CASE STUDY: UNEXPECTED INTERGOVERNMENTAL COLLABORATION LEADS TO COAL ASH AMELIORATION OF SEWAGE IMPACTED SOIL DURING COVID-19

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Who is SANEDI?

Department of Electricity and Energy

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South African National Energy Development Institute

- Technology RD&I
- Policy Information
- Data Management
- Thought Leadership
- Capacity Building
- Project Management
- Demonstration & Pilot Projects

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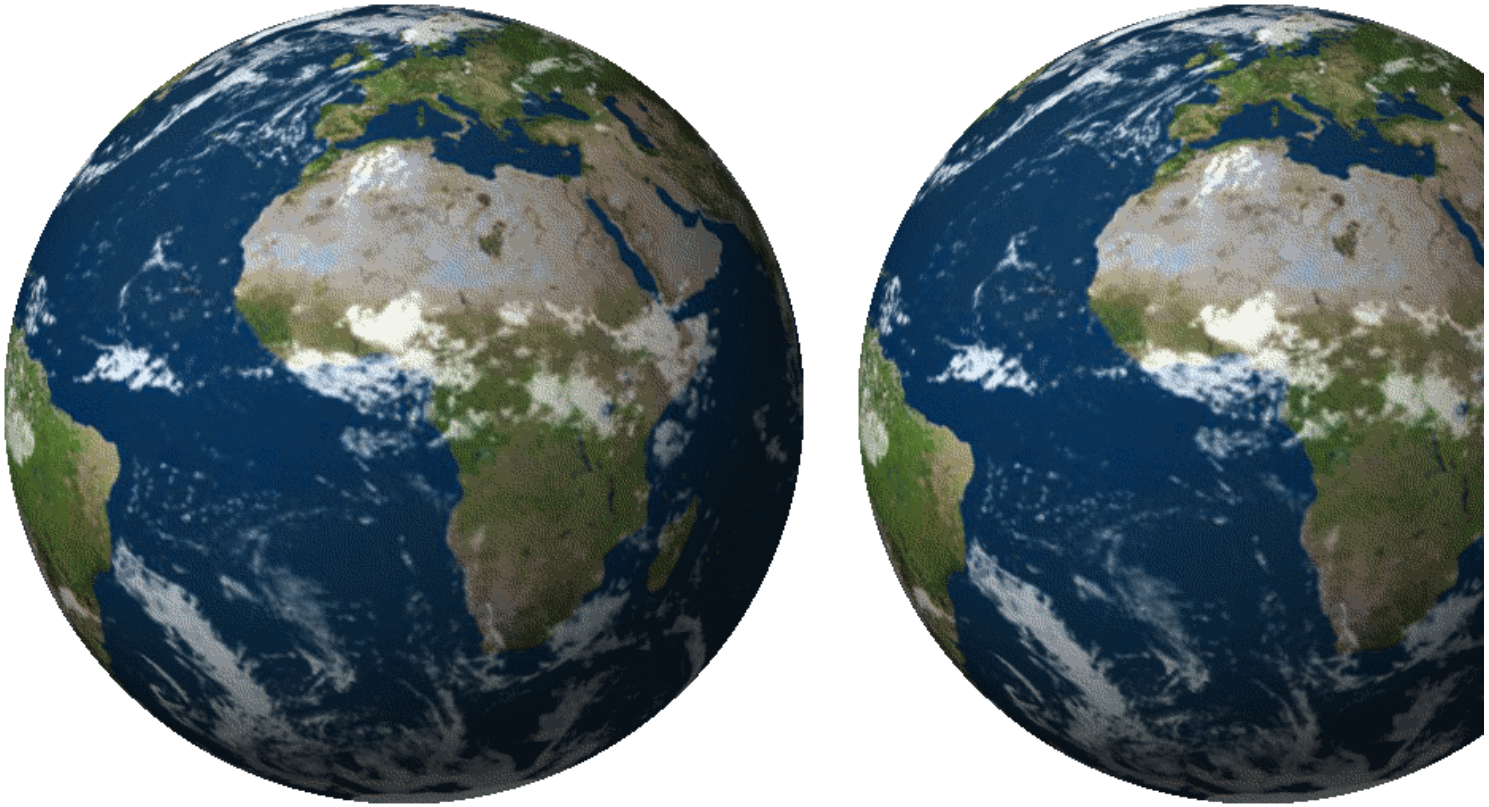
Current Global Scenario

