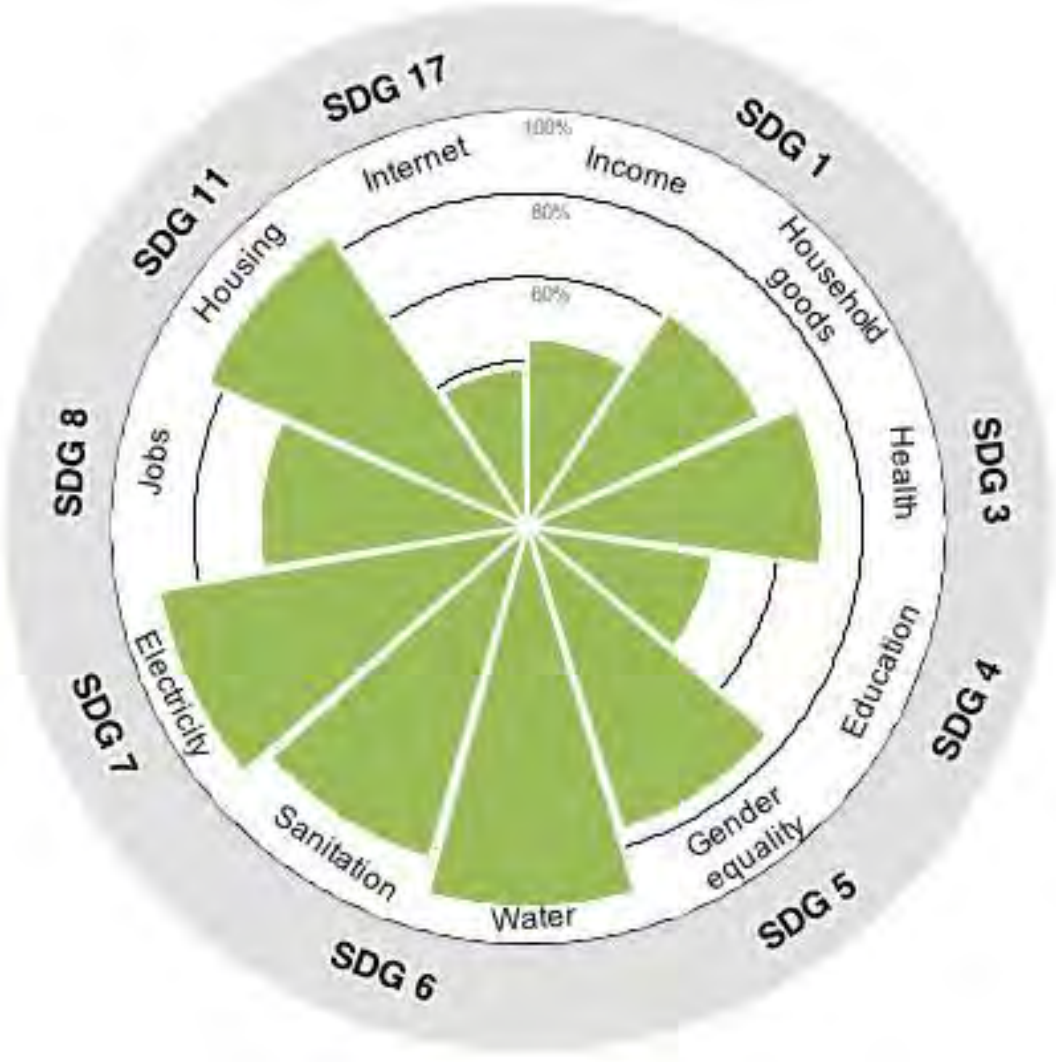
COAL MINE LEGACIES AND THE JUST TRANSITION

TOWARDS REGENERATIVE POST-COAL FUTURES IN MPUMALANGA, SOUTH AFRICA

Jennifer Broadhurst (MtM), Shilpa Rumjeet (CeBER),
Bernard Kengni (MLiA)

