COAL UTILIZATION IN AN UNCERTAIN ECONOMIC WORLD
(A SOUTH AFRICAN PERSPECTIVE)

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All other South African coal researchers

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USA
Outline

• **Introduction**
  • Setting the coal scene
  • The energy needs - Africa

• **Economics**
  • Global economic information
  • South African scenario

• **Other alternatives**
  • State of Energy Research in South Africa
  • Renewable non-bio Energy (wind, solar, fracking)
  • Nuclear Energy
  • Bio-Energy
  • Fossil Fuel Energy – the one remaining source

• **Final Conclusions**
  • Research: NWU
  • IPCC 2016
Setting the coal scene

Regions with very large coal reserves (Billion Short tons)
The energy needs - Africa

- Almost 90% of South Africa's electricity is generated in coal-fired power stations.
- Koeberg, a large nuclear station near Cape Town, provides about 5% of capacity. A further 5% is provided by hydroelectric and pumped storage schemes.
- Renewables are starting to come online.

- Around 77% of South Africa's energy needs are directly derived from coal.
- 92% of coal consumed on the African continent is mined in South Africa.
- South Africa supplies two-thirds of Africa's electricity.


The Total Primary Energy Supply in South Africa 2012 [% TPES]

- Coal, 69.0%
- Crude Oil, 14.8%
- Gas, 2.9%
- Nuclear, 2.4%
- Hydro, 0.1%
- Solar, Wind, etc., 0.1%
- Biofuels and Waste, 10.7%
How to stimulate the Economy

- Print more money
- Undermine the currency
- Implement structural changes

The Global Yield Curve

Bond rates from the country at the center of world power

Italy  Netherlands  Britain  USA

Lending rates decrease as standards of living increase...

700 Year Low in 2012
South African scenario

### SA's Political Economy

#### The Tri-Partite Alliance

<table>
<thead>
<tr>
<th>ANC</th>
<th>Then</th>
<th>Cosatu</th>
<th>Now</th>
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<tr>
<td>Pre-94, Liberation Org.</td>
<td></td>
<td>Marketing arm of ANC</td>
<td>Joined political elite</td>
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<tr>
<td>'94-'08 Turned Neo-Liberal</td>
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<td>Power on shop floor</td>
<td>Vacuum on shop floor</td>
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<td>Post '08 NDR vs. NDP</td>
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<td>Well organized</td>
<td>Rivals Amcu et. al.</td>
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<td>2009 &quot;Z&quot;-years</td>
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<td>Workers first</td>
<td>Self Destruct</td>
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<td>Institutional destruction</td>
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#### Result

- Ideologically confused
- Contradictory policies
- Weak implementation

- Ideological Base
- Intellectually strong
- Pro- workers/poor
- Not Marxists but, Leninists

- Bling communists
- Intellectually weak
- Political rent seekers
- Very influential
- No Support Base
- Remain Leninists
Additionally about 20% have stopped seeking jobs.

Unemployment

- Labour Issues
- Weak Growth
- Poor Skills
- Inefficient Gov.

Policy Focus: Social instead of Economic

Gov. solution, employ more! And Pay them More!? 

Source: STATSSA, EFG
Latest Research Russouw et al. (2014)
- 2008-2014
- Avg. annual inflation 5.9%
  - Avg. annual "wage" increase 13.1%
  - wage bill, not wages...
Productivity and Wages

• Most negatively impacted by mining strikes?

Source: SARB, EFG
The Bigger Picture, Fiscal Finance/GDP

Source: National Treasury, EFG

Dawie Roodt SAUCGA 23/08/15
GDP

- Eskom
- Strikes: Gold, Coal, Gov?
- Mixed Signals
  - Manufacturing
- Commodity Prices
  - Fundamentals

NDP or NDR?

Source: STATSSA, EF Group
How to deal with the energy crisis in South Africa and the utilization of resources when these economic matters are in play?

THAT IS THE QUESTION

Double, double toil and trouble;
Fire burn, and cauldron bubble.

