 guidelines, includes international aviation and maritime bunker fuel emissions as memo items.

South Africa’s proposed mechanisms for addressing its national GHG emissions footprint i.e. the national GHG reduction targets described in the 2011 Climate Change Response White Paper and associated enabling initiatives (such as the proposed Carbon Budget for the Transport Sector) are consequently expected to exclude consideration of international aviation and maritime emissions. SA’s proposed Carbon Budget for the Transport Sector will in all probability adopt the same scope as the IPCC 2006 guidelines and therefore limit itself to road, rail and pipeline GHG emissions only. This is based on the assumption that the South African government will continue to support the status quo whereby international maritime and aviation emissions are managed via the ICAO and IMO, as stipulated in the Kyoto Protocol. It is noted, however, that while progress by the IMO in tackling GHG emissions (as per its mandate, and as described in Section 5) is greater than that achieved by the ICAO, certain countries as well as the European Union (EU) feel that the progress falls short of...
what is ultimately needed. These nations are increasingly calling for international maritime emissions to be included in their own national GHG emission targets, in order to enforce more aggressive mitigation measures.

A topic of debate within the IMO is how the wording of Article 2.2 of the Kyoto Protocol should be interpreted and if the principle agreed under UNFCCC of “common but differentiated responsibility” should apply to a GHG emissions regime for international shipping rather than the IMO’s basic principle of “no more favourable treatment” i.e. that maritime sector emissions from Annex I countries be treated the same as for non-Annex I countries such as South Africa. Many delegations are of the opinion that, given the global mandate of the IMO in regards to safety of ships and the protection of the marine and atmospheric environment from all sources of ship pollution, the IMO regulatory framework on GHG emissions should be applicable to all ships, irrespective of the flags they fly, the trade routes they operate, or ports they call at.

This opinion is, unsurprisingly, opposed by many developing countries, especially those with large merchant navy fleets. In this regard, it is worth noting that the registration of a ship can move between jurisdictions several times over its lifetime and that about three quarters of the world tonnage, by deadweight, of all merchant vessels engaged in international trade is registered in developing countries; it would be ineffective for any regulatory regime to act only on the remaining portion, namely one quarter of the world fleet (IMO, 2009). The 20 largest merchant marine fleets ranked by country in 2007 were: Panama, Liberia, China, Malta, the Bahamas, Singapore, Russia, Antigua and Barbuda, Hong Kong, Indonesia, Marshall Islands, Cyprus, Greece, South Korea, Norway, Japan, Italy, Cambodia, Saint Vincent and the Grenadines, and the Netherlands. The top five countries of registration with the largest registered dead weight tonnage as at January 2007 were: Panama, Liberia, Bahamas, Greece and the Marshall Islands, accounting for 48 per cent of the world’s dead weight tonnage (Australian Dept. of CC&EE, 2009).

At present, South Africa has effectively no merchant navy to speak of (for the past 20 years or so), although the government is reportedly giving consideration to developing a substantial South African-flagged merchant navy fleet (Fin24.com, 2012).

4 Transnet Group Corporate Climate Change Policy

4.1 Overview

Transnet is at the initial stage of developing an integrated strategic response to climate change. In its voluntary submission to the CDP Investor Response for 2011\(^1\), Transnet indicated that the following activities have been concluded:

- High Level Risk and Vulnerability Assessment;
- GHG Emission Inventory 2011/2012;\(^2\)
- General mitigation roadmap;
- The focus for 2012/2013 is to develop an integrated energy and carbon strategy with a target date of April 2013. The outcome will address the following focus areas;
  - Energy and Carbon management (Short, Medium and Long Term);
  - GHG emissions reduction targets;
  - Road to Rail GHG emission reduction tracking;

Transnet is part of the Industry Task Team on Climate Change (ITTCC), a voluntary non-profit association established to undertake fact-based technical work on climate change and to work with Government to find optimal solutions for achieving a sustainable, low carbon economic growth path for South Africa.

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\(^{11}\) It is understood that Transnet has responded again to the 2012 Investor Response, however these responses have not yet been publicly released by the CDP.

\(^{12}\) Scope 1 and 2 emissions for the corporate centre and five main Operating Divisions: Transnet Port Terminals, Transnet National Ports Authority, Transnet Freight Rail, Transnet Rail Engineering and Transnet Pipelines.
While Transnet’s plans on Climate Change are still being formulated, it is expected that Transnet’s GHG emissions will “increase over the next five years due to an aggressive growth mandate that will provide for infrastructure investment, job creation, local supplier development and increase South Africa’s overall global competitiveness” (CDP, 2012). Of key relevance to the proposed development is that the growth strategy supports a modal shift of freight from road to rail to service the inland market (Gauteng etc.). This is in line with the mitigation measures outlined in the LTMS to underpin GHG emissions reductions in the Transport Sector (where most of the emissions are related to road vehicles and where alternatives such as rail are considered to have a lower GHG emissions intensity. Hence Transnet’s approach is predicated on the fact that even if its GHG emissions increases (in absolute terms), this is likely to be beneficial from a national perspective, as the alternative would likely be even higher GHG emissions associated with increased road freight.

In addition, Transnet is acting to prioritise energy efficiency within major equipment expenditure contracts. Examples include the energy regeneration capabilities in Class 15E and Class 19E locomotives on the iron ore and coal lines respectively, installation of 6 Liebherr STS Cranes also with regenerative capabilities, and the inclusion of energy efficiency within the selection criteria for new locomotive fleet.

### 4.2 Transnet’s GHG Inventory

According to Transnet’s CDP 2011 Investor Response, TNPA’s GHG emissions footprint was 27,056 tCO2e per annum for scope 1 emissions (i.e. fuel consumption, including bunker fuel for TNPA’s maritime operations) and 183,865 tCO2e per annum for scope 2 emissions (i.e. from purchased electricity). Scope 3 emissions (i.e. those related to tenants, international maritime vessels, freight trucks not owned by TNPA etc.) were not reported. TNPA accounted for around 2% of Transnet’s total GHG emissions.

GHG emissions associated with 3rd party vessels docking at TNPA ports are considered to be scope 3 emissions i.e. emissions that are not under the direct operational control of Transnet. Corporate and port-related GHG inventory guidance documents typically regard reporting on scope 3 emissions as a “voluntary” activity. This type of reporting is typically undertaken by those organisations who are regarded as being leaders in the area of sustainability, for example the Port of Los Angeles, which does include maritime sector emissions as part of their GHG inventory reporting process. Within the context of ports, whereby the port authorities essentially act as a landlord, scope 3 emissions represent a far greater quantity of GHG emissions than scope 1 and 2 emissions. Certainly within the context of Transnet’s five Operating Divisions, scope 3 emissions are expected to be of far greater importance for TNPA than for any of the other divisions.

Transnet Port Terminals (TPT) report a further 249,374 tCO2e per annum for scope 1 and 2 emissions (6% of Transnet’s footprint), while Transnet Freight Rail (TFR) reports 3,249,064 tCO2e per annum (scope 1 and 2 emissions), accounting for 75% of Transnet’s total carbon footprint. Taken together, Transnet’s GHG emissions are likely to place it as a Top 10 corporate emitter13 within South Africa (and certainly a top 20 emitter). Nevertheless, these emissions are relatively small compared to Transport Sector emissions associated with road vehicles.