We are currently using the resources of 1.7 planet Earths



Climate Change

Hotter temperatures
Increased drought

More severe storms
A warming, rising ocean

Glaciers shrinking
Loss of species

Not enough food
Poverty & displacement

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South Africa

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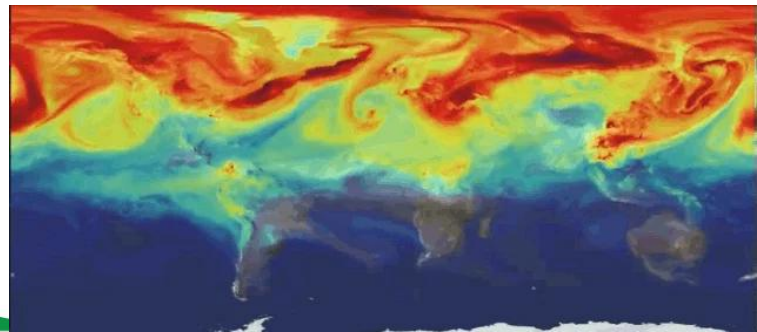
“South Africa’s coal reserves are estimated at 53 billion tonnes and with our present production rate there should be almost 200 years of coal supply left.”

Eskom Fact Sheet August 2021

South Africa is….

- Responsible for 1.9% of global Green House Gas (GHG) emissions
- The highest GHG emitter in Africa
- Home to the largest point source of CO_2 emission in the world

Fossil Fuel Based Energy System



Basic Coal Industry Facts

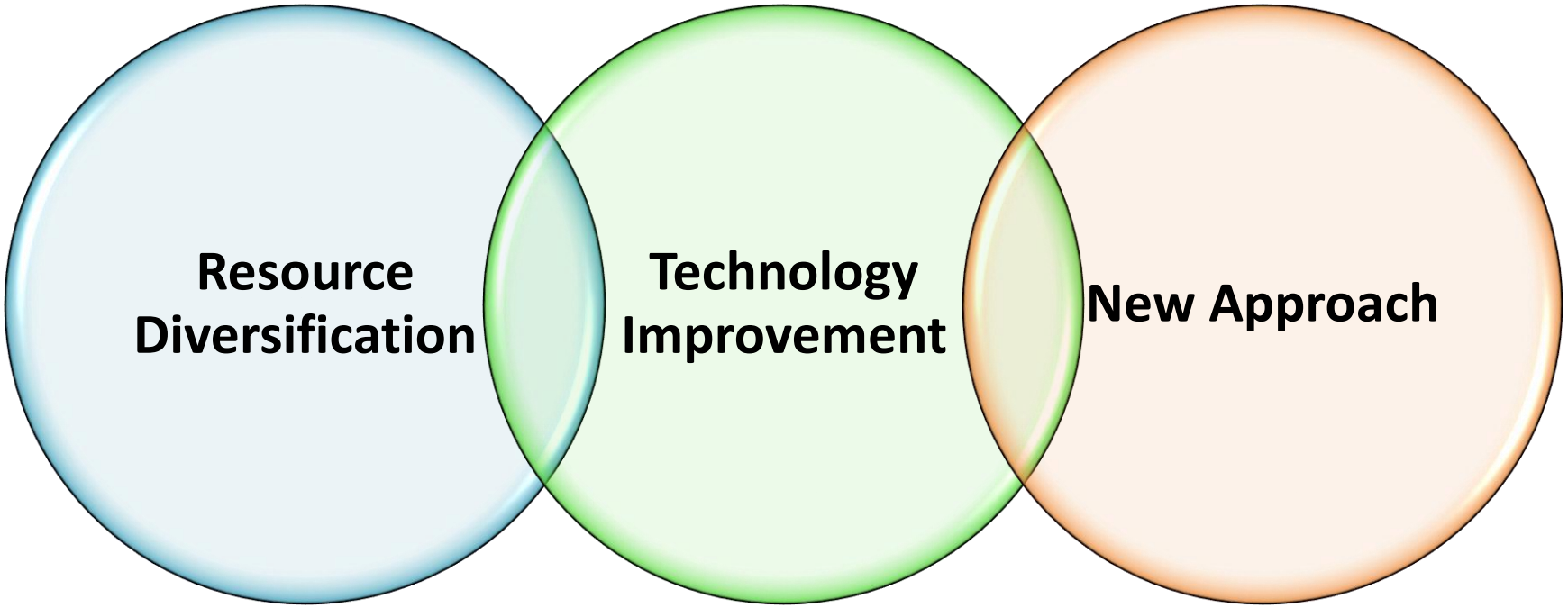
- Approximately 77% of South Africa's energy needs are directly derived from coal
- South Africa is the 5th largest exporter of coal in the world, with 30% consumed overseas
- 92% of coal consumed on the African continent is produced in South Africa
- 80% of South Africa's CO_2 emissions come from energy supply that is dependent on coal
- 248 Mt of saleable coal produced in 2020
  - Highest revenue earner, contributing 21.4% (R130.57 billion) of total mining revenue (R608.99 billion)
  - Generated 10.13% (R45.55 billion) of total foreign exchange earnings (R449.83 billion)
  - Third largest employer in mining industry, directly employing 89.5k people