November 2022

Socio-economic well-being of coal mine host communities in Mpumalanga



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Original article

Mapping and classification of mining host communities: A case study of South Africa

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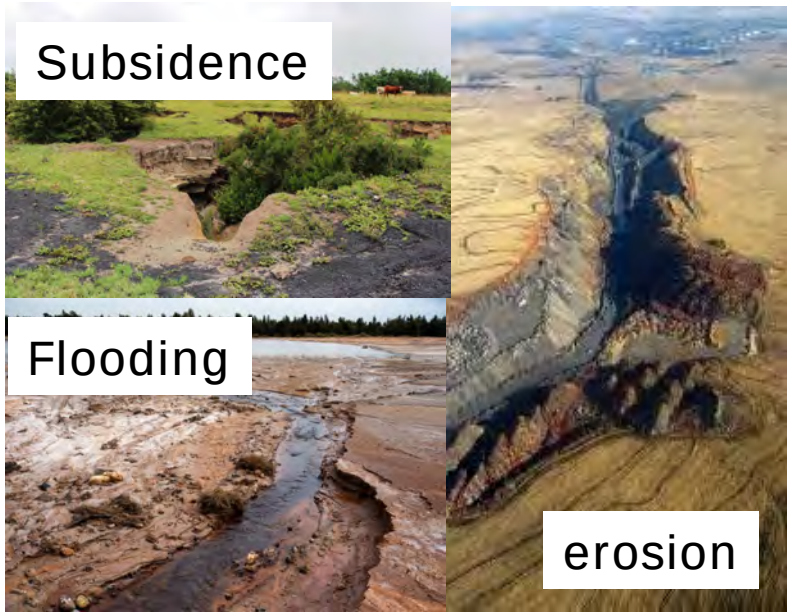
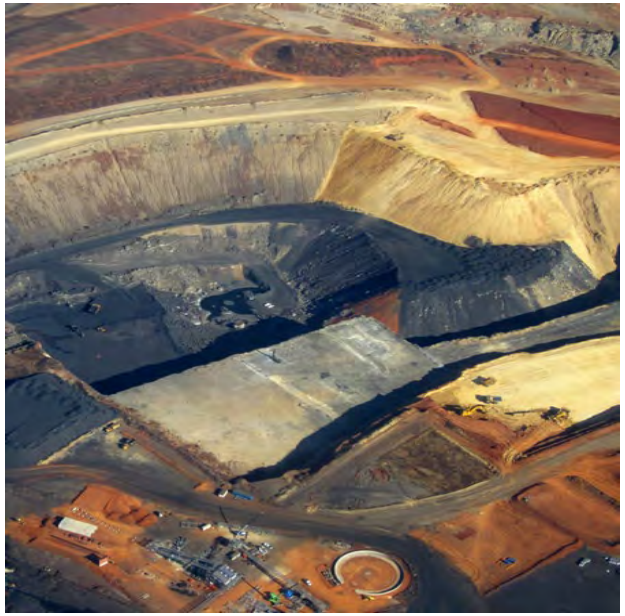
Measuring the sustainable development goals (SDGs) in mining host communities: A South African case study

Megan J. Cole [a,b,*], Jennifer L. Broadhurst [a]