<table>
<thead>
<tr>
<th>Transnet Division</th>
<th>Scope 1 Emissions</th>
<th>Scope 2 Emissions</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freight Rail</td>
<td>445,960</td>
<td>2,803,104</td>
<td>3,249,064</td>
</tr>
<tr>
<td>Rail Engineering</td>
<td>15,399</td>
<td>416,275</td>
<td>431,674</td>
</tr>
<tr>
<td>Pipelines</td>
<td>3,307</td>
<td>213,299</td>
<td>216,606</td>
</tr>
<tr>
<td>Port Terminals</td>
<td>65,509</td>
<td>183,865</td>
<td>249,374</td>
</tr>
<tr>
<td>National Ports Authority</td>
<td>27,056</td>
<td>60,080</td>
<td>87,136</td>
</tr>
<tr>
<td>Other (Corporate)</td>
<td>13,837</td>
<td>61,369</td>
<td>75,206</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>571,068</strong></td>
<td><strong>3,737,992</strong></td>
<td><strong>4,309,060</strong></td>
</tr>
</tbody>
</table>

13 Excluding Eskom.
5 International Maritime Shipping Emissions

International shipping is regarded as the lowest emitting mode of bulk freight transport. Shipping is estimated to represent around three percent of global GHG emissions, while transporting approximately 85 percent of goods traded internationally. The most authoritative assessment of maritime GHG emissions to date is the 2nd IMO GHG Study issued in 2009 by the Marine Environment Protection Committee (MEPC) of the IMO. Some of the pertinent findings of the 2nd IMO GHG Study are:

- Shipping is estimated to have emitted 1,046 million tonnes of CO₂ in 2007, which corresponds to 3.3% of the global emissions during 2007. International shipping is estimated to have emitted 870 million tonnes (about 83% of total shipping emissions), or about 2.7% of the global emissions of CO₂ in 2007.
- Mid-range emissions scenarios show that, by 2050, in the absence of policies, ship emissions may grow by between 150% to 250% (compared to the emissions in 2007) as a result of the growth in international trade.
- If the climate is to be stabilized at no more than 2°C warming over pre-industrial levels by 2100 and emissions from shipping continue as projected in the scenarios that are given in the 2nd IMO GHG report, then they would constitute between 12% and 18% of the global total CO₂ emissions in 2050 that would be required to achieve stabilization (by 2100) with a 50% probability of success. This is regarded as unsustainable.

Container ships (such as is expected to berth at Berths 203 – 205) are typically the highest GHG producing ships involved in international trade, primarily due to their faster speed of travel, and are estimated to account for 25% of international shipping emissions.

In July 2011, the IMO MEPC adopted mandatory measures to reduce GHG emissions from international shipping through amendments to MARPOL Annex VI Regulations. These amendments include the application of the Energy Efficiency Design Index (EEDI) for new ships which will require ships to meet a minimum level of energy efficiency. This means that ships built between 2015 and 2019 will need to improve their efficiency by 10 per cent, which will graduate to 20 per cent between 2020 and 2024 and 30 per cent for ships delivered after 2024.

The EEDI applies to all new ships built of gross tonnage 400 and above from 1 January 2013, although ships flagged under non-Annex I countries have a four to six and a half year exemption period (a measure championed by South Africa, among others). From the 1st January 2013, existing ships are also required to document their energy usage through the introduction of a Ship Energy Efficiency Management Plan (SEEMP) that is linked to the ship’s broader management plan (IMO, 2011). The measures implemented by the IMO mark the first ever mandatory global GHG reduction regime for a specific industry sector.

It is predicted that these two measures (the EEDI and SEEMP) will result in annual reductions in CO₂ emissions of 151.5 million tonnes by 2020 and 330 million tonnes a decade later. Compared with the IMO’s BaU scenario, this is a reduction in fuel consumption and emissions of 13 per cent and 23 per cent by 2020 and 2030 respectively. By 2050, the figure is set to reach 39 per cent. This compares to South Africa’s planned (in policy at least) GHG emissions reduction of 34% below BaU by 2020 and achieving year-on-year absolute reductions by before 2050.

Further substantial GHG emission reductions are already being achieved via operational measures, in particular “slow steaming”16, a practice that is becoming increasingly common. The IMO however acknowledges that the above measures are insufficient to result in arresting the increase and ultimately an absolute reduction in maritime sector GHG emissions. The primary reasons for this are, firstly, that the EEDI measures do not address GHG emissions within the existing global maritime fleet, but only apply to new ships, and secondly that the proposed measures are insufficient to offset the increase in emissions resulting from projected increases in global trade volumes.

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14 The 1st GHG Study was published in 2000.
15 With the notable difference that the IMO has implemented these initiatives while South Africa is still in the process of implementing, or has yet to implement, the initiatives required to achieve the national target.
16 Slow steaming refers to the practice whereby ships travel at reduced speeds in order to improve overall fuel efficiency and, as a consequence, results in reduced GHG emissions. The practice relies on efficient port operations allowing the ships to plan their journeys to arrive “just in time” for berthing.
Consequently, the IMO is continuing to explore additional market-based measures, such as GHG emissions trading or a levy on bunker fuel. Progress on these market-based measures has, however, been slow, resulting in certain roleplayers, notably the EU and United Kingdom (UK), threatening to implement their own regional measures for managing maritime emissions (IMO, 2012).

6 Project GHG Emissions Modelling

6.1 Overview

The following project activities have been considered for the present assignment:

- **Freight Logistics GHG Emissions**: This would include GHG emissions associated with international maritime container vessel transport between Durban and the various international destinations, maritime feeder transport between local ports (i.e. Coega and Durban), rail freight transport between Durban and Johannesburg, and truck freight transport between coastal ports (i.e. Coega and/or Durban) and inland centres (i.e. Johannesburg).

- **Construction-related GHG Emissions**: This would include bulk earthworks, dredging, cement and concrete casting, transporting of building materials to and from the construction site etc. For the purposes of the present assignment, construction related GHG emissions have been assessed qualitatively and relatively briefly, due to the lower amount of GHG emissions expected to be associated with this activity as compared to GHG emissions associated with freight logistics components of the development.

Operational emissions associated with maintenance dredging, port terminal operations, tugboats etc. are excluded from the present analysis but are expected to be relatively modest. For GHG emissions associated with the freight logistics component of the project, a carbon calculator has been developed which calculates (quantitatively) the GHG emissions associated with each leg of the logistics journey.

The carbon calculator provides for a theoretical calculation of GHG emissions (in tonnes of CO$_2$ emitted per annum) for the different development scenarios under consideration, and broken down for each component on the freight logistics journey.

Three development scenarios are considered, in line with those presented in the Economic Impact Assessment for the proposed development (Urban-Econ, 2012), namely:

- **Scenario A: No Development**;
- **Scenario B: Partial Development (deepening of berths but no extension)**; and
- **Scenario C: Full Development (deepening and extension)**

The calculations are based upon a number of idealised assumptions. Actual emissions will vary from theoretical calculations e.g. due to the actual fuel consumption and consequent emissions varying with operational voyage characteristics such as speed, cargo load and weather conditions, as well as other factors. Nevertheless, the carbon calculator provides for a useful tool for comparison of the GHG emissions associated with the various scenarios under consideration.

6.2 Model Input Parameters

6.2.1 Relationship between Freight Volumes and Berth Development Scenarios

Freight volume projections for the period 2012/13 – 2024/25 have been sourced from the Economic Impact Assessment (Urban-Econ, 2012). The freight volume projections are based on various assumptions of growth in international trade volumes between South Africa and the rest of the world (both imports and exports).

17 The UK has reportedly agreed to postpone consideration of maritime sector interventions until 2016 at least.
Perhaps the most important assumption for modelling purposes is that these trade volumes are independent of the project development scenarios (Scenarios A – C). The project scenarios are considered relevant only in terms of determining the point of entry for these trade volumes and the physical pathways the freight follow on their journey. For example, it is assumed that the twenty-foot equivalent unit (TEU) containers that would have entered (or exited) South Africa at Berths 203 - 205 if the Berths were to be fully upgraded (Scenario C), will be redirected to an alternative point of entry in the case of the reduced capacity at the Berths under Scenario A (No Development).

In reality, it is possible that some of the redirected trade volume may actually:

1. “Disappear” (i.e. cancelled orders) due to the consequent increase in price on the trade activity (for example, as a result of redirecting the trade to the Port of Ngqura and then having to pay for transporting the trade back to Durban via a feeder vessel) making the trade financially unattractive. This should result in a net decrease in GHG emissions.

2. Be replaced with a locally or regionally produced alternative. Notwithstanding any economic pros and cons associated with this possibility, from a GHG emissions perspective, one cannot draw any conclusions about whether this would result in a net positive or negative impact. The GHG emissions associated with the freight logistics component (and especially with the shipping component) of a good’s lifecycle carbon footprint is typically only a small percentage of the total lifecycle carbon footprint. A more important factor is the upstream GHG emissions i.e. from product usage, and/or downstream emissions emitted during the production and processing of the good or commodity. There are numerous international examples of imported products whose lifecycle GHG footprint are substantially lower than locally produced alternatives. Within the South African context, this may well prove to be the case, considering that South Africa has one of the most carbon intensive electricity grids compared to many of our trading partners such as the UK, France, Japan, Brazil etc. Furthermore, the GHG emissions efficiency of container freight vessels compared to road freight means that it may well be a lower GHG emissions alternative to ship an item from China than to transport it via road from a Sub-Saharan trade partner. This is not to say that “localisation” or “regionalisation” of trade is not desirable for other reasons, merely to state that it cannot be assumed to be beneficial from a narrow GHG emissions perspective.

