

TRANSNET



delivering on our commitment **to you**

freight rail



Heavy Haul Operations in South Africa

IHHA 2011

Calgary, Canada

Willem Kuys, Transnet Freight Rail

19 June 2011

Presentation Outline



1 Heavy Haul in South Africa: Context

2 The Richards Bay Coal Export line

3 The Sishen – Saldanha Iron Ore Export line

4 Heavy Haul: Concluding Remarks

Presentation Outline



1 **Heavy Haul in South Africa: Context**

2 The Richards Bay Coal Export line

3 The Sishen – Saldanha Iron Ore Export line

4 Heavy Haul: Concluding Remarks

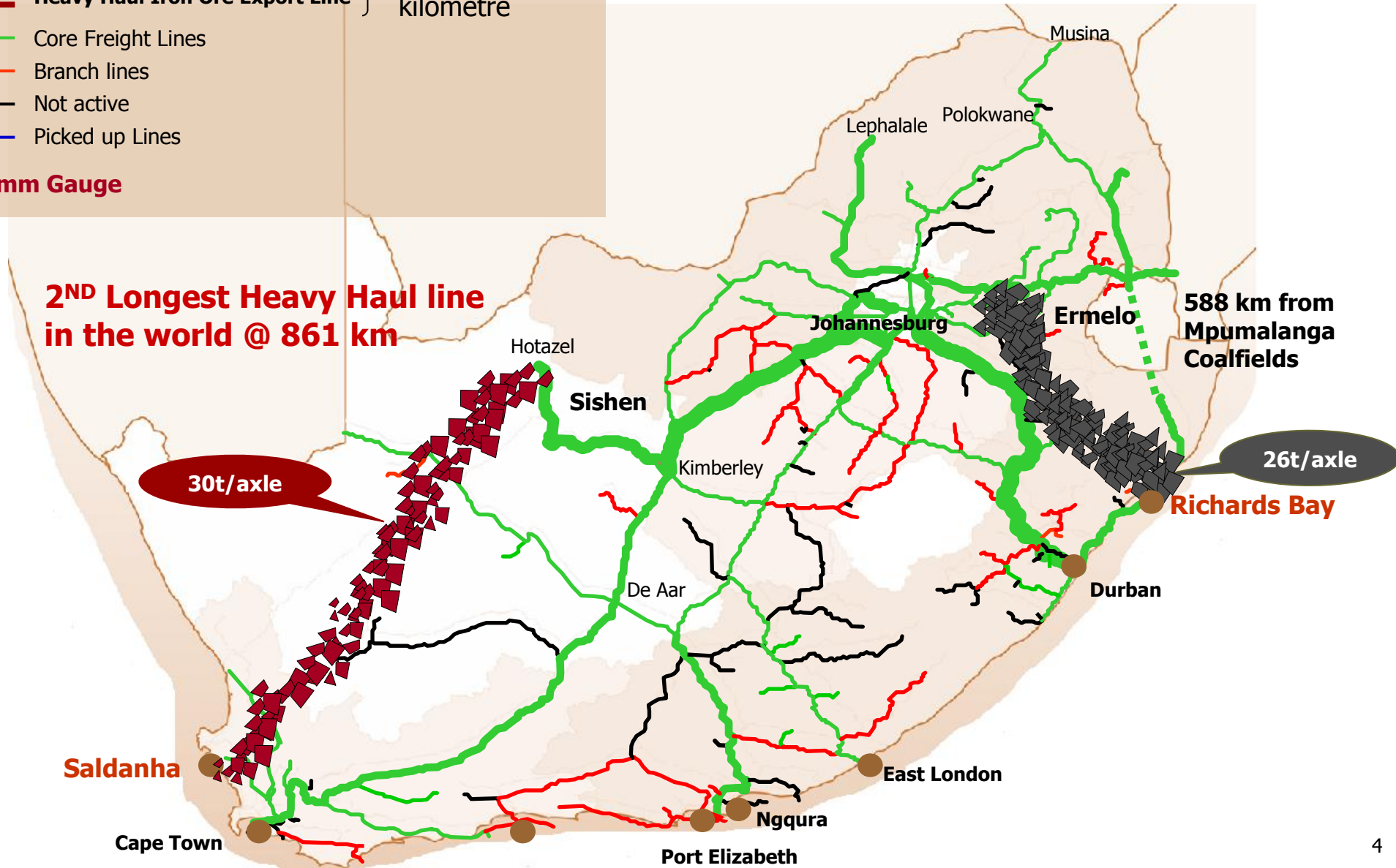
Transnet Freight Rail Network



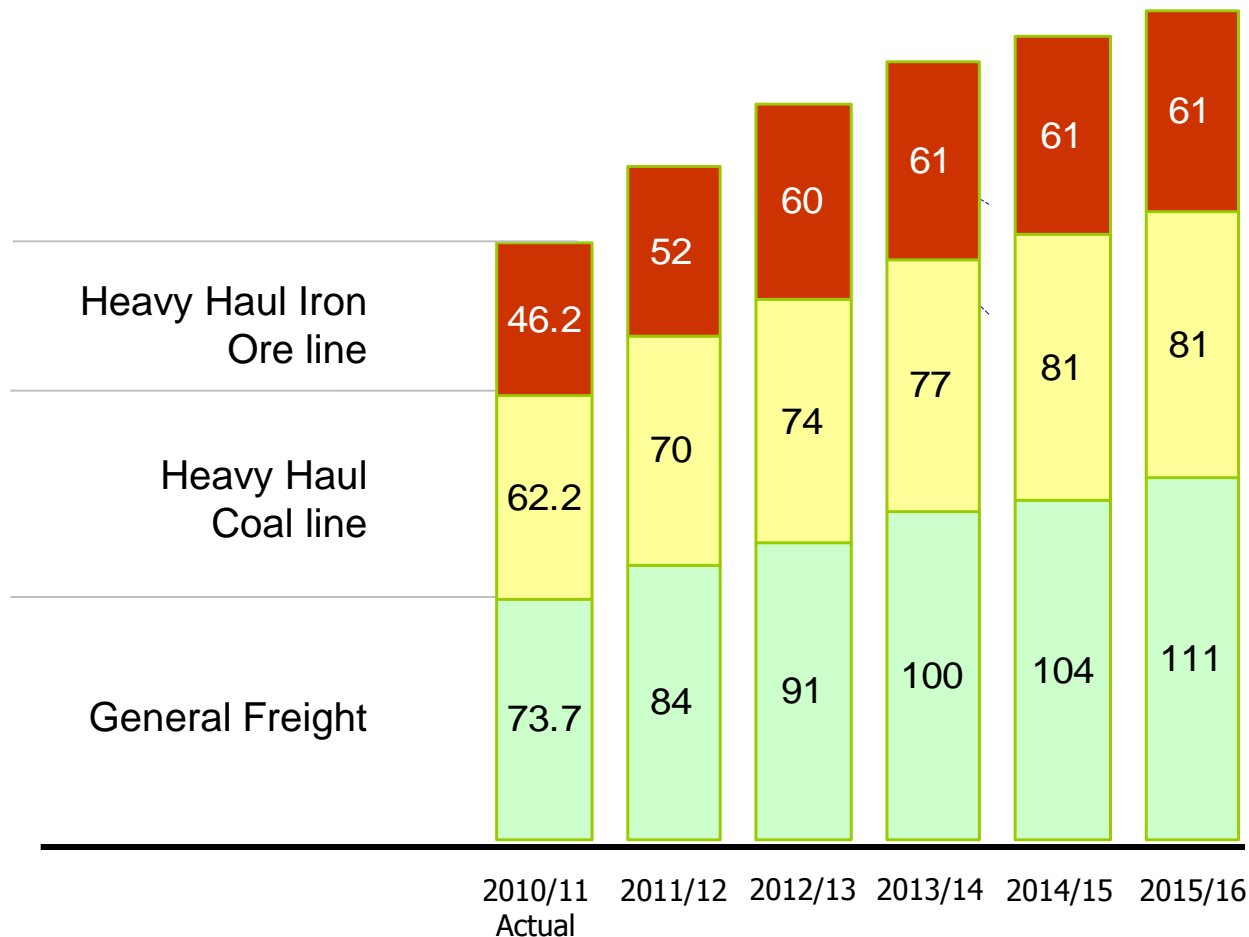
- Heavy Haul Coal Export Line
- Heavy Haul Iron Ore Export Line