Degraded Land

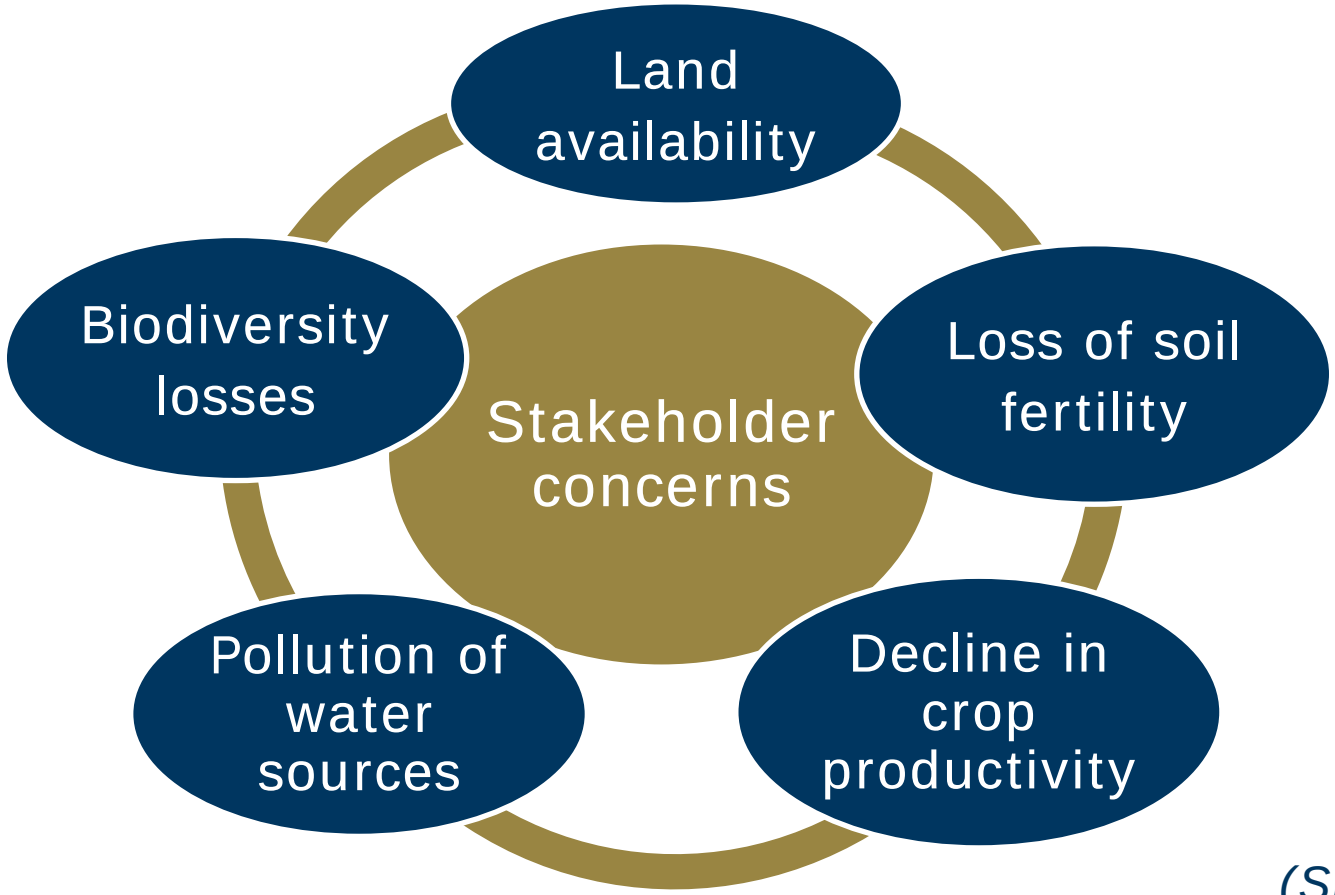


Mining Operations



Waste Piles

Emissions



(Shongwe, 2018)