Notwithstanding the above, it is obvious that major port infrastructure projects, such as the proposed expansion at Berths 203 – 205, when taken collectively and at a national scale, facilitate both economic growth and increased international trade volumes; and that there is a clear correlation in the national economy between increased economic growth and trade, and a consequent increase in GHG emissions, as more goods and materials are mined, manufactured, transported, and utilised. It may therefore be argued that it is incumbent upon major infrastructure projects that facilitate this increased trade to integrate measures that address the projected increase in GHG emissions associated with such trade, in line with the national targets as described in the 2011 National Climate Change Response White Paper. This approach is considered consistent with the fundamental principles of sustainable development contained in the National Environmental Management Act (No. 107 of 1998), as well as being consistent with Transnet’s own internal policies and the DPE’s Climate Change Policy Framework for State Owned Companies.

6.2.2 Freight Movements

A key element to the calculator is determining the “freight logistics pathway” for each of the above scenarios i.e. under a partial development scenario, which physical path the various units of freight will follow (i.e. port of entry and exit, transport from where and to where, and by which mode i.e. truck or rail).

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18 Whether a raw product that has been mined, agricultural produce like a tomato, or a manufactured good like a fridge or motor vehicle, the literature indicates the same principle to greater or lesser degrees.
Table 2: Key Assumptions on Freight Movement for GHG Modelling Purposes

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Key Assumptions on Freight Trade Movement</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Scenarios</td>
<td></td>
</tr>
<tr>
<td>All Scenarios</td>
<td>The modelling period under consideration for GHG emissions is 2012/13 through to 2024/25.</td>
</tr>
<tr>
<td>All Scenarios</td>
<td>The freight volumes considered for modelling are the container trade, measured in TEUs, that are projected to flow across Pier 2 if there are no capacity constraints. These freight volumes have been sourced from the Economic Impact Assessment (Urban-Econ, 2012).</td>
</tr>
<tr>
<td>All Scenarios</td>
<td>Trade volumes are independent of the project development scenarios (i.e. Scenarios A – C). The total volume of trade entering and exiting South Africa is assumed to be unaffected by the scenario selection for this project. Trade that cannot enter via Berths 203 – 205 (dependent on the scenario selected) is assumed to be redirected to an alternative point of entry. For the purposes of this model, the alternative point of entry is assumed to be either the Port of Ngqura (at Coega) or the proposed Durban Dig Out Port (DDOP), which is assumed to come on line in 2020/21.</td>
</tr>
<tr>
<td>All Scenarios</td>
<td>The country (or region) of origin/destination for international container trade passing across Pier 2 has been estimated based upon South African government export and import trade data for 2010. For each country or region, a “representative port” has been selected for calculating the shipping distances (i.e. Rotterdam for Europe). These ratios and the relevant ports are summarised in Table 3. The percentage split between the trade partners is assumed to remain constant over time.</td>
</tr>
<tr>
<td>Scenario A: No Development</td>
<td></td>
</tr>
<tr>
<td>Scenario A: No Development</td>
<td>Trade will enter and exit across Pier 2 (Berths 203 – 205) as normal until 2016/17, at which point shipping companies will start redirecting some trade (associated with their larger vessels which can no longer dock at Pier 2) to Coega.</td>
</tr>
<tr>
<td>Scenario A: No Development</td>
<td>Freight landing at Coega will follow one of three routes:</td>
</tr>
<tr>
<td>Scenario A: No Development</td>
<td>a) Loaded onto a container feeder vessel and shipped back up to Durban;</td>
</tr>
<tr>
<td>Scenario A: No Development</td>
<td>b) Sent via road freight (i.e. trucks) to Johannesburg; or</td>
</tr>
<tr>
<td>Scenario A: No Development</td>
<td>c) Sent via road freight (i.e. trucks) to Durban.</td>
</tr>
<tr>
<td>Scenario A: No Development</td>
<td>When the proposed DDOP comes on line (assumed to be 2020/21), it is assumed that all freight that was being diverted from Pier 2 to Coega, will now be diverted to the proposed DDOP. While it makes no difference from a carbon modelling point of view, it is also assumed that a substantial proportion of the freight landing at Pier 2 will also be diverted to the proposed DDOP.</td>
</tr>
<tr>
<td>Scenario A: No Development</td>
<td>Freight landing at Durban (Pier 2 or proposed DDOP) will follow one of three route possibilities:</td>
</tr>
<tr>
<td>Scenario A: No Development</td>
<td>a) Remain in Durban (as its end point destination);</td>
</tr>
<tr>
<td>Scenario A: No Development</td>
<td>b) Travel to Johannesburg via road freight (i.e. trucks); or</td>
</tr>
<tr>
<td>Scenario A: No Development</td>
<td>c) Travel to Johannesburg via rail freight.</td>
</tr>
<tr>
<td>Scenario B: Partial Development</td>
<td></td>
</tr>
<tr>
<td>Scenario B: Partial Development</td>
<td>Trade entering and exiting across Pier 2 (Berths 203 – 205) will be significantly disrupted from 2012/13 when civil engineering works are scheduled to commence until 2015/16 when completed. Trade will be redirected to Coega.</td>
</tr>
<tr>
<td>Scenario B: Partial Development</td>
<td>Post construction, there will remain a much smaller volume of trade that is diverted from Pier 2 to Coega, due to the limited capacity of Pier 2 (i.e. no</td>
</tr>
</tbody>
</table>

---

19 Obviously some of the trade redirected to Coega may actually end up going to other ports on the East African seaboard. However, the above assumption is regarded as reasonable for modelling purposes.

20 The freight volume estimates provided for the model assumed that engineering works would have already commenced by 2012/13.
extension of the berths) and plentiful capacity at Coega.

- Freight landing at Coega will follow the same route options as described in Scenario A.
- When the proposed DDOP comes on line, it is assumed that all freight that was being diverted from Pier 2 to Coega, will now be diverted to the proposed DDOP and that a substantial proportion of the freight currently landing at Pier 2 will also be diverted to the proposed DDOP.
- Freight landing at Durban (whether from international destinations or from Coega), will follow the same route options as described for Scenario A.

**Scenario C: Full Development**

- No capacity constraints are incurred at Pier 2, and all trade that wishes to land at Berths 203 – 205 is able to do so.
- As it makes no difference from a GHG emissions modelling perspective, the proposed DDOP has been ignored for this scenario.
- Freight landing at Durban will follow the same route options as described for Scenario A.

* The terms “exit” and “entry” are used relatively interchangeably in the table above i.e. it makes no difference if one models GHG emissions for an exported TEU container that travels from Johannesburg to Durban and onwards to China, or whether one models the emissions for an imported TEU container that comes from China to Durban and then onwards to Johannesburg.

Trade volumes and the South African port of entry/exit for each of the above scenarios are shown in Tables 4-6. The following aspects (among others) are excluded from the model:

- GHG emissions associated with offloading and onloading procedures;
- First and last mile logistics emissions i.e. short haul truck transport from the port to local logistics centres or from these centres to the point of “final” destination (i.e. a supermarket shelf);
- Indirect emissions. Only the direct emissions resulting from ship, locomotive or truck fuel consumption are considered (i.e. “Scope 1 emissions”21).

