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Clean Coal Technologies in South Africa

UN EWG CCS
10 & 11 Sep07
New York

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OVERVIEW



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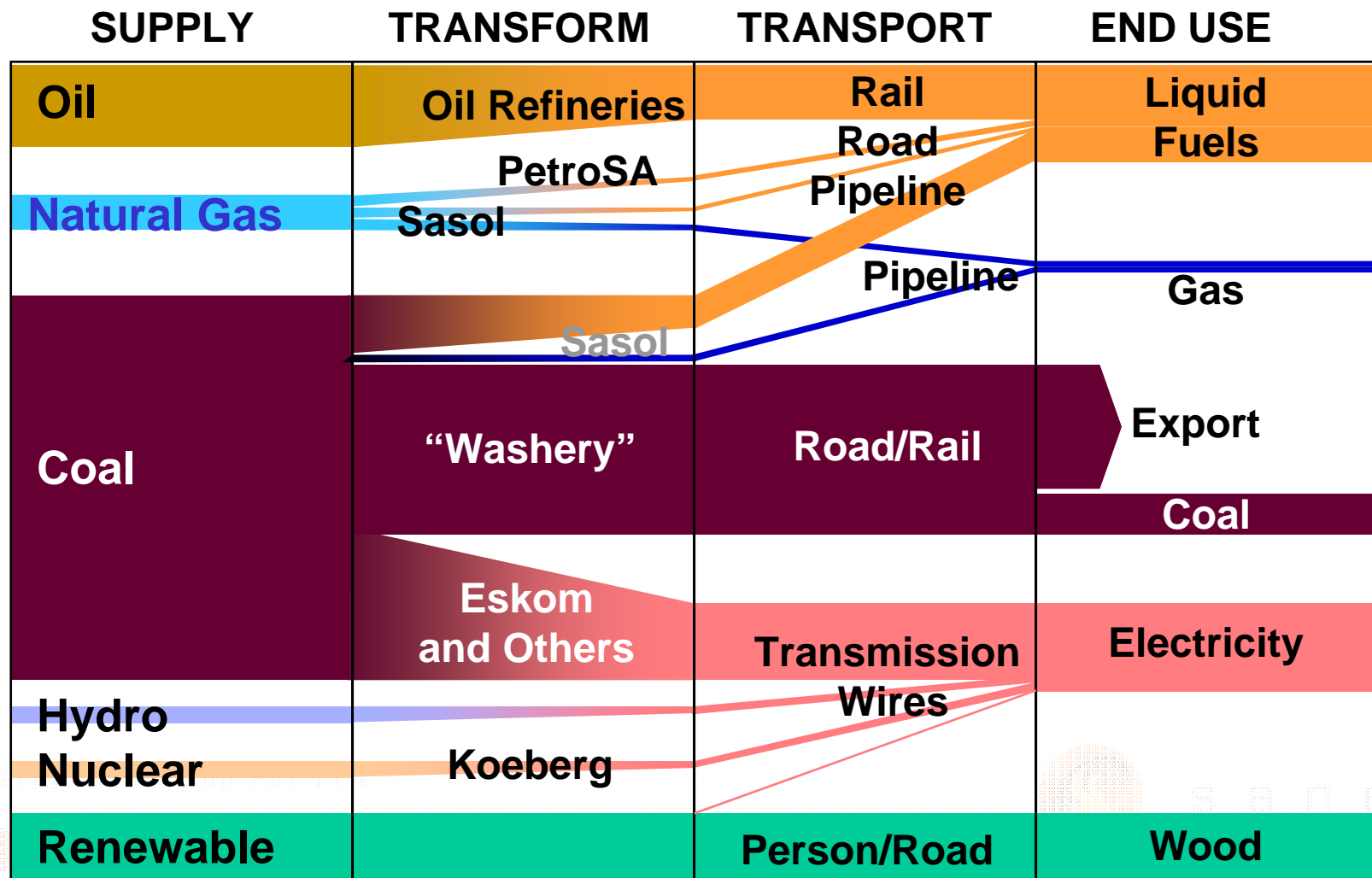
- 🔥 Energy Flows
- 🔥 Current & Future Electricity Capacity
- 🔥 Current & Future Liquid Fuels Capacity
- 🔥 Carbon Capture & Storage
 - 🔥 Other Clean Coal Technologies
- 🔥 South African National Energy Research Institute
- 🔥 Areas of Possible Co-operation
- 🔥 Summary