- Core Freight Lines
- Branch lines
- Not active
- Picked up Lines

7% of route kilometre

1067mm Gauge



Transnet Freight Rail: Projected Demand (Mt)

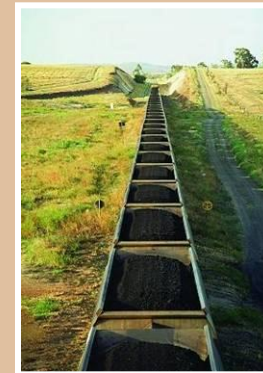


- 60% of Volumes generated from coal and iron ore exports
- Economic slowdown reduced volumes. Renewed effort to regain revenue and volumes to pre-slump levels
- Emphasis on General freight growth that is critical for viability
- Expansion programmes for export lines more conservative

1 Heavy Haul in South Africa: Context

2 The Richards Bay Coal Export line

- *Profile*
- *Operating Philosophy*
- *Technology*
- *Expansion Programme*



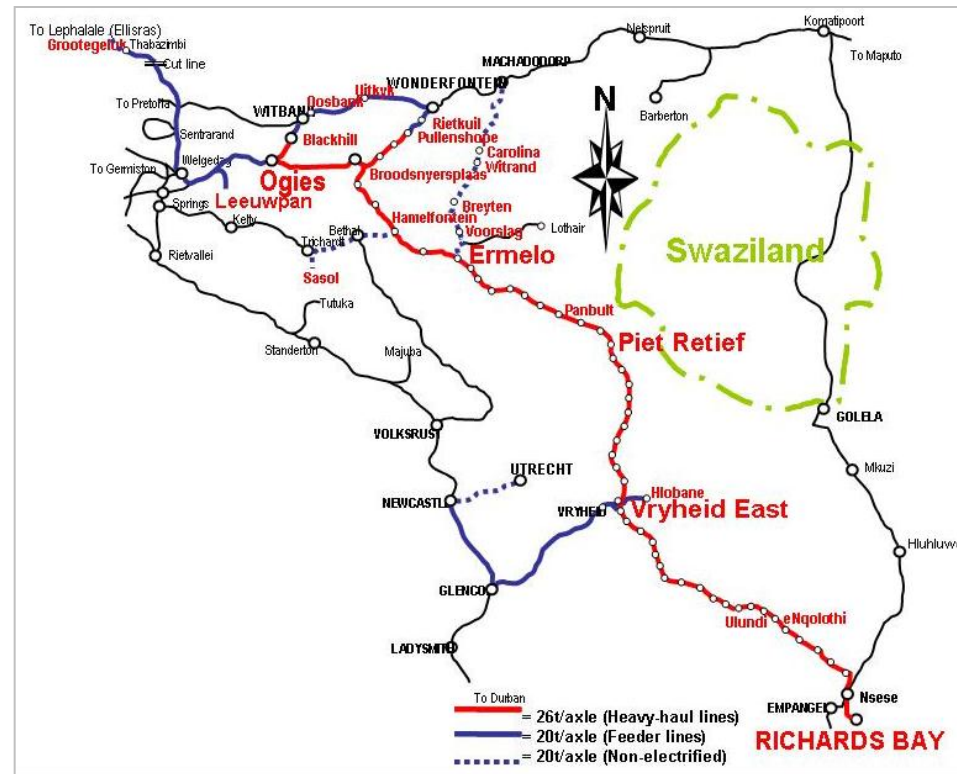
3 The Sishen – Saldanha Iron Ore Export line