Table 3: International Ports of Origin/Destination and % Trade for Container Volumes Being Modelled

<table>
<thead>
<tr>
<th>Trade Partner</th>
<th>% Split in Trade22</th>
<th>Representative Port</th>
<th>km’s to Dbn/Coega23</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>15%</td>
<td>NY</td>
<td>14,021</td>
</tr>
<tr>
<td>Europe</td>
<td>40%</td>
<td>Rotterdam</td>
<td>12,803</td>
</tr>
<tr>
<td>China</td>
<td>25%</td>
<td>Shanghai</td>
<td>12,781</td>
</tr>
<tr>
<td>Japan</td>
<td>12%</td>
<td>Tokyo</td>
<td>14,116</td>
</tr>
<tr>
<td>India</td>
<td>5%</td>
<td>Mumbai</td>
<td>7,904</td>
</tr>
<tr>
<td>South America</td>
<td>3%</td>
<td>Santos</td>
<td>7,701</td>
</tr>
</tbody>
</table>

Table 4: Trade Volumes for Berths 203 – 205 (in TEUs) assuming no Capacity Constraints at the Berths i.e. Scenario C – Full Development (Source: Urban-Econ, 2012)

<table>
<thead>
<tr>
<th>Year</th>
<th>TEUs</th>
<th>Year</th>
<th>TEUs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012/2013</td>
<td>1,977,010</td>
<td>2019/2020</td>
<td>3,438,797</td>
</tr>
<tr>
<td>2013/2014</td>
<td>2,095,631</td>
<td>2020/2021</td>
<td>3,713,901</td>
</tr>
<tr>
<td>2014/2015</td>
<td>2,244,411</td>
<td>2021/2022</td>
<td>4,011,013</td>
</tr>
<tr>
<td>2015/2016</td>
<td>2,449,633</td>
<td>2022/2023</td>
<td>4,331,894</td>
</tr>
<tr>
<td>2016/2017</td>
<td>2,622,929</td>
<td>2023/2024</td>
<td>4,678,446</td>
</tr>
<tr>
<td>2017/2018</td>
<td>2,948,214</td>
<td>2024/2025</td>
<td>5,052,721</td>
</tr>
</tbody>
</table>

21 See the WBCSD/WRI Corporate GHG Protocol for a detailed explanation (www.ghgprotocol.org).
22 Based on WSP estimates derived from Trade and Investment South Africa (TISA) data for 2010, sourced from http://www.exporthelp.co.za/statistics/sa_stats.html
23 http://www.portworld.com/map/
### Table 5: Trade Volumes at the various Ports (in TEUs) for Scenario A (“No Development”)*

<table>
<thead>
<tr>
<th>Year</th>
<th>TEUs</th>
<th>Pier 2</th>
<th>DDOP</th>
<th>Coega</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012/2013</td>
<td>1,977,010</td>
<td>1,977,010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013/2014</td>
<td>2,095,631</td>
<td>2,095,631</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2014/2015</td>
<td>2,244,411</td>
<td>2,244,411</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015/2016</td>
<td>2,449,633</td>
<td>2,449,633</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2016/2017</td>
<td>2,622,929</td>
<td>2,544,241</td>
<td>78,688</td>
<td></td>
</tr>
<tr>
<td>2017/2018</td>
<td>2,948,214</td>
<td>2,859,768</td>
<td>88,446</td>
<td></td>
</tr>
<tr>
<td>2018/2019</td>
<td>3,184,071</td>
<td>3,088,549</td>
<td>95,522</td>
<td></td>
</tr>
<tr>
<td>2019/2020</td>
<td>3,438,797</td>
<td>3,335,633</td>
<td>103,164</td>
<td></td>
</tr>
<tr>
<td>2020/2021</td>
<td>3,713,901</td>
<td>1,856,951</td>
<td>1,856,951</td>
<td></td>
</tr>
<tr>
<td>2021/2022</td>
<td>4,011,013</td>
<td>2,005,507</td>
<td>2,005,507</td>
<td></td>
</tr>
<tr>
<td>2022/2023</td>
<td>4,331,894</td>
<td>2,165,947</td>
<td>2,165,947</td>
<td></td>
</tr>
<tr>
<td>2023/2024</td>
<td>4,678,446</td>
<td>2,339,223</td>
<td>2,339,223</td>
<td></td>
</tr>
<tr>
<td>2024/2025</td>
<td>5,052,721</td>
<td>2,526,361</td>
<td>2,526,361</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>42,748,671</strong></td>
<td><strong>31,488,864</strong></td>
<td><strong>10,893,988</strong></td>
<td><strong>365,820</strong></td>
</tr>
</tbody>
</table>

* Adapted from Urban-Econ, 2012.

### Table 6: Trade Volumes at the various Ports (in TEUs) for Scenario B (“Partial Development”)*

<table>
<thead>
<tr>
<th>Year</th>
<th>TEUs</th>
<th>Pier 2</th>
<th>DDOP</th>
<th>Coega</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012/2013</td>
<td>1,977,010</td>
<td>1,324,597</td>
<td></td>
<td>652,413</td>
</tr>
<tr>
<td>2013/2014</td>
<td>2,095,631</td>
<td>1,404,073</td>
<td></td>
<td>691,558</td>
</tr>
<tr>
<td>2014/2015</td>
<td>2,244,411</td>
<td>1,503,755</td>
<td></td>
<td>740,656</td>
</tr>
<tr>
<td>2015/2016</td>
<td>2,449,633</td>
<td>1,641,254</td>
<td></td>
<td>808,379</td>
</tr>
<tr>
<td>2016/2017</td>
<td>2,622,929</td>
<td>2,596,962</td>
<td></td>
<td>25,967</td>
</tr>
<tr>
<td>2017/2018</td>
<td>2,948,214</td>
<td>2,919,027</td>
<td></td>
<td>29,187</td>
</tr>
<tr>
<td>2018/2019</td>
<td>3,184,071</td>
<td>3,152,549</td>
<td></td>
<td>31,522</td>
</tr>
<tr>
<td>2019/2020</td>
<td>3,438,797</td>
<td>3,404,753</td>
<td></td>
<td>34,044</td>
</tr>
<tr>
<td>2020/2021</td>
<td>3,713,901</td>
<td>1,856,951</td>
<td>1,856,951</td>
<td></td>
</tr>
<tr>
<td>2021/2022</td>
<td>4,011,013</td>
<td>2,005,507</td>
<td>2,005,507</td>
<td></td>
</tr>
<tr>
<td>2022/2023</td>
<td>4,331,894</td>
<td>2,165,947</td>
<td>2,165,947</td>
<td></td>
</tr>
<tr>
<td>2023/2024</td>
<td>4,678,446</td>
<td>2,339,223</td>
<td>2,339,223</td>
<td></td>
</tr>
<tr>
<td>2024/2025</td>
<td>5,052,721</td>
<td>2,526,361</td>
<td>2,526,361</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>42,748,671</strong></td>
<td><strong>28,840,957</strong></td>
<td><strong>10,893,988</strong></td>
<td><strong>3,013,727</strong></td>
</tr>
</tbody>
</table>

It is noted that the figures provided for “freight loss” at Pier 2 under the Scenario B “Partial Development” scenario are substantial during the construction phase, while no loss in trade is experienced during the construction phase for the Scenario C “Full Development” scenario. This is assumed to be related to the required closure of the berths for construction under Scenario B whereas under Scenario C, it is presumed that construction can take place in phases, such that no disruption to trade is experienced.

Key ratios governing the movement of freight within South Africa are summarised in the Table 7 below.
### Table 7: Baseline Assumptions for Movement of Freight within South Africa

<table>
<thead>
<tr>
<th>Freight Leg (within South Africa)</th>
<th>Applied Ratios</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freight Routing for TEUs landing at Coega:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>■ Container Ship: Coega – Durban</td>
<td>50%</td>
<td>WSP assumption</td>
</tr>
<tr>
<td>■ Truck: Coega – Durban/Joburg</td>
<td>50%</td>
<td>WSP assumption</td>
</tr>
<tr>
<td>Freight Routing for TEUs landing at Durban:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>■ Freight ending its journey in Durban</td>
<td>20%</td>
<td>WSP assumption</td>
</tr>
<tr>
<td>■ Freight landing in Durban being sent on to Joburg</td>
<td>80%&lt;br&gt;15%&lt;br&gt;85%&lt;br&gt;Variations of the rail/truck ratio are also assessed</td>
<td>EIA Report</td>
</tr>
<tr>
<td>• Rail: Durban – Joburg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Truck: Durban – Joburg</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It is noted that these ratios can be readily altered in the model for sensitivity analysis, if desired.

### 6.2.3 GHG Emission Factors

A key aspect of the model is the development and application of GHG emission factors for both the maritime and land-based legs of the freight journey. The GHG emission factors adopted for the carbon calculator are summarised below.

#### 6.2.3.1 Maritime GHG Emission Factors

Further background on how the maritime GHG emission factors have been derived is presented Appendix A. However, simply put, the GHG emission factors for the maritime transport component of the study are based upon the following assumptions:

- Baseline GHG emission factors for the Africa maritime trade routes have been sourced from the Business for Social Responsibility’s Clean Cargo Working Group (2011 values for dry container shipping).
- No further improvements in GHG emissions factors are derived from technology improvements in the shipping fleet for the modelled period;
- No further improvement in GHG emission factors are derived from improved operational management procedures (i.e. “slow steaming”);
- The only further improvement in GHG emission factors (at a fleet level) is derived from the changing composition of the fleet, over time, in terms of large container vessels (7,500 – 18,000 TEU range) and “smaller” container vessels (<7,500 TEU size).
- The efficiency gain for larger container vessels compared to smaller container vessels has been evaluated for three ranges: a low-range estimate (10% improvement in GHG emissions factor), a mid-range estimate (25% improvement) and high-range estimate (40% improvement). For the most part, the analysis focuses on the mid-range values.\(^{24}\)

The assumed change in fleet composition for the baseline scenario (between smaller and larger vessels) is shown in Table 8.