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ENERGY FLOW



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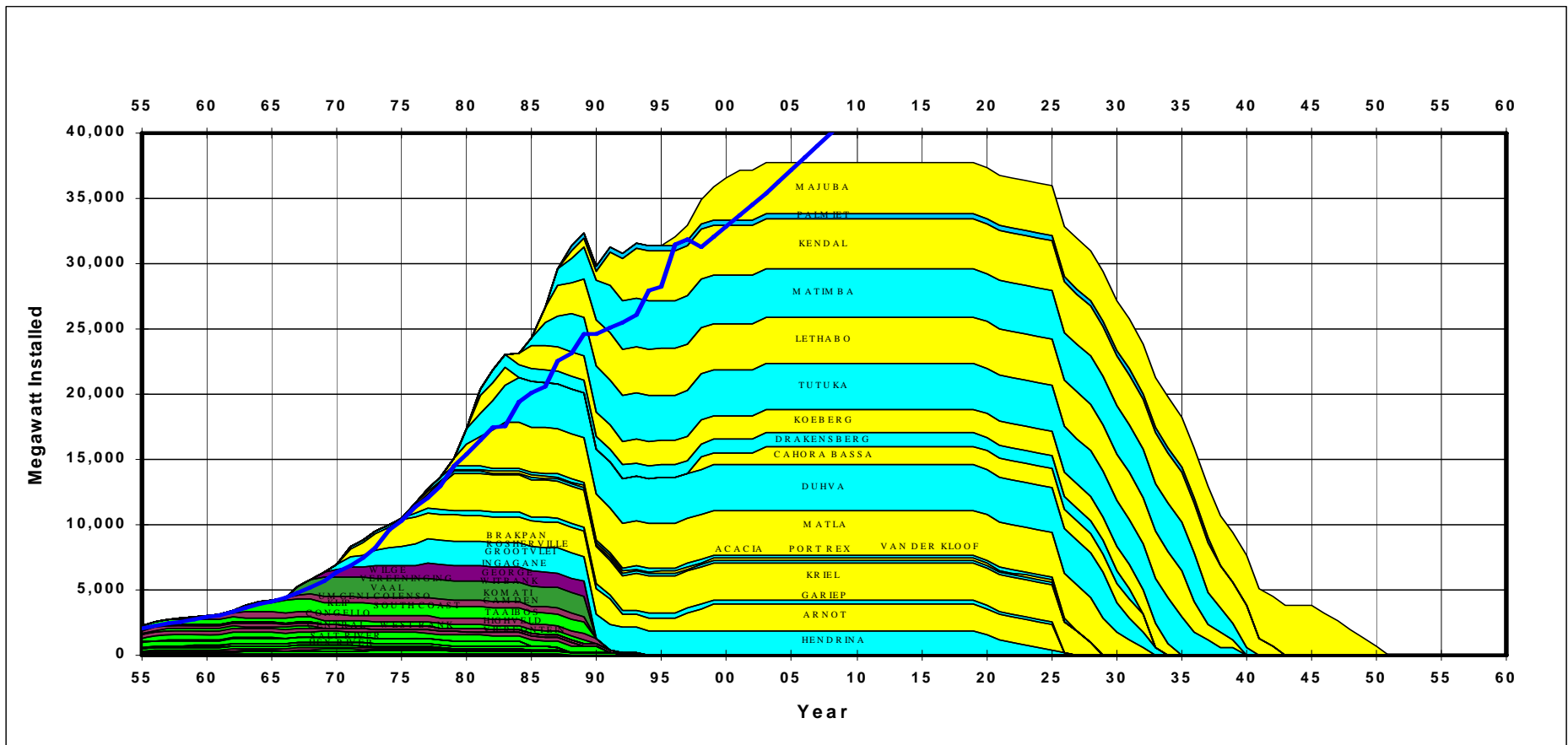
ELECTRICITY

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ELECTRICITY GENERATION CAPACITY