4 Heavy Haul: Concluding Remarks

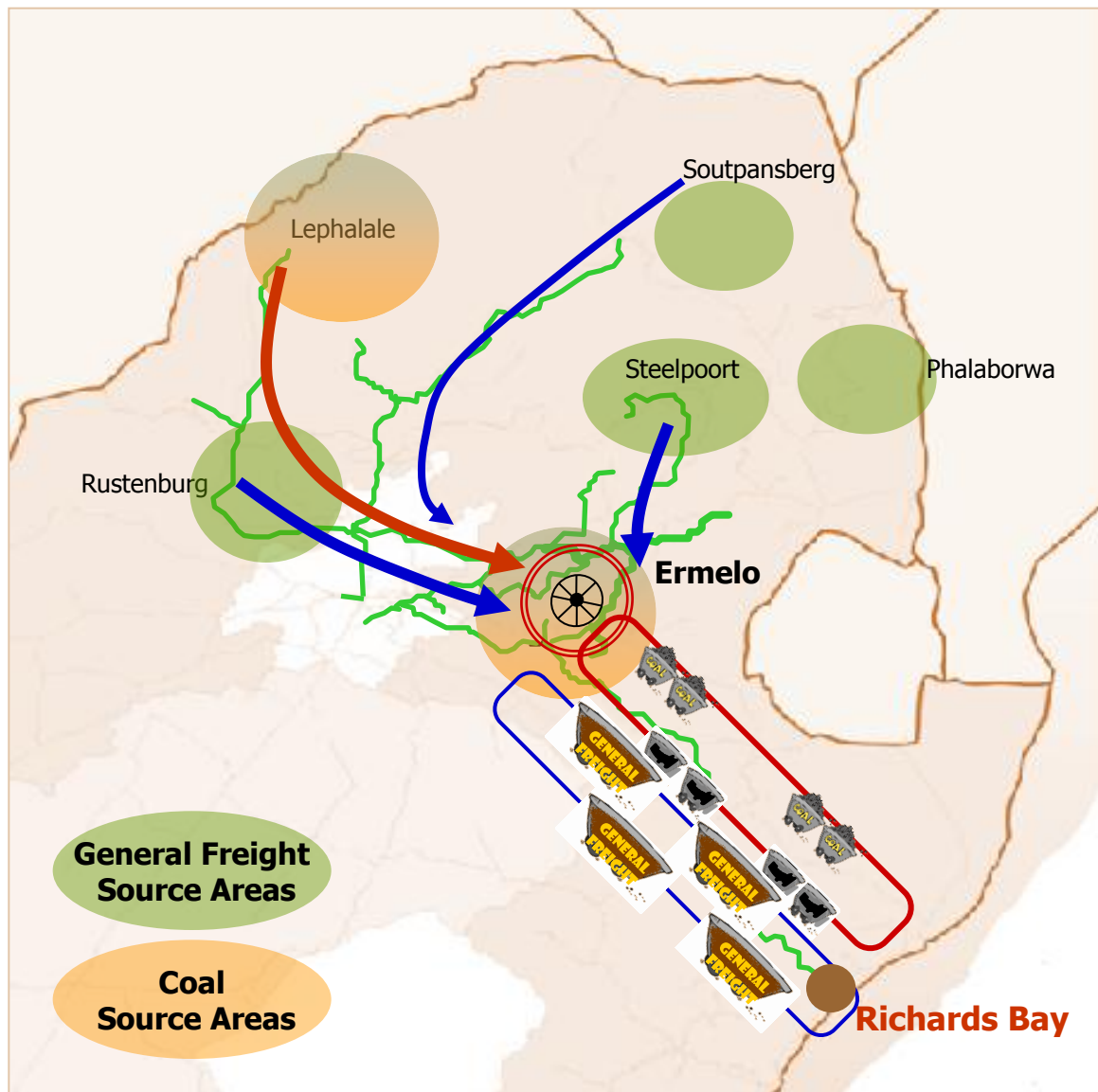
The Coal Line: Profile



Distance	+/- 580km from Blackhill to Richards Bay
Topography	<ul style="list-style-type: none"> o Descends from 1700 meters altitude to sea level o Undulating topography and high rainfall
Axle loads	26 t/axle on heavy haul and some feeder lines
Ruling Gradient	1:100 North of Ermelo 1:160 for loaded trains South of Ermelo on one of the two tracks, and 1:66 for empties
Traction	3kV DC: North of Ermelo 25kV AC: South of Ermelo
Civil	137 bridges, 37 tunnels Overvaal tunnel = 4 km (single)
# of lines	Double, 3 rd line on some feeder sections
Authorisation	Colour light signalling with CTC
Locomotives	<ul style="list-style-type: none"> o 7E/11E on AC, 10E on DC sections o 110 new AC/DC 19E in commissioning
Wagons	CCL gondola: max payload of 84 tons
Gross tons per train	22 000 tons at 2,2km in length
Volumes in 2010/11	62 mt export coal, 11 mt general freight
Capacity	74 mt export coal; 14 mt general freight
Competitiveness	Most affordable global coal transporter



Coal line: Complexity of Operations



- **Operating Philosophy**
 - **100 wagon trains** on the feeder line ; train sets combined at Ermelo as **200 wagon trains** to RBCT
 - **Loaded coal trains** are run separately from general freight trains
 - Regular and evenly spaced weekly schedules to improve cycle times
- Richards Bay is developing as a **mega bulk port**
- Coal line is becoming a multi-product bulk export line
 - Coal export and general freight 'systems' evident
 - General freight potential in excess of 30mt
- General freight trains comply with **heavy haul philosophy**

Coal line: Technology



ECP/WDP

- Increases capacity: Higher speeds & improved braking
- Improves train handling - related derailments and train breaks
- Improves turnaround time
- Increase Safety margins