With thanks: Shakespeare’s Macbeth

Is it better to know or not to know

With Thanks: Shakespeare’s Hamlet
The DST 10 year Innovation Plan (2008)

- Embracing Renewable Energy Technologies (Non-Bio and Bio)
- Nuclear Energy Revisited
- Clean Coal Technologies
• More than 20 000 MW of renewable energy will be contracted – bio, wind, solar.
• Nuclear??
• Older coal-fired power stations will be decommissioned (about 11 000MW) and new coal-fired power stations (about 6 000 MW) commissioned
Wind and solar ??

The first large scale wind farm in South Africa became operational in 2014, and others are in planning and construction stages.

- 6 farms with total energy < 330MW
- 6 planned with total energy 430 MW
- 2 farms with total 800 MW possible

THUS before 2020 <1 GW

Only operational solar plant 100MW 2015
With some 400 MW planned before 2020

http://www.ipprenewables.co.za/
Shale gas in the Karoo will prove "a game-changer" for the South African economy, President Jacob Zuma said on Thursday.

In his state-of-the-nation address, delivered at Parliament, he told MPs government had evaluated the risks and opportunities involved in extracting shale gas, a process known as fracking.

"Having evaluated the risks and opportunities, the final regulations will be released soon and will be followed by the processing and granting of licenses.

"The development of petroleum, especially shale gas, will be a game-changer for the Karoo region and the South African economy."

But what is the current situation ??
Although the moratorium on exploration for shale gas in the Karoo was lifted 10 months ago, no drilling has taken place yet, and is unlikely to do so for 6 to 18 months.

**WHAT THE FRACK**
1 Well: 20 Million litres of water.
2500 trucks.
32 wells on a pad.
10 pads in a development. Many developments in SA.

52% of the Karoo. More than 20% of SA. France has banned it. Many US cities don’t want it. IS Fracking the answer for SA?

http://www.treasurethekaroo.co.za/fracking-facts/applications-for-shale-gas-exploration
Nuclear energy
1 Experimental site – Safari 1
1 Operational site: Koeberg 1.8 GW

Possible deal for $100bn to build 8 nuclear power plants in South Africa by Russia

Currently a hotly debated topic
What is the Ecological Footprint? What is it composed of?
The Ecological Footprint is the area of land and water it takes for a human population to generate the renewable resources it consumes and to absorb the corresponding waste it generates, using prevailing technology.
In other words, it measures the "quantity of nature" that we use and compares it with how much "nature" we have.

What is Biocapacity?
Biocapacity serves as a lens, showing the capacity of biosphere to regenerate and provide for life. It allows researchers to add up the competing human demands, which include natural resources, waste absorption, water renewal, and productive areas dedicated to urban uses. As an aggregate, biocapacity allows us to determine how large the material metabolism of human economies is compared to what nature can renew.
HDI and Ecological Footprint per person for Nations by World Regions

Ecological Footprint values are 2011 values from the 2015 National Footprint Accounts, Global Footprint Network
HDI 2011 values are from the 2014 Human Development Report, UNDP

The Benefits and Challenges Associated With Coal in South Africa.
Rob Jeffrey, Rosemary Falcon, Andrew Kinghorn.
www.cornerstonemag.net
COAL BURNING TRAIN

STILL CLEANER THAN A NEW VOLKSWAGEN
DMR Public Mining Data

South Africa: Coal statistics

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- Crude Oil, 14.8%
- Coal, 69.0%

SA Coal Local and Export Sales Tonnes ('000)

- Local sales tons
- Export sales tons

SA Coal Sales Tonnes ('000)

- 2009: 245,216
- 2010: 253,135
- 2011: 246,696
- 2012: 261,677
- 2013: 256,957
- 2014: 251,949

Coal Revenue ('000)

- Local sales
- Total exports
South African coal chain 2010

Run-of-mine Production 287 Mt → Screenings 55 Mt → Discards 55 Mt → 54 Mt → 1 Mt

Stocks 10 Mt

Washing 232 Mt

Grate fired boilers

Local use 21 Mt

Synduels 40 Mt

Electricity 110 Mt

Lurgi gasification

PF combustion 2 Mt

Export 69 Mt

Courtesy Andre Engelbrecht (CSIR) and SANERI
The most important coal users in South Africa
Sasol – the South African leg