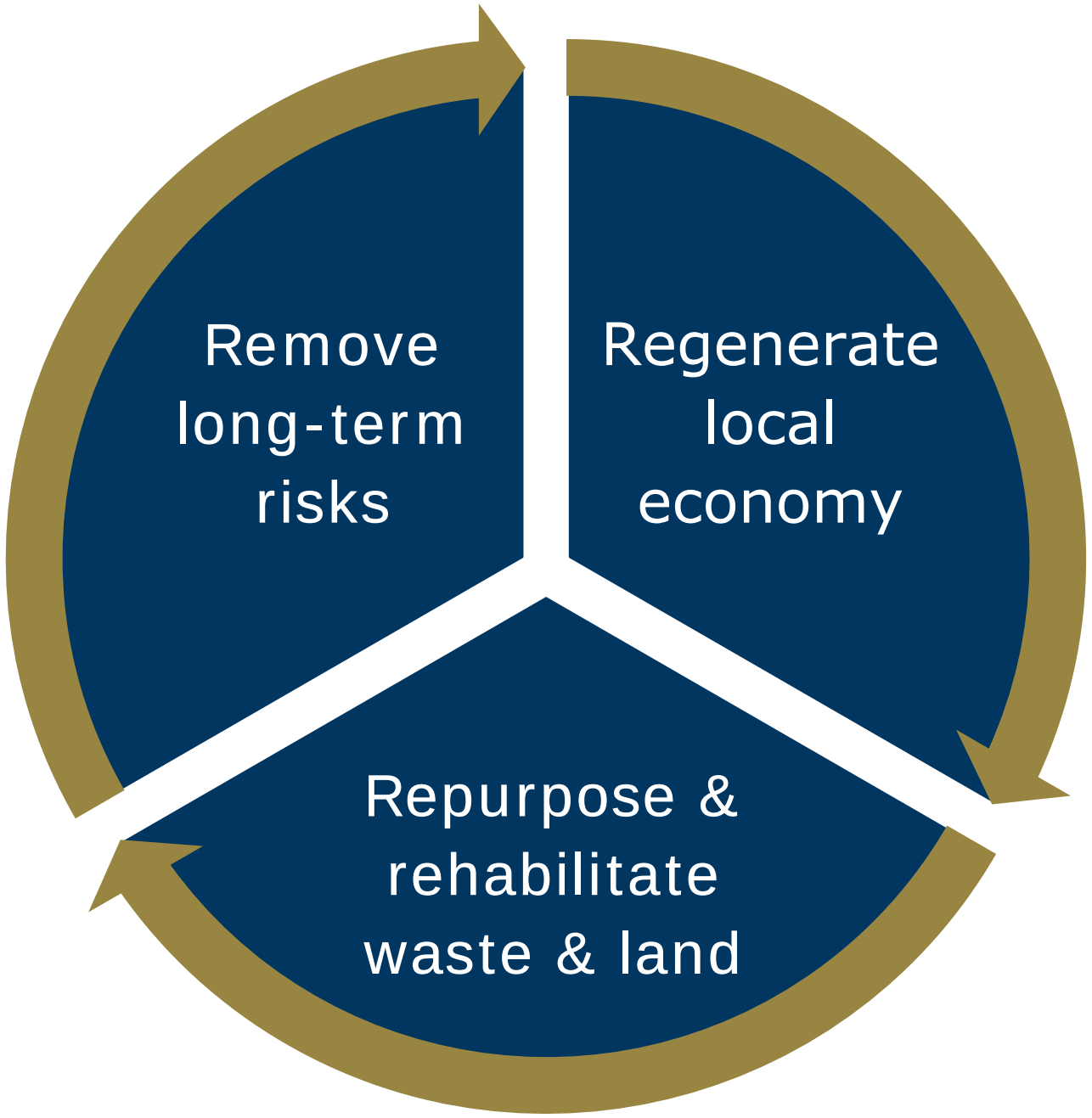
"Practices in opencast coal mines in the Mpumalanga Province are not to the quality that is prescribed by international and local rehabilitation guidelines, nor to the level that is satisfactory to the regulators" *(Gule, 2021)*