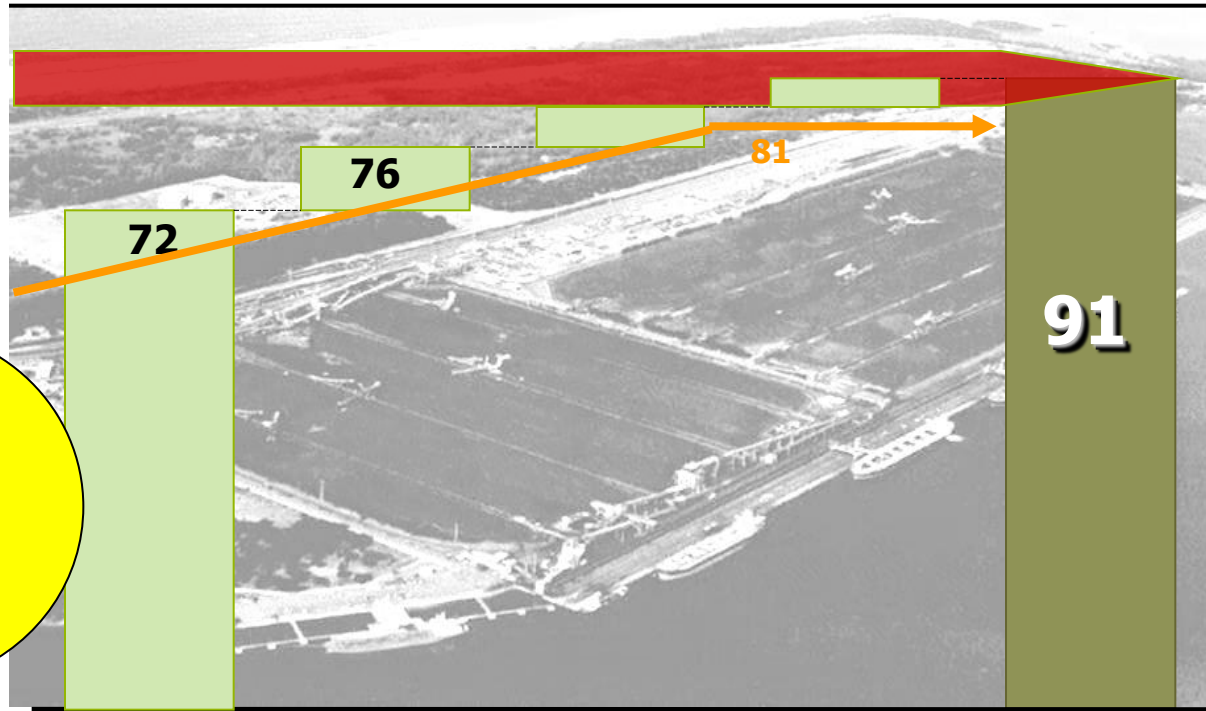
**19 E AC/DC
Locomotives**

- Reduces cycle times in change over yards
- Improved energy efficiency of 18%
- Utilised on AD & DC powered sections or run through
- Increase reliability and availability of the locomotive fleet
- Freeing up of class 7E and 10E locomotive fleet to address the GFB growth requirement

The 19E AC/DC Locomotive



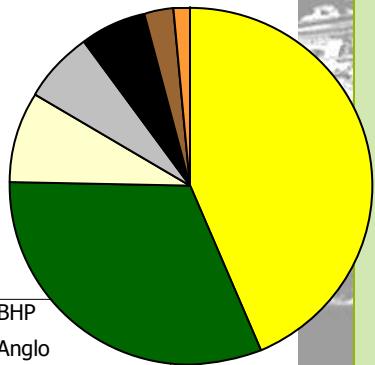
Expansion Plans (Mt p.a.) : Coal Stakeholders



2009 Shareholders capacity

Project Quattro

Total system capacity



- BHP
- Anglo
- Xstrata SA
- Total Coal SA
- Sasol Mining
- Kangra Coal
- Eyesizwe Coal

% Volume of 72 Mt allocation



- RBCT 91mt expansion completed by end of 2009
- New capacity for new small entrants - accommodate broader spectrum of producers
- Rail capacity incrementally increased to 81mt
- Current volumes under potential of system
- Quantum rail expansion after 81mt

Coal Export line: Future Strategy



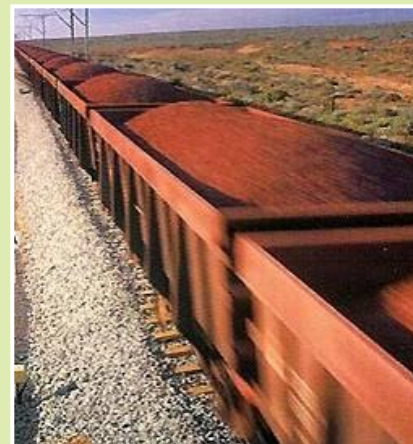
- 1067mm Gauge: Not a constraint as result of self-steering bogeys and rail/wheel management systems
- Focus currently on **Continuous Improvement**, system reconfiguration and **incremental** capacity expansion
- Investment in **Technology** only to maintain cost effectiveness and increase Safety
- Radical Transformation only **beyond 81mt** of export coal
 - Extension of the 'pipe' from 600km to 1200km
 - Increase in length of haul warrants review of **longer trains**
 - Elimination of infrastructure constraints such as **Overvaal Tunnel, cross over points.**
 - **No benefit** from further increase of axle loading beyond 26t/axle due to coal product density
 - **Wagon types** and off-loading technology (gondola vs. bottom-discharge)
- How to accommodate **small loaders**
 - New entrants and small loaders
 - Maintain the integrity of a heavy haul system
 - Consolidation yards
 - Broader economic participation

1 Heavy Haul in South Africa: Context

2 The Richards Bay Coal Export line

3 The Sishen – Saldanha Iron Ore Export line

- *Profile*
- *Expansion Strategy*
- *Operating Philosophy and Resources*
- *Maintenance*
- *Technology*
- *Future Strategy*

