South Africa's Carbon Capture Utilisation and Storage Project

Council for Geoscience 09/09/2021



mineral resources & energy

Minerals Resources and Energy REPUBLIC OF SOUTH AFRICA A proud entity of the Department of Mineral Resources and Energy

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About the CGS – Principles

- The Council for Geoscience is established under the Geoscience Act, Act 100 of 1993, as amended, and is the mandated authority of all geoscientific data and information in South Africa;
- In addition, the Council for Geoscience is listed as a Schedule 3A Public Entity in terms of the Publica Finance Management Act, Act 1 of 1999;
- The Council for Geoscience's operations are enshrined within the principles of the National Development Plan and the Strategic Development Goals;
- These are exclusively focussed toward the improvement of society through innovative geoscience solutions;



The South African energy landscape

The SA energy landscape – Energy generation

- South Africa is one of the largest energy-producers in Africa;
- More than two-thirds of energy generation capacity is developed from the country's vast coal resources;
- Most of the coal-fired energy generation is produced within the Mpumalanga Province;
- Many of these energy generation plants are planned for decommissioning in the next 5-10 years;

Eskom power stations Base load station: ZIMBABWE 2 352MW 7 Lethabo 3 708MV 1 Arnot Musina 2 Duvha 3 600MW Majuba 4 110MW 8 Coa Just over 55 000MW per day will be 3 Hendrina 2000MW 9 Matimba 3 990MW Legend available if everything works 4116MW 10 Matla 3 600MW 4 Kendal LIMPOPO 6 Kriel 3 000MW 11 Tutuka 3 654MW Coal-fired (Operating) 55 000MW Coal-fired .Lephatale Nuclear 5 Koeberg 1940MW Tzaneen 30 000MW Coal-fired (New build) Phalaborwa At this stage, Eskom is struggling to **Return-to-service stations** Nuclear Polokwane reach the 30 000MW per day mark Thabazimbi 12 Camden 1 510MW Hydroelectric 1 200MW 13 Grootvlei BOTSWANA Bela-Bela MPUMAI ANGA Pumped storage scheme Coal 14 Komati 940MW Nelspruit Gas turbine Pretoria Witbank Peak demand stations National grid Johannesburg Hydroelectric Wind Facility NORTH WEST TO B 15 Gariep 360MW 16 Vanderkloof 240MW Concentrating Solar Power Standerton 12 Hydroelectric (Distribution) 10 10 d storage scheme 1 000MW 17 Drakensberg Volksrust 400MW 18 Palmiet Newcastle Welkom . KWAZULU-NATAL NAMIBIA 19 Acacia 171MW Oranjemund Ladysmith FREE STATE 20 Port Rex 171MW Upingtor Bergville 21 Ankerlig 1 338MW **Richards Bay** 746MW 22 Gourikwa Bloemfontein • Pietermaritzburg Kenhardt Renewable energy Durban Springbok Kleinsee Wind Facility 23 Klipheuwel NORTHERN CAPE 3MW De Aar. Port Shepstone Wind Facility Mthatha • New builds 27 • Vredenda **Beaufort West** 4788MW 24 Medupi 02 4 800MW 26 Kusile EASTERN CAPE d storage scheme Saldanha 🚬 🗾 🚔 25 Ingula 1 332MW Distribution WESTERN CAPE East London Wind Facility Hydroelectric George 29 First Falls 6MW Grabouw 27 Sere Wind Facility 100MW Cape Town • 11MW Port Elizabeth 30 Second Falls 42MW 31 Colley Wobbles Mossel Bay Sol 32 Ncora 2MW Cape Agulhas 28 Concentrating These hydroelectric power stations are Solar Power 100MW used to stabilise the distribution network Source: Eskorr in the Eastern Cape Graphics24

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The SA energy landscape – Coal resources

- South Africa is one of the world's largest coal producers and still has significant coal resources;
- The vast majority of these coal resources are currently developed in the Mpumalanga and Limpopo Provinces, with the largest producer being the Mpumalanga Province;
- These coal resources and the associated downstream petrochemical industries form a key contributor toward the development imperatives;



The SA energy landscape – Energy society nexus

- The coal and associated petrochemical industry will still form a key component of South Africa's medium to long-term developmental imperatives;
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Table 9: Jobs created by the coal industry in the rest of the economy (2015) **Primary Industries** 1,953 Agriculture, forestry and fisheries 181 Mining and quarrying 1,772 Secondary industries 48,779 Manufacturing 42,701 Petroleum, chemical, rubber, plastics 16,881 Electricity 5,073 **Tertiary industries** 154,064 Transport and storage 119,558 Other 34,506 222.892 Total Less imported element 49,799 Net jobs created 173,093