Effects of all this on SA…

- International uptake of manufactured goods
  - Amount of content in packaging
  - Tax cost > C footprint
  - Emitter bears cost > economic impact
- Effect
  - Industry impact > stranded assets
  - Resulting electricity price impact > effects all
  - International competition > CBAM
  - Job losses
  - Economic downturn

Energy System Resilience

- Since coal is such an important energy and economic component for SA how do we extend its life expectancy, efficiency and emissions mitigation potential?



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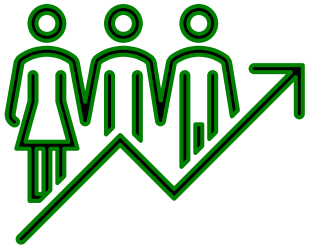
Case Study:

Using Energy Byproducts to Support Environmental Rehabilitation

An Unlikely but Logical Partnership

- A collaboration between SANEDI, Eskom Holdings and the Department of Defence, mitigated a potential health threat caused by a spill of raw human sewage from informal ablution facilities at a temporary Covid-19 support station



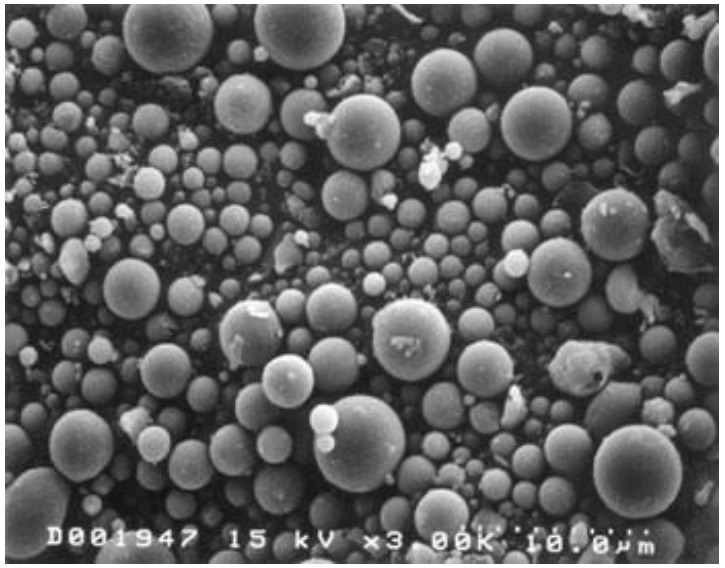
- Before this could become an ecological issue, the quick-action and teamwork of these three partners remediated the situation through the use of a unique approach in environmental amelioration

The Details

- Raw sewage spill occurred between 1-28 July 2020 into a grassland
  - Lephalale, Limpopo in South Africa
  - Human excreta carries seeds of exotic plants due to dietary intake
- Impacted area mainly used for recreational purposes (physical sport and training exercises)
- Military utilisation: imperative area remains as was before sewage spill incident occurred (relating to basal cover and soil pH)
- Existing grass cover (Cynodon dactylon – “kweek grass”) should remain vigorous and intact to ensure alien plants do not establish in the area.
- Spill presented
  - Potential health hazard
  - Potential negative ecological impact
- Required immediate remediation to limit possible spread of disease