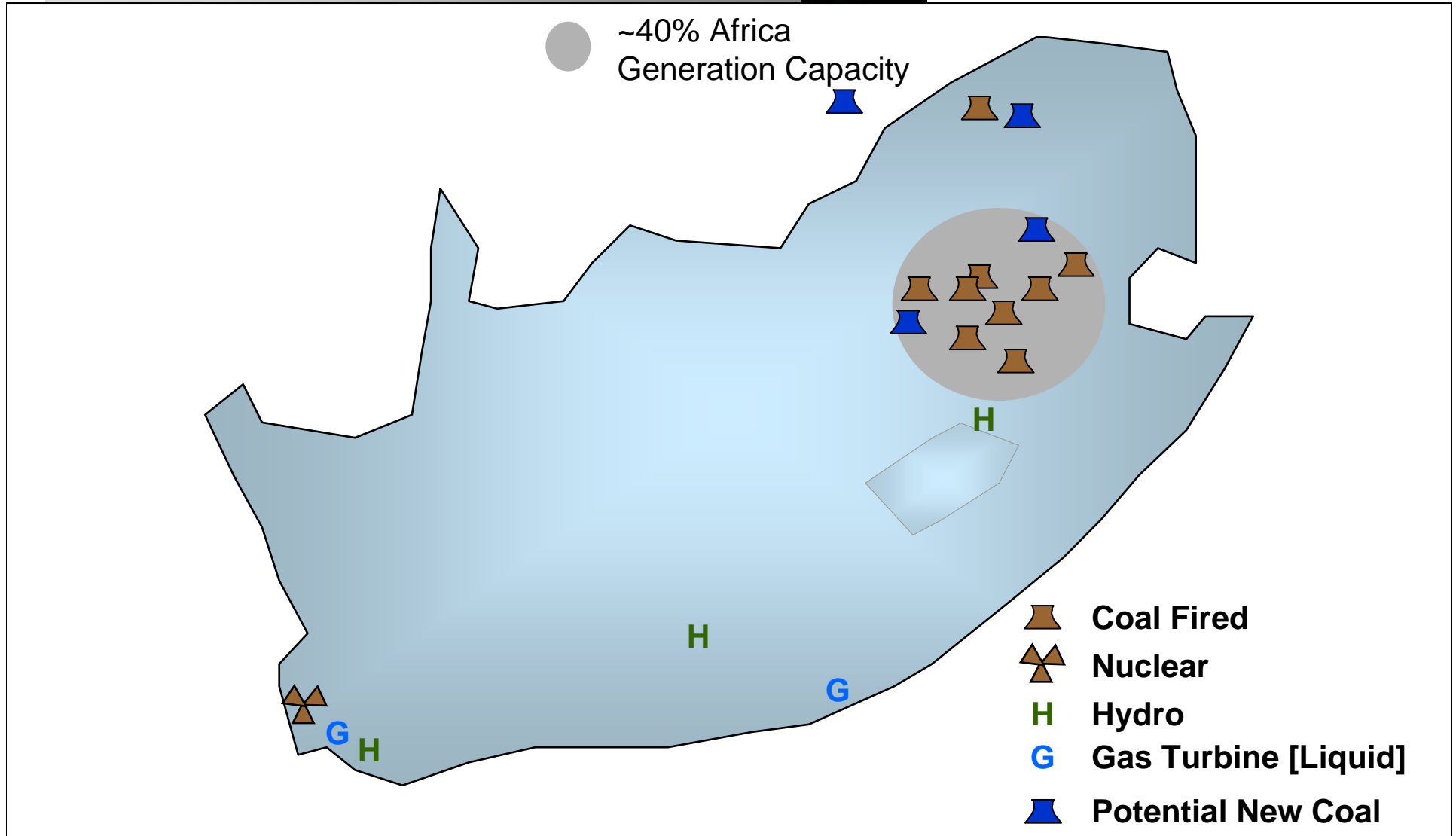
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Eskom [Electricity]



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NEW ELECTRICITY GENERATION STATIONS I





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Coal:

-  Super Critical Coal-Fired: Medupi plus three others under consideration
-  Underground Gasification
-  Return to Service of Coal-Fired Mothballed Plant

Nuclear:

-  Pebble Bed Modular Reactor
-  Pressure Water Reactor

Import:

-  Botswana – Mmamabula – Coal [~200Bt resources?]
-  Mozambique – Cahora Basa – hydro - current
-  Mozambique – Mepanda Uncua – hydro
-  DRC – Inga – possible

Energy  Namibia – Kudu Gas - possible

NEW ELECTRICITY GENERATION STATIONS II



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🔥 Renewable Energy:

- 🔥 Wind – Darling Wind Farm - ~13MW
- 🔥 Mini Hydro – eg Bethlehem
- 🔥 Mini Solar
- 🔥 Electricity Displacement; Solar Hot Water, LPG

🔥 Gas:

- 🔥 Gas Turbine;
 - LNG
 - Liquid
 - Coal Bed Methane

UNDERGROUND GASIFICATION First Flaring



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Eskom

-  20Jan07 First Flaring
-  Technology Provider: Ergo Exergy Inc (Canada)





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LIQUID FUELS

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REFINERY CAPACITY



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Facility	Barrels/day (Crude or equivalent)
Calref (Capetown: Caltex)	100 000
Sapref (Durban: BP/Shell)	180 000
Genref (Durban: Engen)	105 000
Natref (Sasolburg: Sasol/Total)	86 000
Sasol (Coal to Liquid)	150 000
PetroSA (Gas to Liquid)	45 000
TOTAL	666 000

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Current liquid fuel supply: ~40% synfuel.

NEW LIQUID FUELS



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🔥 **New Synfuel Plant:**

🔥 Sasol considering synfuel plant on Waterberg Coalfield

🔥 **Refinery Capacity:**

🔥 Green field

🔥 Brown field

🔥 No decision as yet

🔥 **Bio-Fuels:**

🔥 Bio-Fuel Strategy currently before government.



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CARBON CAPTURE & STORAGE

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CCS in SOUTH AFRICA



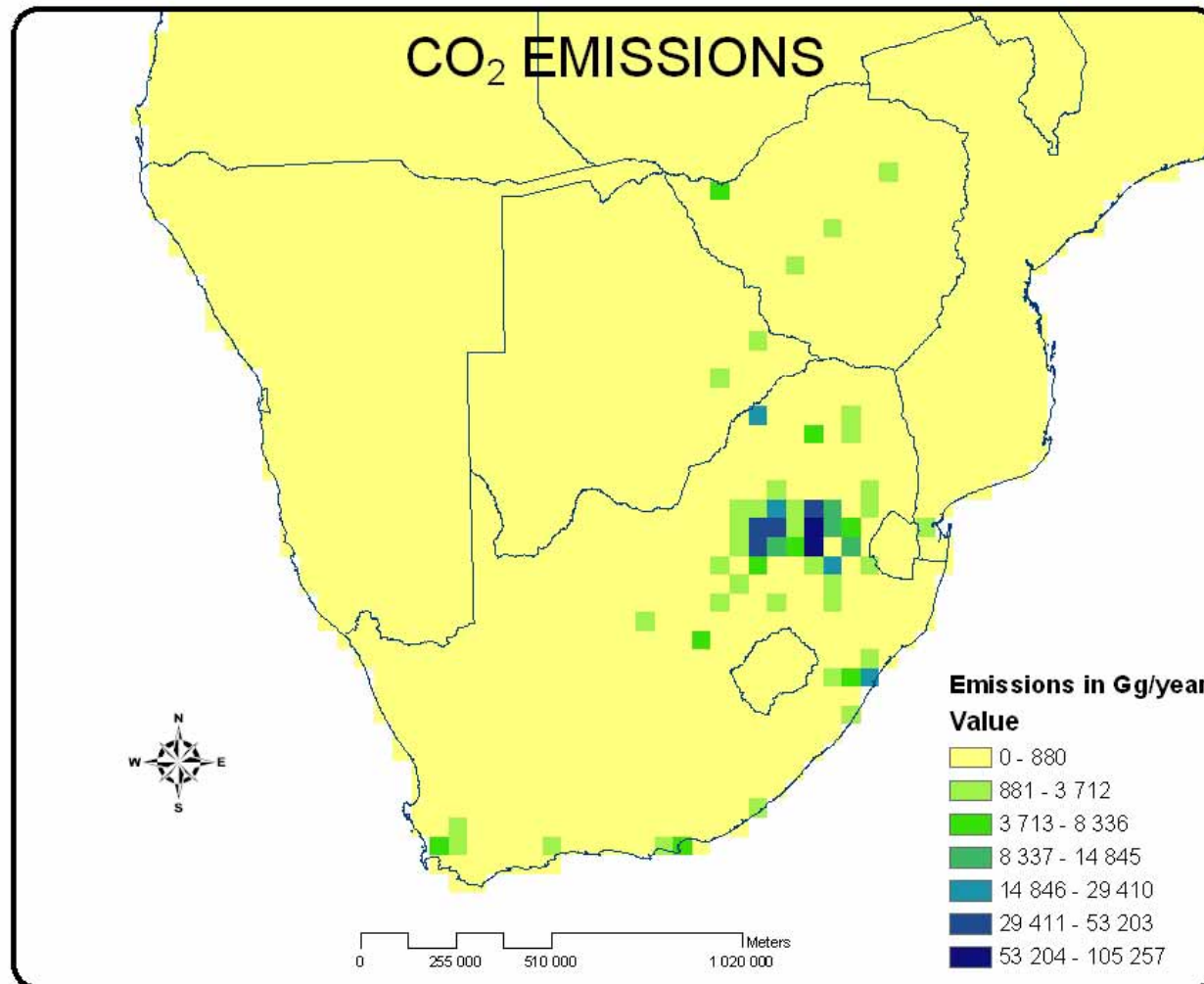
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- 🔥 South Africa is a Member of the Carbon Sequestration Leadership Forum
- 🔥 Processing Membership for IEA GHG
- 🔥 First Step:
 - 🔥 Is there potential for CCS in South Africa
 - If YES – then Undertake Next Steps
 - If NO – then Discard CCS as a Greenhouse Gas Mitigation Tool
- 🔥 First Step Indicated a Possible CCS Potential