1950  S.A. Coal, Oil & Gas Corporation founded
1954  Sigma Colliery starts production in April
       Gasification testing starts in November
1955  First production at Sasol One - 8 drums of creosote
1964  Sigma Colliery produces 20 millionth ton (10 years after commissioning)
1969  Natref oil refinery in Sasolburg commissioned
1974  Sasol Two announced
1974  Construction of Sasol Two starts
       First functional Secunda colliery, Bosjesspruit
1979  Sasol Limited listed on the Johannesburg Stock Exchange.
       Sasol announced plans to construct Sasol Three next to Sasol Tw0
1992  Wonderwater open cast strip mine commences near Sasol One
2003  Sasol listed on New York Stock Exchange
2004  Mozambique Natural Gas project completed – supplying Sasol, Sasolburg
2010  New ethylene purification unit in Sasolburg
2012  Sasol New Energy constructs a 140 MW electricity generation plant, Sasolburg
ADVANCING SUSTAINABLE DEVELOPMENT

At Sasol we believe sustainability practices make good business sense

www.sasol.com
The Sasol process

- **Raw Materials**
  - Natural Gas Production
  - Procured Crude Oil
  - Coal Mines
  - Energy

- **Operations**
  - Gas Transmission & Marketing
  - Oil Refining & Fuel Marketing
  - Synfuels Production

- **Products**
  - Gas to Liquids
  - Automotive Fuels
  - Pipeline Gas
  - Steam Coal

- **Chemicals**
  - South African Chemical Operations
  - Olefins & Surfactants
  - Solvents
  - Polymers
  - Nitrogen Products
  - Waxes

**Southern Africa**

**International**

In production
140 MW Power plant
The influence of the oil price

Crude Oil Price
48.54 USD/bbl
7 Sep '15

Escalating oil price….caused by supply constraints and increased demand resulting in….

Increased emphasis on alternatives
Renewed interest in coal use

CTL likely to be viable at crude oil prices > USD $35/bbl

JC van Dyk  22nd IPCC 2005 and http://www.infomine.com/
ESKOM: Coal fired power plants

20 power plants generate some 40GW of electricity
5 gas turbines supply 2.5GW of electricity

**Medupi:** The power station will be the fourth largest coal plant in the southern hemisphere, and will be the biggest dry-cooled power station in the world. While Unit 6 has just started up, it is the first of the six units and the total output will be 4 764MW

.... unfortunately 6 years behind schedule!
South Africa: UCG

Short History
Sasol 2009
Eskom Majuba 2007
June 2012 Africary

Sasol and Eskom sign research agreement for UCG collaboration in South Africa, June 10, 2013
Sasol New Energy and Eskom have signed a research agreement to jointly explore the full value chain of underground coal gasification (UCG) technology development in South Africa.

BUT

First venture in South Africa to produce 50 MW electricity to the grid
Household coal use is estimated at 3% of total coal consumption, and an estimated 1 million households use coal as a household energy source, especially in winter.
From micro scale to coal face (UCG) possibilities
The problem with coal science……

Not Glamorous enough!(Academic Snobbism) !!!!
Coal publications hot topics – all coal science

Web of Science, filtered journal papers

Coal Processing, Coal ash Mineralogy, Fixed-bed gasification
(1) Who publishes on coal processing?

Web of Science, filtered journal papers

countries: USA, China, India, Poland, South Africa, Canada, Turkey, Australia, Russia
(1) Authors publishing on coal processing?

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(2) Who publishes on coal ash mineralogy?

Web of Science, filtered journal papers
(2) Authors publishing on coal ash mineralogy

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(3) Who publishes on fixed-bed coal gasification?

Web of Science, filtered journal papers
(3) Which organizations publish on fixed-bed coal gasification?

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(3) Authors publishing on fixed-bed coal gasification

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33rd INTERNATIONAL PITTSBURGH COAL CONFERENCE

08 – 12 August 2016

SOUTH AFRICA
Thirty Third Annual International
PITTSBURGH COAL CONFERENCE

Conference Announcement and Call for Papers

Abstracts Due 1 March 2016

8 – 12 August 2016
Cape Town, South Africa
International Convention Centre
Coal - Energy, Environment and Sustainable Development

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Thank you