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\(^{24}\) E.g. if a the Emissions Factor for vessels <7,500 TEU is 100 gCO2/TEU-km, then the Emissions Factor would be 90, 75 and 60 gCO2/TEU-km for the low, mid and high range respectively for the larger vessels (7,500 – 18,000 TEU range).
Using 2011 Business for Social Responsibility (BSR)-sourced emission factors, the vessel fleet composition data, and assuming that the larger vessels carry 9,000 TEU on average and the smaller vessels 4,000 TEU on average, GHG emission factors can be estimated as follows:

Table 9: GHG Emissions Factors for Modelling Purposes

<table>
<thead>
<tr>
<th>Emissions Factor per Vessel Size and Trade Route</th>
<th>Emissions Factor per Vessel Size and Trade Route</th>
<th>gCO₂/TEU-km</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low-range 10% eff. factor</td>
<td>Mid-range 25% eff. factor</td>
</tr>
<tr>
<td>Africa-Asia</td>
<td>&lt;7,500 TEU</td>
<td>71.8</td>
</tr>
<tr>
<td></td>
<td>7,500 - 18,500 TEU</td>
<td>64.6</td>
</tr>
<tr>
<td>Africa-S.America</td>
<td>&lt;7,500 TEU</td>
<td>69.8</td>
</tr>
<tr>
<td></td>
<td>7,500 - 18,500 TEU</td>
<td>62.8</td>
</tr>
<tr>
<td>Africa-N.America</td>
<td>&lt;7,500 TEU</td>
<td>78.2</td>
</tr>
<tr>
<td></td>
<td>7,500 - 18,500 TEU</td>
<td>70.4</td>
</tr>
<tr>
<td>Africa-Europe</td>
<td>&lt;7,500 TEU</td>
<td>89.1</td>
</tr>
<tr>
<td></td>
<td>7,500 - 18,500 TEU</td>
<td>80.2</td>
</tr>
</tbody>
</table>

Container vessels ferrying freight from Coega to Durban are assumed to have a GHG emissions factor of 80 gCO₂/TEU-km.

6.2.3.2 Land-based GHG Emission Factors

Freight is typically transported into and out of a port via smaller articulated trucks (i.e. 3.5t – 33t trucks) that can carry a single TEU (sometimes two TEUs) at a time to or from a nearby logistics center. The freight will typically be off/on-loaded onto larger articulated trucks for long haul travel at these centres. For modelling purposes, all road transport is assumed to be via the larger articulated (>33t) trucks with the short haul routes and off/on-loading procedures being ignored. For converting between metric tonnes and TEUs, a factor of 12 tonnes per TEU is used.

It is noted that much of the rail freight may actually be transported via more efficient electric traction rail rather than diesel electric. However, although TFR is able to report on their overall GHG emissions, emission factors (per tonne-km or TEU-km) are not available for the electric traction freight operations for TFR’s Durban-Gauteng freight corridor (nor for their diesel electric locomotives). Consequently, the UK DEFRA factor for diesel electric has been applied to all rail freight. All emission factors are assumed to remain constant over time, for the duration of the modelled period.

The split between road (truck) and rail freight transport between Durban and Johannesburg is assumed to remain constant at an 85% road and 15% rail split. It is noted that Transnet is actively and aggressively...
pursuing a modal shift strategy to increase the share of rail freight substantially. Preliminary indications are that a target share of 50% may be pursued for the Durban – Johannesburg freight corridor. While the timelines to achieve such a target are not known, it would be anticipated to fall within the modelled timeframes (i.e. by 2024/25). The implications of this modal shift target can be readily assessed via the carbon calculator.

<table>
<thead>
<tr>
<th>Table 10: Modelling Assumptions for Land Freight Transport.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Truck Emissions (assumed constant over time) (UK DEFRA, 2011) (Direct Emissions)</strong></td>
</tr>
<tr>
<td><strong>Articulated 3.5t - 33t</strong></td>
</tr>
<tr>
<td>0.14828</td>
</tr>
<tr>
<td><strong>Articulated &gt;33t</strong></td>
</tr>
<tr>
<td><strong>Rail GHG EF’s (Diesel Electric) (Direct Emissions)</strong></td>
</tr>
<tr>
<td><strong>UK DEFRA, 2011, Freight Rail GHG Factor</strong></td>
</tr>
<tr>
<td>31.61</td>
</tr>
<tr>
<td><strong>Land Freight Distances</strong></td>
</tr>
<tr>
<td><strong>km</strong></td>
</tr>
<tr>
<td>Joburg-Durban</td>
</tr>
<tr>
<td>Coega-Durban/Joburg</td>
</tr>
</tbody>
</table>

6.3 Results and Discussion

The results for the GHG emissions associated with the freight anticipated to move across Berths 203 – 205 are summarised in the Tables 11-16 below. The results indicate the following:

- **Total (cumulative) GHG emissions are essentially the same for the period 2012 – 2024, regardless of the development scenario selected (i.e. Scenarios A – C).**

  As seen from Tables 11-12, “Scenario C: Full Development” comes out with the lowest cumulative GHG emissions of all the scenarios, but only by 0.2% less than the “Scenario A: No Development” option. “Scenario B: Partial Development” is the worst performer, due to the higher volume of freight diverted to Coega. However, once again, this is only a by a marginal difference (1.5% more than the No Development option) compared to the other scenarios.

- **International Maritime GHG emissions associated with the freight projected to move across the Berths (for all scenarios) is anticipated to increase by between 109% and 145% by 2024 compared to 2012 emissions (Table 13), deviating by between 4% and 18% below the Business as Usual projection by 2024.**

  Maritime sector GHG emissions associated with the berths are projected to more than double between 2012 and 2024. These are substantial increases that are far in excess of the reductions that many Annex I countries have been pursuing (i.e. absolute reductions compared to a 1990 baseline).

  Taking a South African perspective, it is perhaps more pertinent to ask how the GHG emissions for 2024/25 compare to a “Business as Usual” projection. The analysis suggests that the GHG emissions will deviate by between 4% and 18% beneath the BaU curve\(^{26}\) by 2024/25. This compares to the South African national government target of a 42% decrease below the BaU projection by 2025.

  Notwithstanding the jurisdictional issue regarding international maritime emissions, and that these emissions are technically excluded from the national government targets, narrowing the gap between the projected deviation of 4% - 18% beneath the BaU projection and a South African target range of 42% will require collaborative action from the IMO, the South African government, TNPA and TNPA’s shipping customers if it is to have any chance of being achieved. It would be hoped that further efficiency

\(^{26}\) It is noted that the assumptions underlying this “Business as Usual” projection may differ from those underlying the national government Climate Change Strategy “BaU” projection. However, for purposes of this assessment, these differences are not regarded as significant.
improvements related to new technologies and operational management procedures will help to close the gap further, especially in view of the EEDI and SEEMP requirements being implemented by the IMO. However it is also incumbent upon TNPA and South Africa to incentivise the adoption of these newer and more fuel efficient container ships for the Africa trade routes. Similarly, it is incumbent upon TNPA and South Africa to ensure that the largest possible container vessels (with the lowest GHG emissions factor per TEU-km) are able to safely dock in South African ports, and to encourage the adoption of these large vessels on the Africa trade routes in general.

- **Assuming that the road to rail mix remains the same as at present, GHG emissions per annum associated with transporting the freight between Johannesburg and Durban is projected to increase by 156% by 2024/25 (Table 14).**

The majority of this increase will be as a result of increased GHG emissions from freight trucks on long haul routes. If we take this mix (85% road, 15% rail) as our “Business as Usual” scenario, Table 1515 shows the impact and level of intervention required to align the freight haulage mix with the national GHG reduction target. The results show that a 50/50 mix between rail and truck haulage by 2024/25 should result in a deviation below the BaU projection of 25% (short of the national target of 42% below the BaU projection by 2025). Increasing the rail mix to 85% results in a deviation below the BaU projection by 49% (although this still represents an absolute increase in GHG emissions of 30% compared to 2012).