CO₂ EMISSION CONCENTRATIONS



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CO₂ EMISSION QUANTIFICATION



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	Mt	% Emission		
SEQUESTERABLE				
Electricity	161	65	}	249 Mt 61 %
Industrial	28	11		
Other Energy	30	12		
Manufacturing	30	12		
NON-SEQUESTERABLE				
Waste	10	6	}	159 Mt 39 %
Agriculture	48	27		
Fugitive	42	24		
Transport	22	21		
Heat Production	37	21		
Total	408			

SYN-FUEL CO2 EMISSIONS



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Plant	Location	CO2 Source	CO2 Emitted (Mt/a)	CO2 Conc (%)
Sasol1	Sasolburg	Boilers & Heaters	7	10-15
		Gasifiers Downstream	4	90-98
SSF Sasol 2	Secunda	Boilers & Heaters	9	10-15
		Gasifiers Downstream	14	90-98
SSF Sasol 3	Secunda	Boilers & Heaters	9	10-15
		Gasifiers Downstream	14	90-98
			Total ~32Mt/y	~95%

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CCS CURRENT ACTIVITIES I



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- 🔥 Sasol Investigating **Enhanced Coal Bed Methane Recovery**
- 🔥 **Country Readiness** *[Enablers in place that will facilitate the implementation of a carbon capture and storage project]:*
 - 🔥 Identification and Characterisation of Sources
 - 🔥 Identification and Characterisation of Storage Sites
 - Terms of Reference being compiled
 - International expertise
 - Technology make-or-break
 - 🔥 Regulatory System – still to be addressed

CCS CURRENT ACTIVITIES II



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Country Readiness continued

 Plant Ready [Stationary Sources]

 Capacity Building:

– Technical Know-How;

- Membership CSLF, IEAGHG?
- Bi/Multi-Lateral Co-operation

– Human Capacity;

- CSLF Training Programme 2007 [USA] ~4 attendees
- IEA Training Programme [Germany] - [Bilal Patel]

– Public Outreach;

- FFF Workshop Jun07
- Journal/Newspaper Articles

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SA CCS PUBLICATION



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NSA - PUBLISHED

EXCLUSIVE
Impats commissions new Zimbabwe underground operation Page 5

FEATURES
Health & Safety in Mining Page 28

NEWS FOCUS
Côte d'Ivoire's coalition solving crisis, says Randgold chairperson Lillard Page 14