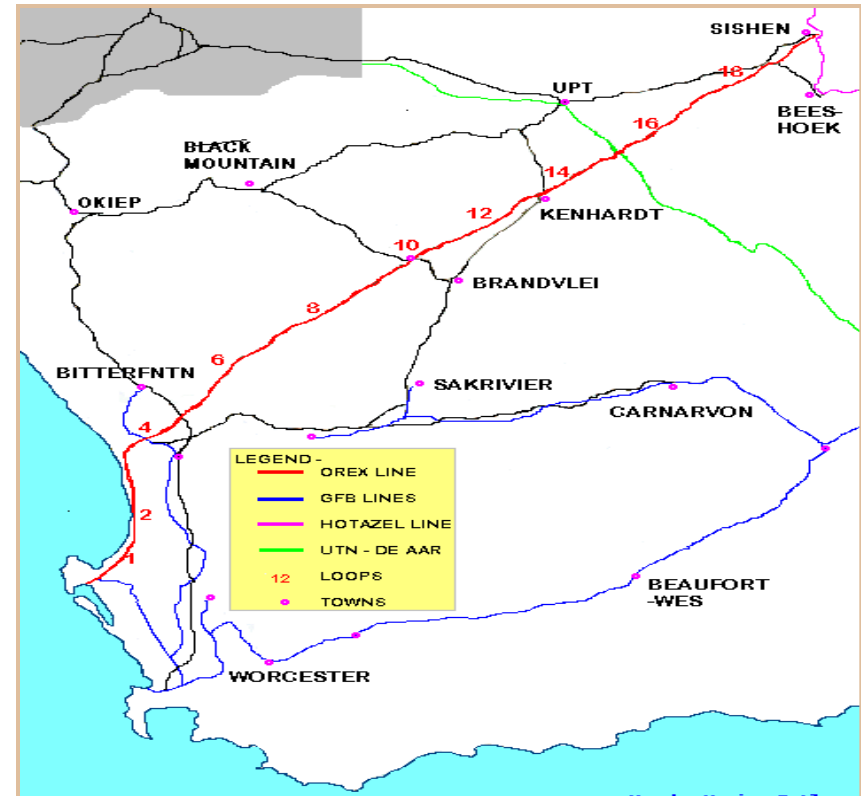


4 Heavy Haul: Concluding Remarks

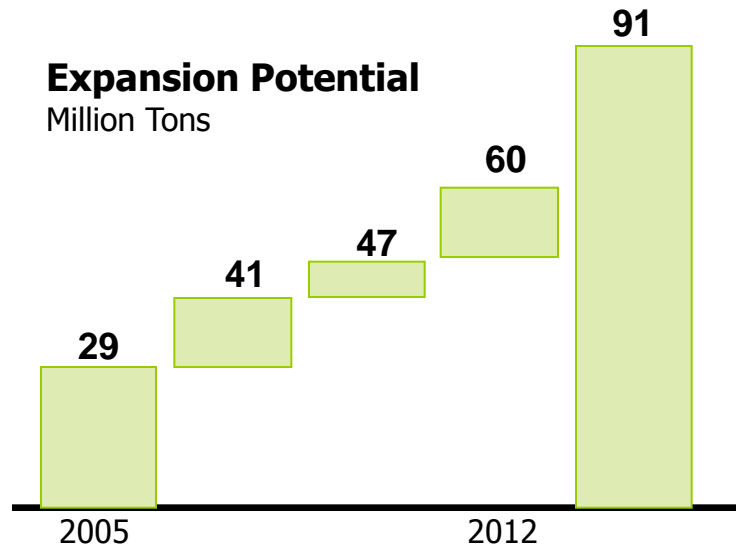
Iron Ore Line: Profile



Distance	861 km
Topography	Semi-desert, descending to the coast from 1 295 m above sea level at the Sishen mines.
Axle loads	Operated at 30 t/axle
Ruling Gradient	1:250 loaded trains 1:100 empty trains
Traction	50kV AC
Civil	Olifantsrivier Bridge
# of lines	Single line with crossing loops at 40km intervals
Train Authorisation	SIMS-S colour light signalling
Locomotives	○ Class 9E and 34 Class Diesels ○ Class 15 E locomotives being commissioned
Wagons	CR type: max payload of 100 tons
Gross tons per train	41 000 tons @ 4km train length
Volumes in 2010/11	46 mt export iron ore, 1 mt general freight
Capacity	60 mt infrastructure capacity excl. power upgrades
Competitiveness	Longest heavy haul production trains in the world



Ore Line : Expansion Strategy

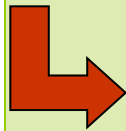


Due to the **long haul**, alternatives to increase capacity are:

- Increase train speeds
- Increase axle loads of wagons
- Increase the train lengths
- Additional crossing loops to run more trains at shorter intervals

Expansion Strategy adopted:

- Increase **axle loading** to operate at **30t/ axle**



Wagons:
Upgrade to carry
100 tons &
Component changes

Condition-based
Infrastructure
Maintenance

- Increase **train length** from **216 to 342** wagons (*Safety limit*)



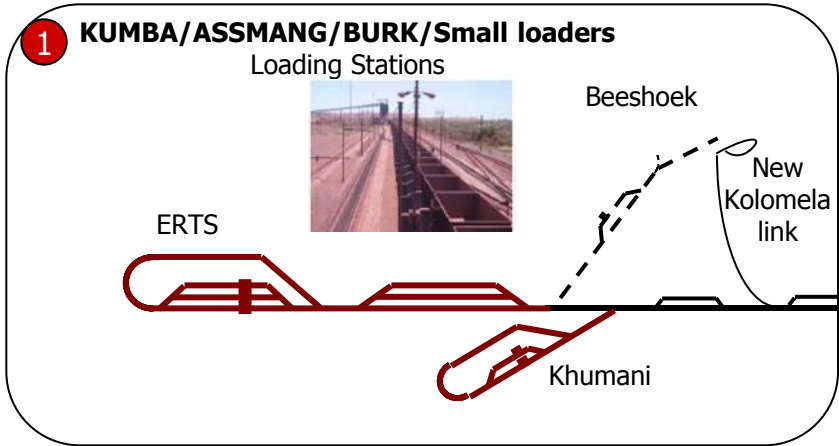
RDP
to improve
Train handling
/safety

More
powerful
Tractive
effort

Infra Changes
(terminals, loops
& power)

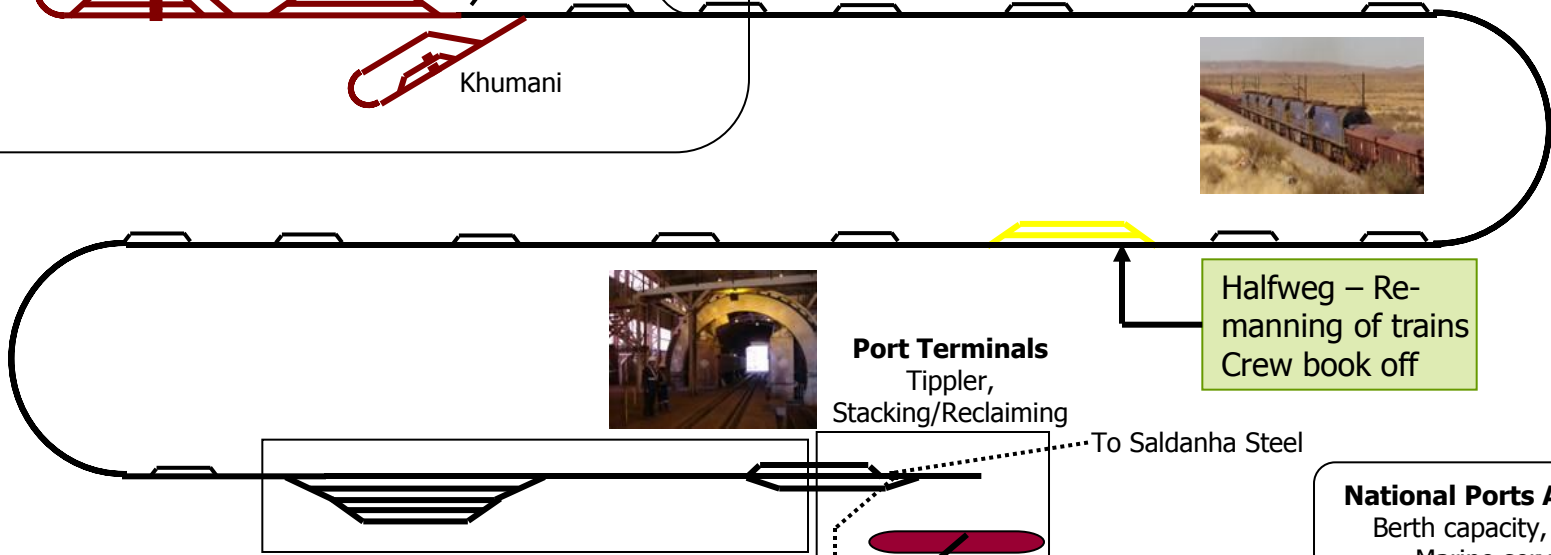
- **Train Operating Philosophy**
- Beyond 60 mt: **Infrastructure quantum changes**