While Transnet’s plans for the road and rail mix is yet to be finalised for the eThekwini-Johannesburg route, it is known that Transnet is looking at a rail mix of up to 85%, with a 50% target viewed as a lower but perhaps more pragmatic target. The results show that if a 50/50 road/rail mix is pursued, additional measures may be needed in order to bring GHG emissions in line with the national target. Examples of additional measures would include fuel efficiency improvements for the truck freight fleet, more fuel efficient diesel electric locomotives and decarbonisation of the electricity supply in respect of electric traction freight rail.

The above also highlights the importance of ensuring that freight is directed to ports which have strong rail linkages through to Gauteng and the major inland centres. From a GHG emissions perspective, this favours development at Pier 2 and/or the proposed Durban Dig Out Port.

It is also notable that in order to reduce the collective GHG emissions for freight transport, Transnet would need to substantially increase its own freight rail carbon footprint (i.e. an increase of 1,340% by 2024/25 emissions for the Durban-Johannesburg freight route under an 85% rail 15% road mix).

### Table 11: Summary of GHG Emissions for Scenarios A – C for Freight moving across Berths 203 – 205 (mid-range efficiency factor for large vessels)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Cumulative GHG Emissions 2012 – 2024 (tCO2e/annum)</th>
<th>Increase versus Scenario A (tCO2e/annum)</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario A: No Development</td>
<td>59,828,646</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Scenario B: Partial Development</td>
<td>60,713,379</td>
<td>884,733</td>
<td>1.5%</td>
</tr>
<tr>
<td>Scenario C: Full Development</td>
<td>59,706,416</td>
<td>-122,230</td>
<td>-0.2%</td>
</tr>
</tbody>
</table>
Table 12: GHG Emissions Results for the proposed development Scenarios (A – C) assuming mid-range (i.e. 25%) large ship efficiency factor

<table>
<thead>
<tr>
<th>Efficiency Factor for Large Container Vessels</th>
<th>2024 Emissions (All Scenarios)</th>
<th>Baseline Emissions (2012, No Development)</th>
<th>Increase tCO2/annum</th>
<th>Increase %</th>
<th>Deviation beneath a “BaU” Projection</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-range (40%)</td>
<td>4,128,626</td>
<td>1,974,447</td>
<td>2,154,179</td>
<td>109%</td>
<td>18%</td>
</tr>
<tr>
<td>Mid-range (25%)</td>
<td>4,490,462</td>
<td>1,975,576</td>
<td>2,514,886</td>
<td>127%</td>
<td>11%</td>
</tr>
<tr>
<td>Low-range (10%)</td>
<td>4,832,899</td>
<td>1,973,467</td>
<td>2,859,432</td>
<td>145%</td>
<td>4%</td>
</tr>
</tbody>
</table>

* based upon the TEU-km projections for 2024 and the GHG Emissions Factors for 2012.

Table 13: International Maritime Sector GHG Emissions by 2024 for containers passing across Berths 203 – 205 (Pier 2)

<table>
<thead>
<tr>
<th>Efficiency Factor for Large Container Vessels</th>
<th>2024 Emissions (All Scenarios)</th>
<th>Baseline Emissions (2012, No Development)</th>
<th>Increase tCO2/annum</th>
<th>Increase %</th>
<th>Deviation beneath a “BaU” Projection</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-range (40%)</td>
<td>4,128,626</td>
<td>1,974,447</td>
<td>2,154,179</td>
<td>109%</td>
<td>18%</td>
</tr>
<tr>
<td>Mid-range (25%)</td>
<td>4,490,462</td>
<td>1,975,576</td>
<td>2,514,886</td>
<td>127%</td>
<td>11%</td>
</tr>
<tr>
<td>Low-range (10%)</td>
<td>4,832,899</td>
<td>1,973,467</td>
<td>2,859,432</td>
<td>145%</td>
<td>4%</td>
</tr>
</tbody>
</table>

* based upon the TEU-km projections for 2024 and the GHG Emissions Factors for 2012.
### Table 14: GHG Emissions for Land-based Freight going across Berths 203 – 205, 2024 versus 2012

<table>
<thead>
<tr>
<th>Land Freight Emissions</th>
<th>Baseline Emissions (2012)</th>
<th>2024 Emissions</th>
<th>Increase (tCO₂e/annum)</th>
<th>Increase (2024 cmp 2012) %</th>
<th>Contribution to Total Increase %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail 15%, Road 85% by 2024</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road Freight: Durban-Joburg</td>
<td>838,724</td>
<td>2,143,558</td>
<td>1,304,835</td>
<td>156%</td>
<td>94%</td>
</tr>
<tr>
<td>Rail Freight: Durban-Joburg</td>
<td>53,994</td>
<td>137,995</td>
<td>84,001</td>
<td>156%</td>
<td>6%</td>
</tr>
<tr>
<td>Total</td>
<td>892,718</td>
<td>2,281,553</td>
<td>1,388,836</td>
<td>156%</td>
<td></td>
</tr>
<tr>
<td>Rail 50%, Road 50% by 2024</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road Freight: Durban-Joburg</td>
<td>838,724</td>
<td>1,260,917</td>
<td>422,193</td>
<td>50%</td>
<td>51%</td>
</tr>
<tr>
<td>Rail Freight: Durban-Joburg</td>
<td>53,994</td>
<td>459,984</td>
<td>405,998</td>
<td>752%</td>
<td>49%</td>
</tr>
<tr>
<td>Total</td>
<td>892,718</td>
<td>1,720,900</td>
<td>828,182</td>
<td>93%</td>
<td></td>
</tr>
<tr>
<td>Rail 85%, Road 15% by 2024</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road Freight: Durban-Joburg</td>
<td>838,724</td>
<td>378,275</td>
<td>(460,449)</td>
<td>-55%</td>
<td>-172%</td>
</tr>
<tr>
<td>Rail Freight: Durban-Joburg</td>
<td>53,994</td>
<td>781,972</td>
<td>727,978</td>
<td>1348%</td>
<td>272%</td>
</tr>
<tr>
<td>Total</td>
<td>892,718</td>
<td>1,160,247</td>
<td>267,529</td>
<td>30%</td>
<td></td>
</tr>
</tbody>
</table>

### Table 15: Comparison of Land-based Freight Transport Emissions with BaU Projection for Berths 203-205

<table>
<thead>
<tr>
<th>BaU - Road 85% / Rail 15% 2024/25 (tCO₂e/annum)</th>
<th>Road 50% / Rail 50% 2024/25 (tCO₂e/annum)</th>
<th>Deviation below BaU</th>
<th>Road 15% / Rail 85% 2024/25 (tCO₂e/annum)</th>
<th>Deviation below BaU</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,281,553</td>
<td>1,720,900</td>
<td>25%</td>
<td>1,160,247</td>
<td>49%</td>
</tr>
</tbody>
</table>

28 Ibid.
6.4 Mitigation Options

6.4.1 International Maritime Shipping

While the TNPA is not directly responsible for international maritime emissions associated with the freight landing at Berths 203 – 205, they are clearly key stakeholders with significant influence on the direction and scale of GHG emissions increases associated with shifting this freight to and from the Berths.

Several of the world’s leading ports – i.e. Port of Rotterdam and Port of Los Angeles – have a number of initiatives aimed at incentivising lower maritime emissions. Key among these initiatives is the establishment and implementation of the Environmental Shipping Index (ESI) programme (http://esi.wpci.nl/Public/Home), led by the World Ports Climate Initiative (WPCI). Currently there are 55 ports from around the world participating in the ESI programme. The ESI can cover all major cargo vessel types, including container ships using Berths 203 - 205.

TNPA already offers some incentives for “green” ships, via its participation in the Green Awards Scheme (http://www.greenaward.org/greenaward/). According to the Green Award website, the TNPA offers Green Award certified vessels a 10% port dues rebate for Crude oil/Product Tankers in all South African national ports if not enjoying a 5% rebate in terms of double-hulled/SBT scheme. However this scheme, as implemented by the TNPA at present, targets bulk liquid tankers and does not cover container ships such as those utilising the Berths 203 – 205.

Key mitigation options that Transnet can consider in relation to international maritime emissions include:

- Ensuring that the ports (and Berths 203 – 205) can handle the largest and most modern container vessels, and incentivising their use on African trade routes. The evidence is clear that larger container vessels have substantially lower GHG emissions per TEU-km.
- Expanding the TNPA GHG inventory to include tracking of international maritime emissions as part of its scope 3 emissions reporting.
- Engaging with the WPCI regarding adoption of the ESI (or similar initiative). Participation in the ESI would make the TNPA the world’s first port authority from a developing country to engage with this initiative and would demonstrate considerable leadership in the field of climate change mitigation.
- Consider and implement other measures addressing maritime GHG emissions not captured in this assessment i.e. cold ironing for berthed vessels (if not already implemented).