Creamer Media's

MINING WEEKLY

May 10-24 2007 Volume 13 no 18

CARBON CAPTURE

South Africa years away from being 'country ready' ▶ 8

ALSO PUBLISHER OF ENGINEERING NEWS AND POLITY

COVERSTORY

CLIMATE CHANGE CARBON CAPTURE & STORAGE

South Africa years away from being 'country ready'

Christy van der Merwe | Staff Writer

Carbon capture and storage (CCS) is currently high on the fossil-fuel agenda as a means of mitigating carbon dioxide (CO₂) emissions, which are seen as contributing to climate change. It is estimated that fossil-fuel combustion releases 26 gigatonnes of CO₂ into the atmosphere and many are proposing the capture of fossil-fuel carbon prior to its release into the atmosphere and its storage in permanent reservoirs as a way of stabilising future atmospheric CO₂ emission concentrations. But retaining hundreds of gigatonnes of carbon into permanent storage is a mammoth task, and to address the economic, environmental and social barriers associated with the widespread application of the CCS process, substantial research, technology development and regulatory projects will be required.

While South Africa's Department of Minerals and Energy (DME), in particular, has placed CCS on the agenda, DME deputy director of coal **Heriberto Kghomo** cautions that the country is not in an unconditioned position as developing countries when it comes to investing in CCS research and development, given its social priorities. Kghomo forecasts, however, that "over time, South Africa will be more involved".

Mamohlele, government representatives and industry stakeholders are being encouraged to attend conferences on the subject and South Africa will host the upcoming 2008 Carbon Sequestration Leadership Forum (CSLF), where the central CSF issue will be described out.

South Africa's joining the CSLF is a means of keeping the country abreast of technology it may have to use in the future.

Of the 22 CSLF-regimented CCS projects currently in place globally, most are for enhanced oil-field recovery. But two notable projects for non-emission coal-fired power plants are the **Prattville** project in the US, which expects full-scale emission-mitigating operations starting in 2012, and the **Zenon** project in Australia, which expects plant operation as early as 2011.

"What South Africa can do," explains South African National Energy Research Institute senior manager **advised fossil fuel use Dr Tony Sarridge**, "is to concentrate on becoming 'country ready'."



TONY SARRIDGE

What South Africa can do to concentrate on becoming 'country ready', so that if CCS does become more affordable, proves to meet sustainability aspects and is accepted as a clean development mechanism, it can be implemented in the country.



PETER BEATTIE

The potential to capture and store up to 420 000 t of CO₂ a year would be equivalent to taking 81 000 cars off the road for the same period, and would also create about 700 jobs in the construction phase and 100 permanent jobs during operation.



PHILIP LLOYD

Pre-combustion, which turns the fossil fuel into hydrogen, is at the heart of the Sarridge process and they know more about it than anyone [else] in the world. For these reasons, South Africa could be leaders in the implementation of this technology.

In that way, CCS can be implemented should it become more affordable, meet sustainability aspects and be accepted as a Clean Development Mechanism (CDM), which the South African Climate Action Network (Sancan) is opposing.

Sarridge sees 'country readiness' as involving various steps:

- Firstly, the identification of regulatory gaps is needed. While South Africa has adequate legislation governing the removal of carbon from the earth, it has no legislation governing putting it back into the earth. An update of the energy White Paper will thus be required. Worldwide, countries are faced with gaps in legislative and gap studies and analyses are a major challenge under scrutiny at present.
- Secondly, the identification of the potential sources of CO₂ will be needed, as well as

identification of appropriate technologies to sequester that CO₂.

Thirdly, identification of potential storage sites needs to take place. Initial investigations into potential storage sites in South Africa shows that they would be quite a distance from capture sites, since the most significant capture sites are in the Witbank and Mpumalanga areas. Because identification of storage sites involves a process similar to that used when undertaking exploration drilling to search for oil, South Africa already has a vast amount of geographical knowledge of the potential for storage sites. Also, monitoring and verification of the integrity of storage sites need to be addressed.