Iron Ore Line: Operating Philosophy



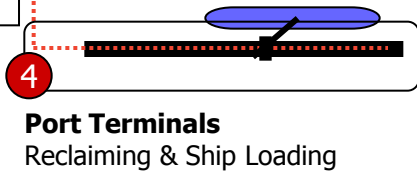
2 Rail operations
Train operations, Crews, Traffic Control, Per way, Communication, Signalling, Power supply, Infrastructure- and Rolling Stock maintenance
Haul distance of 860 km

System 1: Mines
System 2: Rail
System 3: Stockpile
System 4: Ship-loading



SALKOR
Compiling/De-compiling trains, Shunting, NTG, Wagon & Locomotive maintenance

National Ports Authority
Berth capacity, Berths, Marine services



342 wagon RDP Trains – total mass 41 000 tons
114 wagon rakes – total mass 13 667 tons

Iron Ore Line: Resources



- 30 x 9E electric locomotives
- 104 Diesel Locomotives – 34 class GE 2500 HP
- 44 x 15E electric locomotives – 5 MW
- 5 600 CR13/14 wagons - payload 100 tons
- Radio Distributed Power
- Gross Train mass 41000 ton
- 6 locomotives per train
- 3 x 114 wagon rakes
- 3 x 9E and 7 x 34 Diesels



[1x9E+2x34D]+[114 wagons] + [1x9E+2x34D]+[114 wagons] + [1x9E+1x34D]+[114 wagons]+[2x34D]



Iron Ore Line: Resources



- 30 x 9E electric locomotives
- 104 Diesel Locomotives – 34 class GE 2500 HP
- 44 x 15E electric locomotives – 5 MW
- 5 600 CR13/14 wagons - payload 100 tons
- Radio Distributed Power
- Gross Train mass 41000 ton
- 6 locomotives per train
- 3 x 114 wagon rakes
- 3 x 9E and 7 x 34 Diesels



$[1x9E+2x34D]+[114\text{ wagons}] + [1x9E+2x34D]+[114\text{ wagons}] + [1x9E+1x34D]+[114\text{ wagons}]+[2x34D]$