Job losses
Farming impacts
Health & safety effects
Illegal mining

Avoid future liabilities

&

Achieve restorative justice



Liabilities

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To

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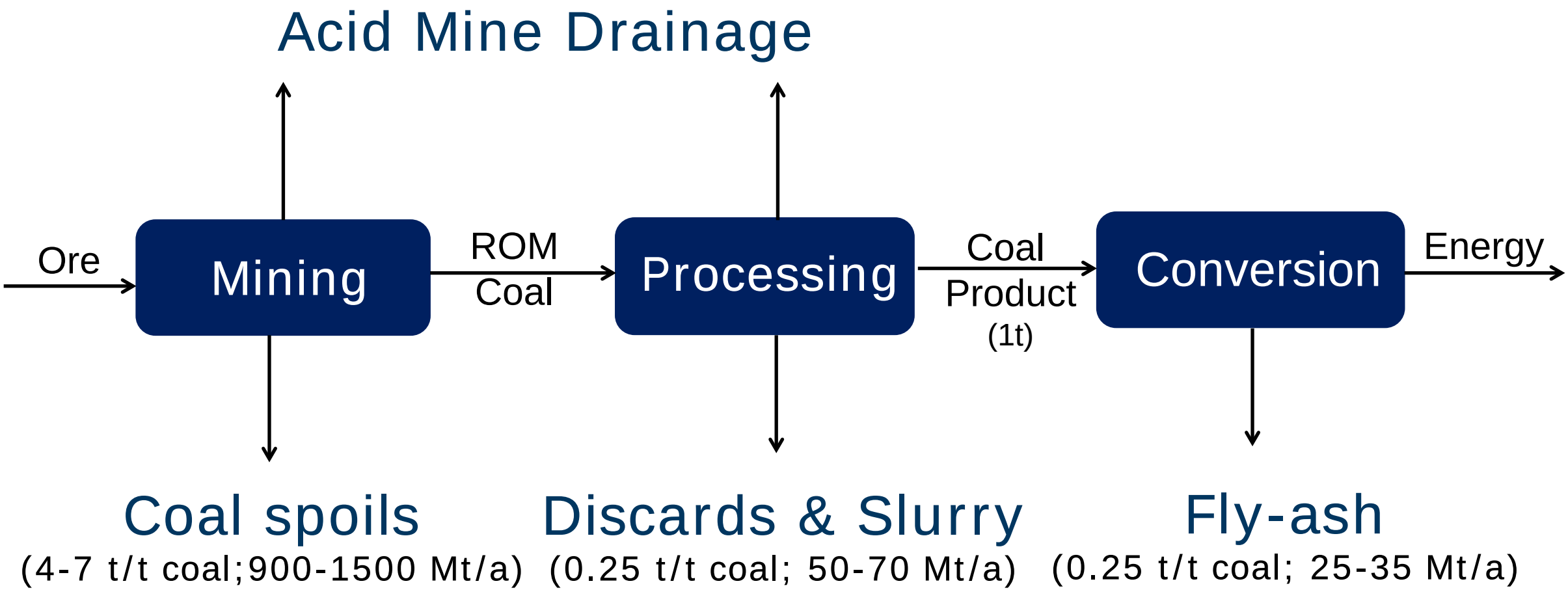
Assets


Acid Mine Drainage
Ore
Mining
ROM
Coal
Processing
Coal
Product
(1t)
Conversion
Energy
Coal spoils
(4-7 t/t coal;900-1500 Mt/a)
Discards & Slurry
(0.25 t/t coal; 50-70 Mt/a)
Fly-ash
(0.25 t/t coal; 25-35 Mt/a)

Coal processing waste

- **Metallurgical processing**
  - Bulk leaching
  - Roasting
- **Physical separation**