6.4.2 Land-based Freight Transport

GHG emissions associated with the land-based transport of freight arriving at Berths 203 – 205 are projected to substantially increase. If no intervention is taken, this will result in GHG emissions increasing in a way that is incompatible with the stated national government targets for GHG emissions reduction, namely a 34% deviation below “Business as Usual” by 2020 and 42% deviation by 2025.

The GHG modelling demonstrates that one of the key methods by which projected land-based GHG emissions can be brought in line with the national government targets is via a massive expansion of the freight rail capacity and increasing its share in the container freight transport sector between coastal ports (such as Durban) and the main inland centres (such as Johannesburg).

Key initiatives that can be implemented by Transnet include:

- Massive expansion in the freight rail share of container transport (between Durban and Johannesburg) from the current estimated share of 15% to a minimum share of 50% and arguably as high as 85%.

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29 This recommendation is from a narrow “carbon mitigation” perspective and should be balanced with other considerations such as ecological impacts etc. associated with any such expansion.
30 This also assumes that these vessels are fully or close to fully laden. Partially laden large vessels (such as those that currently dock at the Berths 203 – 205 on the high tide only, due to the berth depth limitations) may have worse GHG emissions factors than smaller vessels that are fully laden.
Continued investment in lower emission diesel electric locomotives.

A strategy of decarbonisation of the electric traction network in relation to the rail servicing Pier 2 and the Port of Durban generally.\textsuperscript{31}

Implementation of a GHG data gathering systems that allows for the generation of corridor specific emissions factors (i.e. kg CO\textsubscript{2e} per tonne cargo for specific freight rail corridors). While the complexity of gathering this type of data is substantial, generation of these emissions factors will greatly assist Transnet with its strategic planning for climate change mitigation purposes.

It is not improbable that intervention on the freight rail side alone will be insufficient to bring GHG emissions in line with the national target. Therefore, the TNPA, in its capacity of landlord for the port zones, should also aim to incentivise GHG emission reductions in truck freight entering and leaving Pier 2 and the Berths 203 – 205. Some proposed mitigation measures include:

- Minimum standards and enforcement thereof for air emissions from freight trucks.
- Establishment of a Clean Truck Programme or similar incentive scheme aimed to encourage replacement of older trucks with newer and lower emitting vehicles. This should not be implemented in a way that penalises marginal operators (who cannot necessarily afford new vehicles), but could take the form of a grant scheme, soft loan finance scheme for qualifying operators or similar.

6.4.3 General

It is notable that many of the above initiatives will require close cooperation between the various Transnet Operating Divisions, namely TFR, TNPA and TPT. Furthermore, the present assignment raises the possibility and demonstrates the value of creating a freight logistics GHG model that can be used by Transnet for evaluation of intervention measures in an integrated manner and on a national level.

6.5 GHG Emissions – Construction Activities

GHG emissions will be incurred by the construction activities taking place as part of any proposed development. Emissions will be associated with the operations of bulk earth engineering, operation of construction plant and equipment (using diesel, presumably), road transport GHG emissions (trucks etc. transporting materials to and from the site, as well as embedded GHG emissions within construction materials, especially cement and steel. Emissions associated with dredging will also be incurred.

At present, there is inadequate data available for the estimation of GHG emissions associated with the construction phase, other than to indicate that Scenario A ("No Development") will incur no construction related GHG emissions, Scenario B ("Partial Development") can be expected to incur moderate GHG emissions, while Scenario C ("Full Development") can be expected to incur relatively substantial GHG emissions.

That said, emissions incurred during the construction phase can be expected to be far smaller than those incurred during the “operational phase” i.e. in relation to the movement of freight to and from the Berths.

\textbf{Table 16: Construction Phase GHG Emissions.}

<table>
<thead>
<tr>
<th>Scenario A</th>
<th>Scenario B</th>
<th>Scenario C</th>
</tr>
</thead>
<tbody>
<tr>
<td>No construction-related GHG emissions.</td>
<td>Moderate levels of GHG emissions associated with berth deepening operations (dredging, some bulk earthworks, and embedded emissions within materials such as cement).</td>
<td>Significant GHG Emissions associated with bulk earthworks, machinery, road transport of goods and materials, dredging activities as well as embedded emissions within construction materials such as cement and steel.</td>
</tr>
</tbody>
</table>

\textsuperscript{31} Electric traction freight rail has been excluded from the present model due to an absence of usable emission factors for modelling purposes. Hence, for modelling purposes, all freight rail has been assumed to be via diesel electric using UK DEFRA emission factors.
6.5.1 Mitigation Options – Construction Phase

There is no existing framework to evaluate carbon mitigation during construction projects in South Africa. At present the DBSA is leading the establishment of the Green Infrastructure Council of South Africa based on the Australian model. This model will form the basis for resource efficiency and climate change mitigation and adaptation for infrastructure development of all types in South Africa. Transnet is participating as a stakeholder in the process and will continue to do so as this process may become the baseline for future infrastructure development in SA. In the interim, and specifically for this project, the following recommendations are proposed.

- Contractors to disclose their GHG Inventory, in terms of the CDP methodology, for Scope 1, 2 and 3 emissions.
- Energy management plans to form part of the overall environmental management plan.
- The design teams to investigate low emission materials options for the project.

7 Conclusions

In conclusion, the following key comments can be made regarding the proposed development at Berths 203 – 205:

Climate Change Adaptation

- At present, Transnet (and the TNPA) does not have a port wide approach or methodology to assessing and incorporating climate change risks such as sea level rise and coastal storm surge. Assessment of these issues is undertaken at an individual project level, via Transnet’s project lifecycle planning process.
- It is the opinion of the consultant that adequate scientific and technical data exists to enable the appointed design engineers to adequately assess climate change risks associated with sea level rise and storm surge, and to incorporate mitigation measures into the design for this specific development project. However, it remains the primary responsibility of the design engineers to properly evaluate this and to incorporate these risks into the design parameters.
- From a climate change adaptation perspective, the development options may be viewed as more favourable than the “No Development” option as it will allow for climate change adaptation criteria to be incorporated into the Berths 203 – 205 design parameters. The present structures were designed at a time when climate change adaptation criteria were not typically included in design parameters.

Climate Change Mitigation

- The selection of development scenario (i.e. No Development, Partial Development or Full Development) does not meaningfully impact on the GHG projections (either cumulative total for 2012/13 – 2024/25 period or annual emissions by 2024/25). The primary reason for this is the underlying assumption (for modelling purposes) that the projected increase in trade growth is independent of the development scenario i.e. that container trade which cannot land at Berths 203 – 205 will find an alternative point of entry e.g. Coega. Emissions that are dependent on the scenario selection are minor compared to GHG emissions associated with the overall growth in freight volumes for the modelled period.
- While trade growth is assumed (for modelling purposes) to be independent of the three project development scenarios, in reality it cannot be ignored that these types of port infrastructure projects facilitate both increased trade volumes and economic development. Hence initiatives that address GHG emissions associated with this increase in trade must be considered and integrated as part of these types of large infrastructure projects. This is critical if South Africa is to meet the GHG emissions reduction target as stated in the 2011 National Climate Change Response White Paper i.e. a 32% deviation below “Business as Usual” by 2020 and 42% deviation by 2025.
- Recommended GHG mitigation initiatives during the construction phase include:
  - Contractors to disclose their GHG Inventory, in terms of the CDP methodology for Scope 1, 2 and 3 emissions.
Energy management plans to form part of the overall environmental management plan.

The design teams to investigate low emission materials options for the project.

Key GHG mitigation initiatives targeting international maritime sector emissions include:

- Ensuring that the Berths 203 – 205 can readily accommodate the largest sized container vessels possible (assuming that this is acceptable from a broader environmental perspective).
- Adoption of an incentive programme to encourage the use of the most modern and low carbon container vessels at Berths 203 - 205, such as the WPCI’s ESI programme.
- Expanding TNPA’s GHG inventory to include reporting on international maritime vessels docking at Berths 203 – 205.
- Implementing measures to address GHG emissions not captured in this assessment i.e. cold ironing for vessels at Berths 203 – 205 (if not already implemented).