- Train with all electric 15E locomotives

- Train length 4.1 km
- 1 x Train Driver and 1 x Train Assistant

342 Wagon RDP Train

End of train @ 4 kilometres



Saldanha: Infrastructure

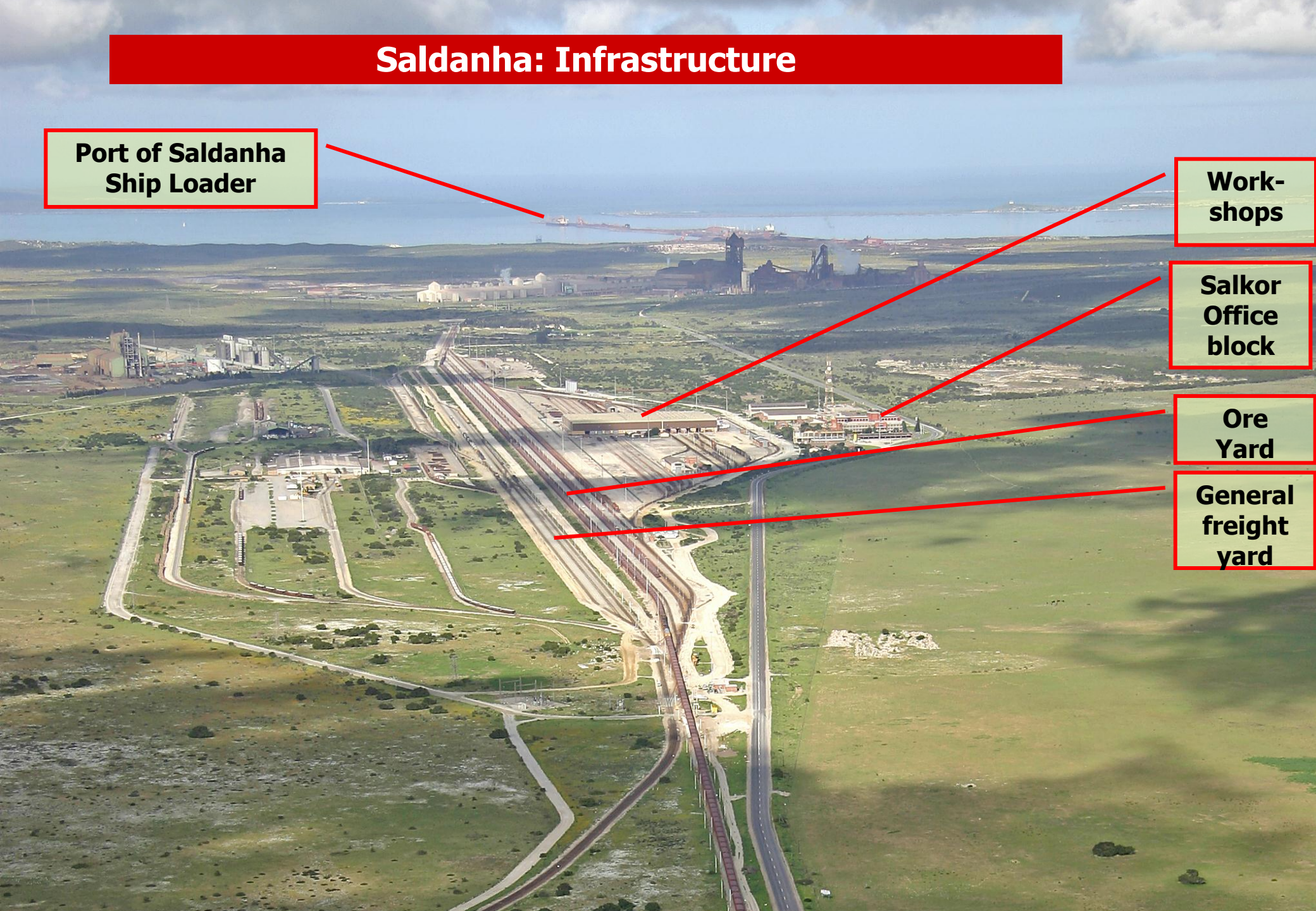
**Port of Saldanha
Ship Loader**

**Work-
shops**

**Salkor
Office
block**

**Ore
Yard**

**General
freight
yard**



Iron Ore Line: Track Maintenance



Track Maintenance Philosophy

- Scheduled Preventative Maintenance
- Asset Based Condition Inspections
- Plan the work, work the plan
- Daily maintenance - between trains
- Annual "Shut Down" Activities

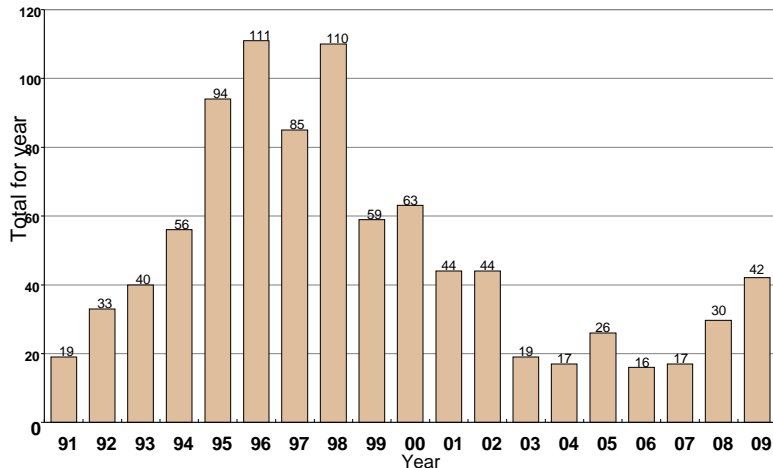
Inventory Management

- Medium & long term contracts with approved suppliers.
- Stock levels based on asset condition, usage, budget and lead times.
- Delivering of material just in time.
- 10% emergency stock levels based on history & lead times.

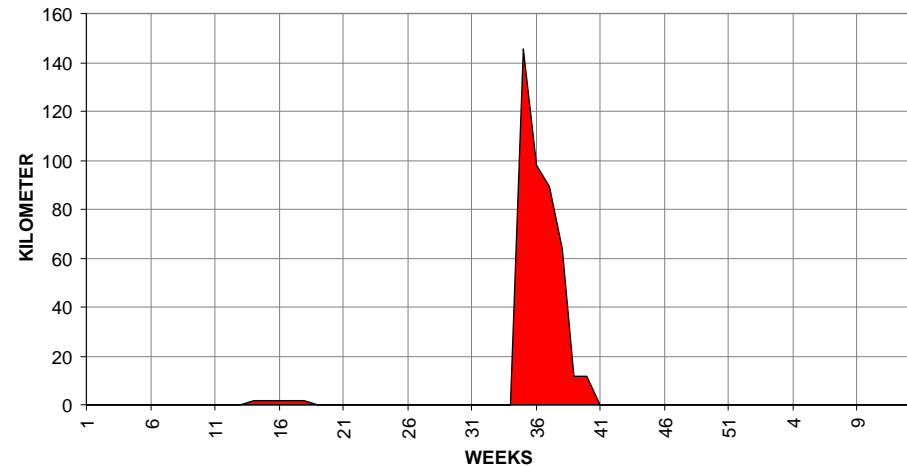
Increased maintenance with volume growth

Year	2007	2008	2009	2010	2011	2012	2013
Million Gross Tons	55	62	73	82	88	103	138
Tamping Cycle per year	7	6	6	5	5	4.8	4
Grinding cycle per year	2	2	3	3	4	4	6
Rail life span / rail replacement (per year)	27 (64Km)	24 (72Km)	21 (82Km)	18 (96Km)	17 (102Km)	15 (116km)	11 (158Km)
Ultrasonic Measurement Car cycles / year	4	6	8	8	10	10	12
IM2000 cycle per year	4	5	6	6	7	8	11

IN-SERVICE RAILBREAKS



SPEED RESTRICTIONS 2008/09



Signalling

- Electronic interlocking
- Saldanha CTC via microwave communication/fiber

Wayside Monitoring

- VIS Vehicle Identification System
- Hot Box Detector
- Dragging Equipment Detectors
- Wheel Impact Monitoring System
- Wheel profile monitoring system
- Skew bogie detector
- BAM- Bearing Acoustic Measuring System for wheels
- WILMA - Wayside Intelligent Long-stress Management system.
- UBRD – Ultrasonic Broken Rail Detector system

Telecommunications

Telecommunication system is being upgraded to TCS-R and GSM train communication
Constrained by SKA (Square Kilometre Array radio telescope)

Iron Ore Line: Locomotive Statistics



	DIESEL	ELECTRIC
GTK per Loco per Annum: 371 415 756		
Average Monthly distance travelled	17,000 km	18,000 km
Wheels re-profiling	4 months	6 months
Wheels re-tyre / replace	18 months	24 months

Inventory Management :

- Maintenance material stock levels are maintained at 135 days requirement (including strategic stock for electric locomotives)

Maintenance Strategy :

- Condition based activities performed on fixed time schedule
- Each loco receives scheduled examination every 45 days
- Activities vary based upon A, B, C or D-type examinations
- Total staff complement of 106 currently