The SA energy landscape – Mpumalanga's economy

- Within Mpumalanga, the largest economic driver is the mining and manufacturing industries;
- These are largely linked to the coal and associated industries;
- There are however opportunities in other industries, e.g., agriculture;
- The balance is critical to maximise these opportunities;

Economy of South Africa's nine provinces



The SA energy landscape – CO₂ emissions

- Long-term usage of coal has made South Africa one of the largest rate of CO₂ emissions in the world;
- The South African Government has however committed to reducing CO2 emissions by up to 50% in the next 10 years;
- However, there is a significant socioeconomic requirement on



coal and therefore the reduction must take a sustainable approach;



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South Africa

carbonbrief.org

The SA energy landscape – Just Transition

- South Africa will shift toward a low-carbon economy, however will need to do so in a sustainable manner;
- Social, economic and environmental considerations must be balanced to ensure a thorough Just Transition;
- Innovative solutions are needed to enable this sustainable transition;
- Carbon Capture, Utilisation and Storage provides such a possible solution. In particular, within areas with a large coal reliance, such as Mpumalanga;

South Africa is the world's 14th largest emitter of greenhouse gases.

The country's energy system depends heavily on coal, though recent policy turns have signalled a possible a major shift towards renewables and gas.

South Africa has ratified the Paris Agreement and has pledged to peak emissions between 2020 and 2025, before reducing them in the 2030s.











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SASOL Securida is a vast coal-to-fuels and chemical plant located in South Africa. The facility issues 56.5 million tons of gases.



 An assessment of available geological data shows the availability of deep coal seams and potential CO₂ storage reservoirs can support CCUS development in the Mpumalanga Province;



Opportunities for Utilisation

- There are a number of possible industrial and chemical industries that can use the captured CO₂. These are largely linked to currently available industries and may influence additional economic development;
- Furthermore, captured CO₂ can be used of Carbon-Offsetting where Carbon credits may be used for additional ۲ economic development;
- Importantly, CO2 can also be used to remediate the long-term negative effects of mining, including assisting in various agricultural needs; Construction Materials Fuel New materials
 - Cement and concrete Asphalt
 - Aggregate
 - Timber/super hardwood

- · Synthetic (methanol, butanol,
- natural gas, syngas, etc.) Micro-algae fuel
- Macro-algae fuel

- Carbon fiber
- Carbon nanotubes and fullerenes
- Graphene

Chemicals

- Preservatives (formic acid)
- Medicinal
- Antifreeze (ethylene glycol)
- Carbon black
- Many more

Industrial gas & fluids

- Enhanced oil recovery
- Enhanced coal bed methane recovery
- Enhanced water recovery
- Semiconductor fabrication
- Power cycles



Polymers

- · Polyurethene foams
- Polycarbonate (glass replacement)
- Acrylonitrile butadiene styrene
- Many more



Biochar, bio-pesticides, bio-cosmetics

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Opportunities for Utilisation- Acid Mine Drainage

- Application CO₂ mineralisation to treat acid mine drainage. Mineral carbonation could be applied strategically in the <u>ex situ</u> treatment of mine water in South Africa, with the <u>four-fold holistic purpose</u> of :
 - o Sequestering CO₂ for climate change mitigation,
 - o Treating mine water for environmental pollution management,
 - o Producing high-quality water from mine water for various uses (e.g. irrigation, livestock, recreational, industrial, or even domestic uses) and long-term water resource sustainability, and
 - o Reducing the volumes of mineral waste residues for reduced residue management cost, reduced environmental pollution risks, and possible land reclamation.



Opportunities for Utilisation- Fertilizer production





Location: Cimalux site at Rumelange (Luxembourg)



Take-home message

- 1. Hydrocarbons are important for current and future socioeconomic development;
- 2. South Africa will use it's natural resources for continued development;
- 3. Mpumalanga relies heavily on the hydrocarbon sector;
- 4. South Africa will reduce CO2 emissions and focus on environmental sustainability;
- 5. CCUS provides a solution for this Just Transition;
- 6. The CGS will work toward implementing this technology;
- The CGS aims to develop a pilot CCUS site in Leandra;
- 8. All focus is toward social, economic and environmental sustainability;





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