Key GHG mitigation initiatives targeting land-based freight transport emissions include:

- Massive expansion in the freight rail share of container transport flowing in and out of Pier 2 (i.e. Berths 203 – 205), as compared to truck freight. The current share for rail freight is estimated at 15% of TEUs. A minimum target of a 50% share should be aimed for by 2024 and, ideally, closer to 85%.
- Continued investment in lower emission diesel electric locomotives operating the container freight route to/from Pier 2 and a strategy of decarbonisation of the electric traction network in relation to the freight rail servicing Pier 2.
- Implementation of GHG data gathering systems that allows for the generation of freight rail corridor specific emission factors (i.e. kg CO$_2$ per tonne-km or TEU-km for specific freight rail corridors).
- Minimum standards and enforcement thereof for air emissions from freight trucks handling cargo at Berths 203 – 205.
- Establishment of a Clean Truck Programme to encourage replacement of older trucks with newer and lower GHG emitting vehicles. This should not be implemented in a way that penalises marginal operators (who cannot necessarily afford new vehicles).

It is notable that many of the above initiatives will require close cooperation between the various Transnet Operating Divisions, namely TFR, TNPA and TPT. Furthermore, the present assignment raises the possibility and demonstrates the value of creating an integrated logistics network GHG model that can be used for evaluation of intervention measures in an integrated manner and on a national level.
8 References


Appendix A – Trends in Maritime Sector GHG Emissions and Model Assumptions

Overview

A number of studies have looked at GHG emissions in relation to container vessels. The Business for Social Responsibility (BSR) Clean Cargo Working Group (CCWG) released a range of GHG emission factors per global trade lane. The data is based on reports from over 2,000 ships from 13 of the world’s leading ocean container carriers, representing around 60% of global ocean container capacity. The relevant data for the Port of Durban is summarised below:

Table 17: Maritime Container Vessel GHG Emissions Factors for Africa Trade Routes. (Source: BSR, 2012)

<table>
<thead>
<tr>
<th>CO₂ Emissions by Trade Lane (g CO₂/TEU-km)</th>
<th>2011 (2,000+ vessels)</th>
<th>2010 (1,900+ vessels)</th>
<th>2009 (1,000 vessels)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dry Container</td>
<td>Reefer Container</td>
<td>Dry Container</td>
</tr>
<tr>
<td>Africa-Asia</td>
<td>70.6</td>
<td>98.8</td>
<td>81.6</td>
</tr>
<tr>
<td>Africa-S. America</td>
<td>68.6</td>
<td>89.5</td>
<td>84.6</td>
</tr>
<tr>
<td>Africa-N. America</td>
<td>76.9</td>
<td>103.9</td>
<td>87.3</td>
</tr>
<tr>
<td>Africa-Europe</td>
<td>87.6</td>
<td>118.2</td>
<td>94.8</td>
</tr>
<tr>
<td>Average (all Africa routes)</td>
<td>75.9</td>
<td>102.6</td>
<td>87.1</td>
</tr>
</tbody>
</table>

The results show a GHG emissions factor improvement of 16% from 2009 to 2011, and 12% from 2010 to 2011 for dry containers and a similar improvement for reefer (i.e. refrigerated) container vessels. The improvements are presumably related to two key factors: energy efficiency improvements associated with newer (and larger) container vessels coming into service and replacing older (and smaller) vessels operating on these routes; and the increasing prevalence of operational efficiency measures, in particular slow steaming. It is suspected (by the Consultant) that the majority of improvements seen in the table above relate to slow steaming practices, and it is notable that future gains from operational efficiencies measures such as slow steaming may well be limited in future (as they have already been taken advantage of), and with most future GHG efficiency gains being reliant on fleet replacement.

Table 18: % Improvement in Container Vessels GHG Emissions Factors 2009 – 2011.

<table>
<thead>
<tr>
<th>Trade Lane</th>
<th>% Improvement in CO₂ Emissions per annum (2009 – 2011), Dry Container</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa-Asia</td>
<td>8%</td>
</tr>
<tr>
<td>Africa-S. America</td>
<td>6%</td>
</tr>
<tr>
<td>Africa-N. America</td>
<td>11%</td>
</tr>
<tr>
<td>Africa-Europe</td>
<td>7%</td>
</tr>
</tbody>
</table>


The influence of newer and larger container vessels on GHG emissions factors can be seen in the data reported by Shippingefficiency.org\textsuperscript{32}, which allows for viewing the individual CCWG GHG emission ratings for the Maersk container fleet.

Emissions data for seven years’ worth of vessels (those built in 1992, 1994, 2000, 2001, 2002, 2008 and 2009) were compiled, with the GHG emissions factors plotted against the vessel size (measured as deadweight tonnage or DWT). The data demonstrates two trends which are widely reported in the literature. Firstly, that modern container vessels are tending to be larger; and secondly, that the larger the vessel, the lower the GHG emissions per TEU-km (for vessels of the same year), generally speaking. This is demonstrated by the linear trend line on the graph below (showing the relationship between size and GHG emissions factor).

Figure 1. Container Vessel Size versus GHG Emissions Intensity – Selected Maersk Vessels.

By way of example, the four Maersk vessels built in 2009 demonstrate the advantages of container vessel size in terms of GHG emissions: the two vessel sized at around 40,000 tonnes DWT have an emissions factor of approximately 70 gCO\textsubscript{2} / TEU-km; the two vessels sized at 116,000 tonnes DWT demonstrate an emissions factor of only 47 gCO\textsubscript{2} / TEU-km. The largest vessel shown here (DWT of 158,200, built in 2007) has a GHG emissions factor of only 38.15 gCO\textsubscript{2} / TEU-km, almost 50% less GHG emissions factor than the smaller but more recently built vessels from 2009.

The takeaway point from the above is that, from a GHG emissions perspective, it is considered desirable for ports to be able to accommodate larger container vessels, all other things being equal.

Modelling Assumptions

\textsuperscript{32} http://search.shippingefficiency.org/vessel/9192466/
For modelling purposes, the following assumptions have been made:

- Container vessels have been split into two broad groups for modelling purposes:
  - Container ship with <7,500 TEU capacity; and
  - Container ships with 7,500 – 18,000 TEU capacity.
- Only GHG emission factors for dry container freight have been considered\(^{33}\).
- Improved operational efficiencies within the existing fleet: The main method for achieving operational efficiencies for GHG emissions is via slow steaming. It is, however, assumed that from 2011 until 2020, there will limited (if any) scope for further efficiency gains via this practice. Further potential for GHG emissions reductions via operational practices is regarded as being limited.
- Potential for improved GHG emissions via replacement of container ships with newer and more fuel efficient vessels in the <7,500 TEU range is regarded as being limited. While modern vessels will increasingly need to be compliant with the IMO’s EEDI (from 2019 at the latest), ship order trends show a clear move towards larger vessels (Urban-Econ, 2012), hence the rate of replacement with like sized vessels is considered to be modest, as there will be an anticipated oversupply of vessels within the <7,500 TEU category.
- Improved GHG emissions via replacement with newer, larger and more fuel efficient (per TEU-km) vessels. Based on the data presented above, it is anticipated that this measure has the highest potential for reducing GHG emissions on the Africa trade routes, and is expected to account for the majority of GHG emissions reductions (on a TEU-km basis) over the coming 10 – 20 years.

It is noted that the IMO, in its 2009 GHG study, reflects on a number of scenarios (a base, a low and a high scenario estimate) in relation to GHG emissions improvements as a result of: (a) reduced speed, (b) technology improvements and (c) improvements due to larger vessels being used. The “low” scenario projection for speed reductions and for technology improvements are both 0% for 2020.

Therefore, for modelling purposes, no further improvements in GHG emission factors are assumed to occur as a result of slow steaming, operational efficiencies or technology improvements in like sized vessels. All improvements in future GHG emission factor are assumed to result from the changing composition of the container fleet (i.e. as larger container ships with a lower GHG emissions intensity per TEU-km replace smaller container ships).

Finally it is noted that available GHG emission factors for the maritime sector appear to include CO\(_2\) only (i.e. are not given in units of CO\(_2\)e). Land based emission factors, by contrast, are given in units of CO\(_2\)e. Hence shipping emissions can be assumed to be slightly higher than stated in units of CO\(_2\)e. However, for the level of analysis undertaken in this study, the difference is unlikely to be significant.

\(^{33}\) Container vessels handling “reefer” or refrigerated TEUs will have a substantially larger GHG footprint For the present assignment, it has been assumed that all TEUs are dry containers only.