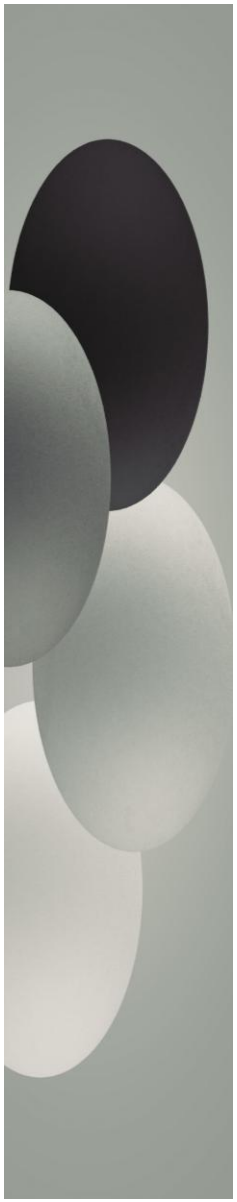
The Books and the Plan…

- Historical research indicates sewage sludge soil contamination can be pasteurised by a pH-driven process
- Addition of a coal ash improves:
  - Structure
  - Fertility
  - pH
  - water holding capacity
- Coal ash reactivity
  - Known pasteurising ability
  - Soil health benefits
- Expectation
  - Sewage spill rapidly ameliorated
  - Organic compounds from the sewage and coal ash trace elements absorbed into the soil



The Ash Selection…

- Ash produced at Medupi Power Station
  - Generated from a single coal source, offering ash of uniform quality and consistency
  - Power station operates supercritical boilers, higher temperatures and pressures than conventional coal-fired power stations
  - Lower volume of coal is required to generate equivalent power output, leading to lower carbon dioxide emissions
  - Ash produced contains a higher amorphous (glass) phase, causing it to be more reactive to both carbon and water (increased pozzolanicity)
- Effectively, once placed into environment, ash dissolves and releases components more readily, therefore a more rapid remediation response
- Coal ash
  - Inorganic elements contained in parent coal plus several trace elements required for plant growth
  - Main elements for healthy, sustained plant growth include: aluminium, silica, iron, calcium, small amounts unburnt carbon



Raw Materials…

The Action…

- Rapid solution was required
- Six tons of fresh “run-of-station ash” were secured from Medupi Power Station and applied to the affected area on 28 July 2020
- Ash was spread on soil surface and into gully formed through liquid sewage runoff
- Seasonal photographs taken over the subsequent years to visually track the environmental rehabilitation progress
- Potential health threat immediately neutralised through the high pH pasteurisation ability of the coal ash
- Over ensuing six months, ash was incorporated into soil through natural weathering processes and grass cover remained healthy and pristine
- Within 12 months, no evidence of sewage spill and little ash remained, having been covered with robust grass growth

Ash Application

Ash applied on soil/spill surface (28 July 2020)

Ash at nine weeks after application, grass growth is beginning

The Result…

- Visible biological indicators of the soil health, such as the dark green colour of the grass layer as well as bird and insect activity in the area, were clear signs of the rehabilitation of the impacted area
- October 2021, area deemed successfully rehabilitated, displaying enriched flora/grass layer, healthy activity of various interactions between all-natural role-players within a balanced diversity
- Area recovered to former condition having no odours or sludge detectable
- Scientifically proven in other studies, soil with slightly higher lime content (pH), improves the palatability and nutritional value of plants
- Although this was not evaluated, it can be assumed to have occurred in this instance
- Collaboration between government entities has proven teamwork and swift action benefited the community and environment

4 Months and 7 Months…

Affected area seven months after ash amelioration during summer (February 2021)

At four months, ash has begun to naturally incorporate into the soil, grass cover is returning (November 2020)

11 Months and 16 Months…

Showing seasonal surface growth rehabilitation of the area at 11 months after application and during winter (May 2021)

October 2021 showing complete rehabilitation

February 2025

Success

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