TYPE, DISTRIBUTION AND USE OF COAL IN SOUTH AFRICA
WHAT IS COAL

- Sedimentary rock
- Heterogeneous and carbonaceous fossil fuel/material

organic and inorganic 70% carbon content, 30% oxygen and hydrogen
FORMATION OF SOUTHERN HEMISPHERE COAL

Permian Period

Carboniferous Period
ORIGIN OF MINERAL MATTER IN COAL
BASIC COAL QUALITY ASSESSMENT: TYPE, GRADE AND RANK

**COAL**

**BENEFICIATION PROPERTIES**
- Particle size distribution
- Grindability
- Float sink
- Hard Grove Index

**CHEMICAL PROPERTIES**
- Ash
- Volatile Matter
- Moisture
- Calorific Value
- Fixed & Total Carbon
- Sulphur

**SWELLING PROPERTIES**
- Swelling Index
- Ash fusion Temperature

**PHYSICAL PROPERTIES**
- Surface Area
- Porosity

**COAL PETROGRAPHY**
- Vitrinite reflectance
- Maceral analysis

**MINERAL MATTER**
- X-Ray Diffractometer
- X-Ray Fluorescence Spectroscopy
## COAL TYPE

### Typical coal found in South African Coalfield

<table>
<thead>
<tr>
<th>COAL TYPE</th>
<th>MOISTURE CONTENT (%)</th>
<th>CARBON CONTENT (%)</th>
<th>CALORIFIC VALUE (MJ/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peat</td>
<td>90%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lignite</td>
<td>35%</td>
<td>25-35%</td>
<td>9 - 21</td>
</tr>
<tr>
<td>Sub-bituminous</td>
<td>10%</td>
<td>35-45%</td>
<td>19-26</td>
</tr>
<tr>
<td>Bituminous</td>
<td>8-10%</td>
<td>45-85%</td>
<td>23-33</td>
</tr>
<tr>
<td>Anthracite</td>
<td>0-5%</td>
<td>85-95%</td>
<td>32-35</td>
</tr>
</tbody>
</table>

![Coal types](image)
VARIATION OF COAL PARAMETERS WITH RANK

- (a) Moisture
- (b) Volatile Matter (dmmf)
- (c) Fixed Carbon (dmmf)
- (d) Calorific Value (dmmf)
COAL TYPE BY USE

GLOBAL

COAL

CARBON/ENERGY CONTENT

HIGH

MOISTURE CONTENT

HIGH

LOW RANK COALS
48%

HARD COAL
52%

% of World Reserves

LIGNITE
20%

SUB-BITUMINOUS
28%

BITUMINOUS
51%

ANTHRACITE
~1%

USES
Largely power generation

Power generation
Cement manufacture
Industrial uses

Manufacture of iron and steel

Domestic/industrial including smokeless fuel

THERMAL
Steam coal

METALLURGICAL
Coking coal
COAL DISTRIBUTION IN SOUTH AFRICA

Coalfields in South Africa

Simplified Geology (Lithology)

- Karoo Supergroup
- Malmesbury, Kaaimans, Gilbert, Klerksdorp
- Natal, Wellington, Vaal, Duiwelskloof
- Overberg, Tulbagh
- Tarka Supergroup
- KwaZulu-Natal Province
- Mpumalanga Province
- Eastern Cape Province
- Western Cape Province
- Northern Cape Province
- Free State Province
- Limpopo Province

Provinces

- South African Coalfields
  1. Witbank
  2. Highveld
  3. Ermelo
  4. Free State
  5. Vereeniging-Sasolburg
  6. South Rand
  7. Klip River
  8. Utrecht
  9. Vryheid
  10. Nongoma
  11. Somkhize
  12. Kangwane
  13. Springbok Flats
  14. Waterberg
  15. Sotho-Booys
  16. Limpopo (Tuli)
  17. Molteno

Symbology

- SA Coalfields
- Provinces

100 90 80 70 0 190 Kilometers
VARIATIONS OF MAJOR COAL SEAMS IN SOUTH AFRICA

MAJOR SEAMS ACROSS THE KAROO BASIN, SOUTH AFRICA
KWAZULU-NATAL, ERMELO, WITBANK TO FREE STATE
Different sequences of seams in each area

Fig. 5 – Tentative correlation of depositional sequences in the major coal fields within the main basin (after A.B. Cadle, quoted by Snyman and Barclay 1989).
VALUE CHAIN OF COAL IN SOUTH AFRICA

Coal Value
- Exploration
- Sampling & Characterization
- Research & Development
- Resources & Reserves

Global Context
- Coal Preparation
- Transport
- Coal Exports

Regional Context
- Electricity
- Coal to Liquid
- Metallurgical use
- Industrial use
- Residential use
- Alternatives to coal
SOUTH AFRICAN COAL PRODUCERS