The New 15 E Locomotive



Iron Ore Line: Wagon Statistics



	Interval
GTK per Annum per Wagon: 10 016 736	
Scheduled maintenance based on hollow wear of wheels	<ul style="list-style-type: none"> ○ Average 24 months to reach 2 mm hollow wear ○ Hollow wear measured real time on ITCMS ○ Work rate of +-180 000 km/year and life span of +- 800 000 km/wheel
Maintenance/replacement of other components done on multiples of base cycle	<ul style="list-style-type: none"> ○ Bearings : 4 years (R) ○ Bogies : 4 years (M) ○ Couplers : 6 years (R) ○ Drawbar : 12 year (R) ○ Draw gear : 12 year (R) ○ Brake components : 10 years (M)
Wagon availability	<ul style="list-style-type: none"> ○ 97%
Annual maintenance cost	+- 4 % of new wagon

Radio Distributed Power

- Distribution of power over the entire length of the train
- Improves in-train forces
- Improves train dynamics, braking and stopping distances
- Fuel and maintenance savings
- Allows the running of longer trains with one crew - cost competitive

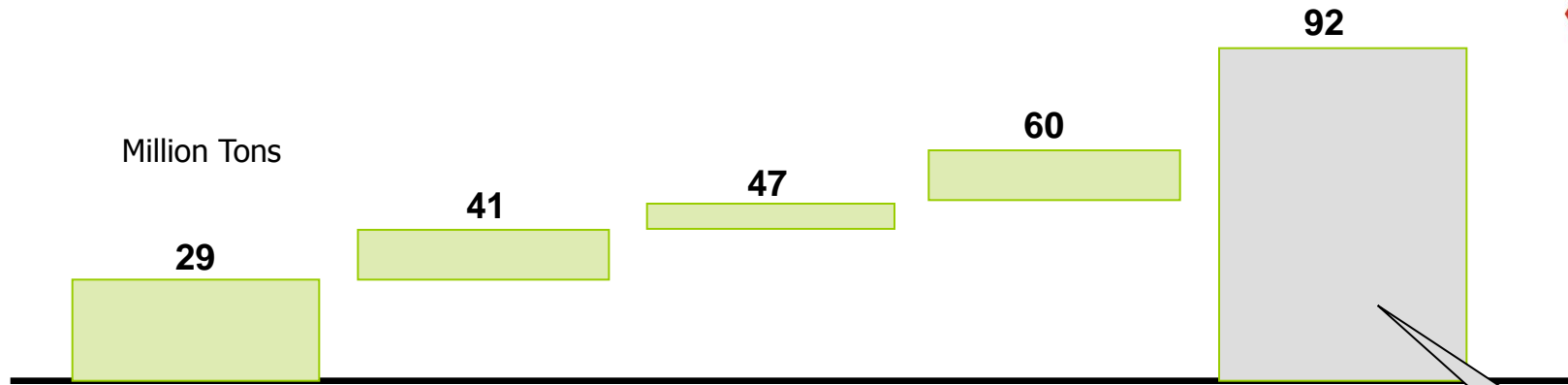
Wayside Monitoring for Condition-based Maintenance

- Technologies deployed on the line reflect the operational complexity & risk of running extremely long trains:
 - Acoustic bearing detectors, wheel profile measuring devices, dragging equipment detectors, weigh-in-motion bridges, hotbox detectors, hot wheel detectors, speed monitoring, wheel impact monitors, rail/concrete and ambient temperature measures, WILMA & UBRD
- Trolleys of the line on statistically determined period all contribute to safe operations

15 E Locomotives

- Most powerful locomotive in TFR with continuous tractive effort of 480 kN
- GPRS and touch-screen cab displays
- Monitoring of all trip and technical data for automatic downloading via wayside readers

Iron Ore Line: Expansion Programme?



	29-41 Mt pa	41-47 Mt pa	47 – 60 Mt pa
Focus	Mines, rail and port infrastructural changes to handle 342 wagons	Rolling stock	Power supply upgrade and new links
Train length	216 to 342 wagons	342 wagons	342 wagons
Slot requirements	40 slot grid for 28 trains per week (use of even loops for ore trains)	From 45 Mtpa onwards a 72 slot grid is required.	72 slot double grid for 44 ore trains per week (use of all loops for ore trains)
Technology	Radio Distributed Power	Radio Distributed Power	Radio Distributed Power
Infrastructure	<ul style="list-style-type: none"> Lengthen 19 loops to handle longer trains Expansion of Salkor yard 	<ul style="list-style-type: none"> Minor adjustments to loops 	<ul style="list-style-type: none"> New Kolomela link line 2nd line: Salkor - timplers 860km elec. feeder line
Wagons	<ul style="list-style-type: none"> 483 wagons upgraded to 100 ton payload 833 new 100ton wagons 	<ul style="list-style-type: none"> 638 additional 100 ton wagons 	<ul style="list-style-type: none"> 1050 new CR wagons
Locomotives	<ul style="list-style-type: none"> 31 9E augmented with 34D locomotives 	<ul style="list-style-type: none"> 44 new 15E locomotives 	<ul style="list-style-type: none"> 32 additional 15E locos for all electric fleet

Feasibility being conducted

Balance of power supply and evenly spaced trains remains a challenge

Iron Ore Line: Future Strategy



- Any upgrading of capacity on the Ore line is crucial for:
 - the development of the mineral rich Northern Cape
 - Retaining a competitive export channel
 - Supporting sustainable development of emerging and junior miners
- General freight bulk commodities i.e. manganese, intermodal freight could be handled on the line, in compliance with heavy haul operations

Presentation Outline



1 Heavy Haul in South Africa: Context

2 The Richards Bay Coal Export line

3 The Sishen – Saldanha Iron Ore Export line

4 Heavy Haul: Concluding Remarks

- Heavy Haul operations provides a **commercial, competitive advantage** in economies with vast mineral resources
- Heavy haul operations in South Africa are at the **cutting edge of technology** on a 1067mm gauge rail system
- Understanding the long term **cost/benefit** when introducing new technology is critical:
 - System-wide impact
 - Skills availability
 - Commissioning time
 - Training
 - Maintenance
- Philosophy of **longer heavy haul trains** have to be viewed against:
 - Operational and safety risks
 - Set up and cycle time
- Accommodation of **emerging small loaders** a challenge

TRANSNET



delivering on our commitment **to you**

freight rail



Thank You