"We are still quite a few years away from being 'country ready', and we still have a lot more work to do. This is one of the main

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OTHER CLEAN COAL ACTIVITIES



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- 🔥 Coal Fired Electricity:
 - 🔥 Super-critical
 - 🔥 TSP/SOX/NOX
- 🔥 Efficiency Measures
- 🔥 Coal/Gas to Liquids
- 🔥 Gasification
- 🔥 Fluidised Bed Gasification
- 🔥 Coal Bed Methane
- 🔥 Basa njengo Magogo

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BASA NJENGO MAGOGO



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*My fire works best,
in 5 easy steps!*



Spare the environment. Spare your health.

- gives less smoke
- burns longer
- Heats quicker
- is much safer



The Department of Minerals and Energy



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SANERI ORIGIN



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- 🔥 **Establishment Directed by Cabinet**
 - 🔥 Increase energy research and development in South Africa
 - 🔥 Increase human capacity in energy research
- 🔥 **Established Third Quarter 2006**
- 🔥 **Established as a company in the CEF Group**
 - 🔥 CEF formed under the Central Energy Fund Act of 1977
- 🔥 **Senior Managers Appointed Dec06**
- 🔥 **Priorities:**
 - 🔥 Develop human capacity
 - 🔥 Undertake in-house research [main function]

THEMATIC AREAS



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- Energy Infrastructure Optimisation
- Energy Efficiency and Demand Side Management
- Impact of Energy Use on the Environment
- Use of Energy to Stimulate Socio-Economic Development
- Cleaner Fossil Fuel Use (including clean coal)
- Renewable Energy
- Alternative Energy Sources (including fuel cells and hydrogen)
- Energy Planning and Modelling
- Energy Policy Research

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ACHIEVEMENTS

Research Projects



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Contract Research Funding

 Call for proposals issued during October 2006

 1st phase review (one pagers)

- 148 projects proposed, totalling R4.5 billion
- 78 projects, totalling R203 million identified as immediate projects

 2nd phase review

- 72 projects reviewed with revised budget of R84.7 million
- **Only 41 projects, totalling ~R49 million supported, due to funding limitations only**

ACHIEVEMENTS

Bursaries



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- 🔥 Call for applications 2006
- 🔥 More than 50 applications received
- 🔥 Awarded:
 - 🔥 10 Masters Studies Bursaries
 - 🔥 15 Doctoral Studies Bursaries

ACHIEVEMENTS

Research Chairs I



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Chairs

 Clean Coal Technologies – Wits

– NWU supported to develop Associate Chair

 Bio-Fuels – Stellenbosch

Associate Chairs

 Bio-Fuels – Stellenbosch

 Bio-Fuels – NWU [Potch campus]

ACHIEVEMENTS

Research Chairs II



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Future Chairs

Call for Chairs in Progress

- Energy Efficiency
- Fuel Cells
- Clean Household Energy
- Hydrogen Economy

 Finalisation expected soon

Hub & Spoke

 Renewable Energy - Stellenbosch

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CO-OPERATION

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POSSIBLE AREAS OF CO-OPERATION



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🔥 Carbon Storage Atlas:

- 🔥 Council for GeoScience has Southern Africa geological expertise.
- 🔥 Need expertise regarding the peculiarities of carbon storage.

🔥 Coal Road Map:

- 🔥 Co-operative Initiative between;
 - Department of Minerals and Energy
 - Industry
 - Fossil Fuel Foundation

🔥 “Wrinkles” of persons who have done it before.

🔥 Methane to Markets Workshop [cFeb 2008]:

- 🔥 Fossil Fuel Foundation workshop to address the regulatory issues and hurdles that inhibit the movement of methane to markets.
- 🔥 International speaker to address regulatory gaps and how they were overcome.

🔥 Identification of CCTs

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SUMMARY



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- **South Africa has Coal Based Energy Economy**

- Coal only current economic energy reserve

- **Undertaking Coal Energy Diversification:**

- Renewables: 10,000 GWh by 2013

- Bio-Fuels

- **Clean Coal Technologies:**

- Super-Critical

- Underground Gasification

- Carbon Capture & Storage

- Other

- Efficiency Increases – 12% by 2014

- **Coal/Gas to Liquids**

- **South African National Energy Research Institute:**

- Newly formed

- Creating human capacity

- Eventually in-house research



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END

THANK YOU

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