- Anglo
- Exxaro
- Sasol
- BHP
- Xstrata
- Others
WHAT HAPPENS AFTER MINING

- Stock: 11.9Mt
- Washing: 209.4Mt
- Screening: 124.2
- Discards: 74.8Mt
- Synfuels: 42.9Mt
- Electricity: 93.2Mt
- Local use: 25.0Mt
- Export: 78.7Mt

Total: 333.6Mt
<table>
<thead>
<tr>
<th>CONSUMPTION SECTORS</th>
<th>COAL TYPE</th>
<th>CV (MJ/kg)</th>
<th>GROSS CV (MJ/kg)</th>
<th>MOISTURE CONTENT (%)</th>
<th>ASH CONTENT (%)</th>
<th>VOLATILE MATTER (%)</th>
<th>FIXED CARBON (%)</th>
<th>TOTAL SULPHUR (%)</th>
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</thead>
<tbody>
<tr>
<td>Power Stations</td>
<td>Bituminous</td>
<td>20.71</td>
<td>20.83</td>
<td>3.70</td>
<td>30.10</td>
<td>22.50</td>
<td>43.70</td>
<td>0.97</td>
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<tr>
<td>Petrochemical</td>
<td>Bituminous</td>
<td>21.34</td>
<td>21.25</td>
<td>4.80</td>
<td>25.80</td>
<td>22.30</td>
<td>47.10</td>
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<tr>
<td>Metallurgical Industries</td>
<td>Anthracite</td>
<td>32.06</td>
<td>31.99</td>
<td>2.30</td>
<td>7.70</td>
<td>5.50</td>
<td>84.50</td>
<td>0.74</td>
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<tr>
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<td>Bituminous</td>
<td>29.76</td>
<td>29.68</td>
<td>2.50</td>
<td>10.70</td>
<td>31.60</td>
<td>55.20</td>
<td>0.81</td>
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<tr>
<td>Domestic (Small industries and households)</td>
<td>Anthracite</td>
<td>29.40</td>
<td>29.31</td>
<td>2.60</td>
<td>15.20</td>
<td>7.00</td>
<td>75.20</td>
<td>0.98</td>
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<td>Bituminous</td>
<td>27.32</td>
<td>27.24</td>
<td>3.10</td>
<td>14.20</td>
<td>26.60</td>
<td>56.10</td>
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<tr>
<td>Exports</td>
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<td>30.92</td>
<td>30.82</td>
<td>2.30</td>
<td>11.00</td>
<td>7.00</td>
<td>79.70</td>
<td>1.06</td>
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<tr>
<td></td>
<td>Metallurgical</td>
<td>31.04</td>
<td>30.99</td>
<td>2.60</td>
<td>7.50</td>
<td>31.70</td>
<td>58.20</td>
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<td></td>
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<td>57.10</td>
<td>0.81</td>
</tr>
</tbody>
</table>

*All figures quoted in an air-dry basis.*
COAL EXPORTS MARKET

SA Export coal exports by destination

- **2013**
  - Europe: 24%
  - Asia/Middle East: 71%
  - Other: 5%

- **2009**
  - Europe: 38%
  - Asia/Middle East: 58%
  - Other: 4%

- **2005**
  - Europe: 79%
  - Asia/Middle East: 14%
  - Other: 7%

- **2000**
  - Europe: 71%
  - Asia/Middle East: 22%
  - Other: 7%

*Taken from Chamber of Mines, 2014 estimates*
COAL USE IN SOUTH AFRICA

Taken from Mintek reports, 2007 FIGURES
COAL USAGE: 2014 FIGURES

- Electricity: 65%
- Synfuels: 22%
- Merchants and domestic: 5%
- Industries: 3%
- Steel: 2%
- Chemical: 1%
- Metallurgical: 1%
- Cement: 1%
- Brick & Tiles: 0%
- Agriculture: 0%

FIGURES TAKEN FROM XMP CONSULTING
EXPORT TERMINALS

[Map showing various export terminals and rail lines, including the 2ND Longest Heavy Haul line in the world at 861 km.]
COAL TO ELECTRICITY
COAL TO LIQUID PROCESS

Diagram showing the process of converting coal into liquid fuels and chemicals.

Steps include:
- Wastes collection
- Gasifier
- Particulate removal
- Gas cleanup
- Air separator
- Oxygen supply
- Compressed air
- Sulfur byproduct
- Shift reactor
- Synthesis gas conversion
- Fuel and chemicals production
- Steam generation
- Heat recovery and electric power generation
- Vitrified solids handling
METALLURGICAL USE
COAL POWER STATIONS IN SOUTH AFRICA

LIMPOPO
- Medupi
- Matimba

MPUMALANGA
- Majuba
- Kendal
- Duvha
- Matla
- Tutuka
- Kriel
- Arnot
- Hendrina
- Camden
- Grootvlei
- Komati

FREE STATE
- Lethabo
COAL STRUCTURAL CONVERSION PROCESS
COAL CHAR TO GRAPHITE

$d = 3.5 - 3.7 \text{Å}$
THANK YOU