Sulfide-enriched fraction

Sulfide-lean fraction

Recovered coal

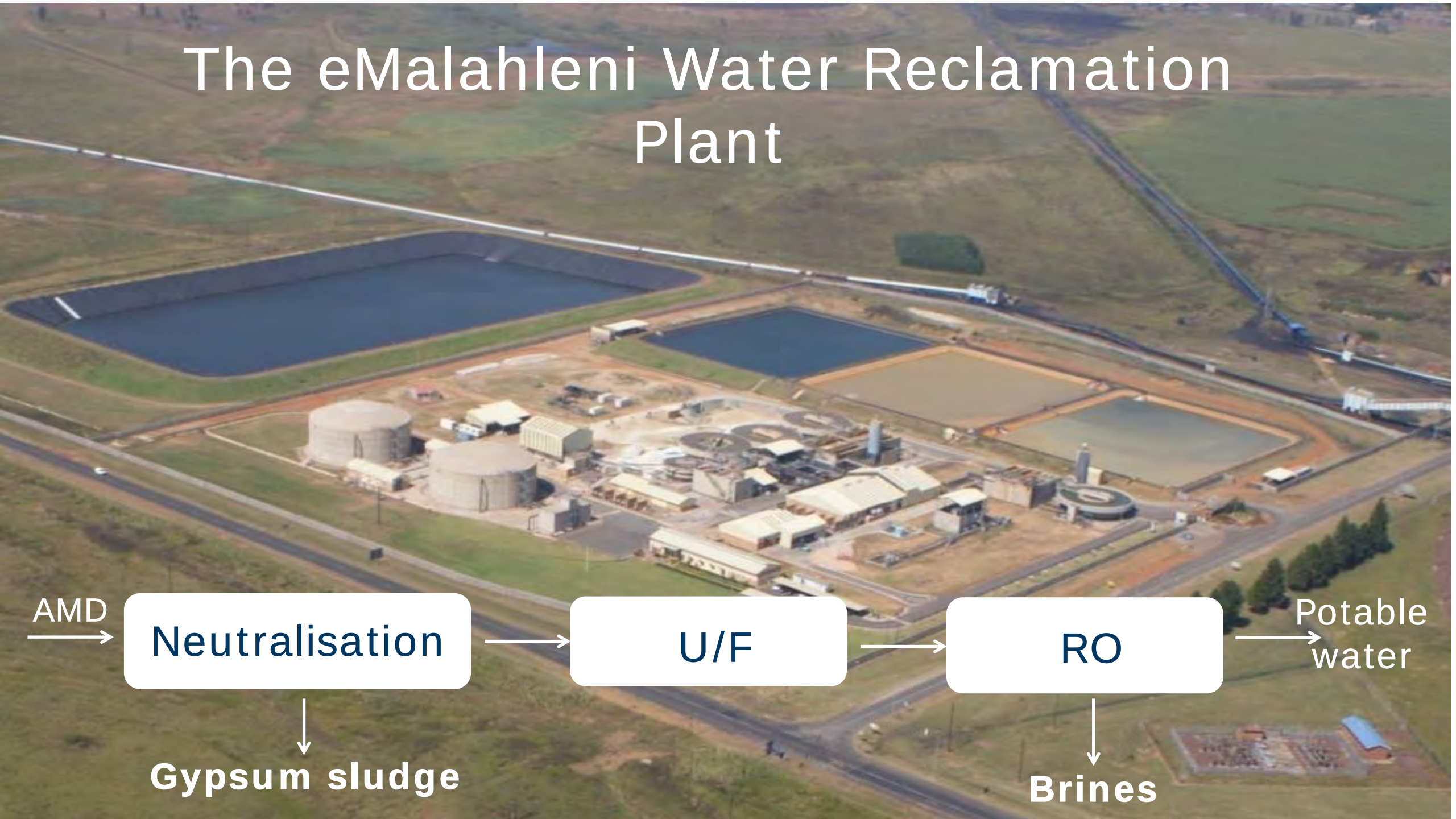
- Iron sulfates
- Iron oxides
- Sulfuric acid
- Soil ameliorant
- Paste backfill
- Cover/barrier For waste
- Fabricated soil
- Construction material
- Energy

Flotation of coal and sulphur from South African ultrafine colliery wastes

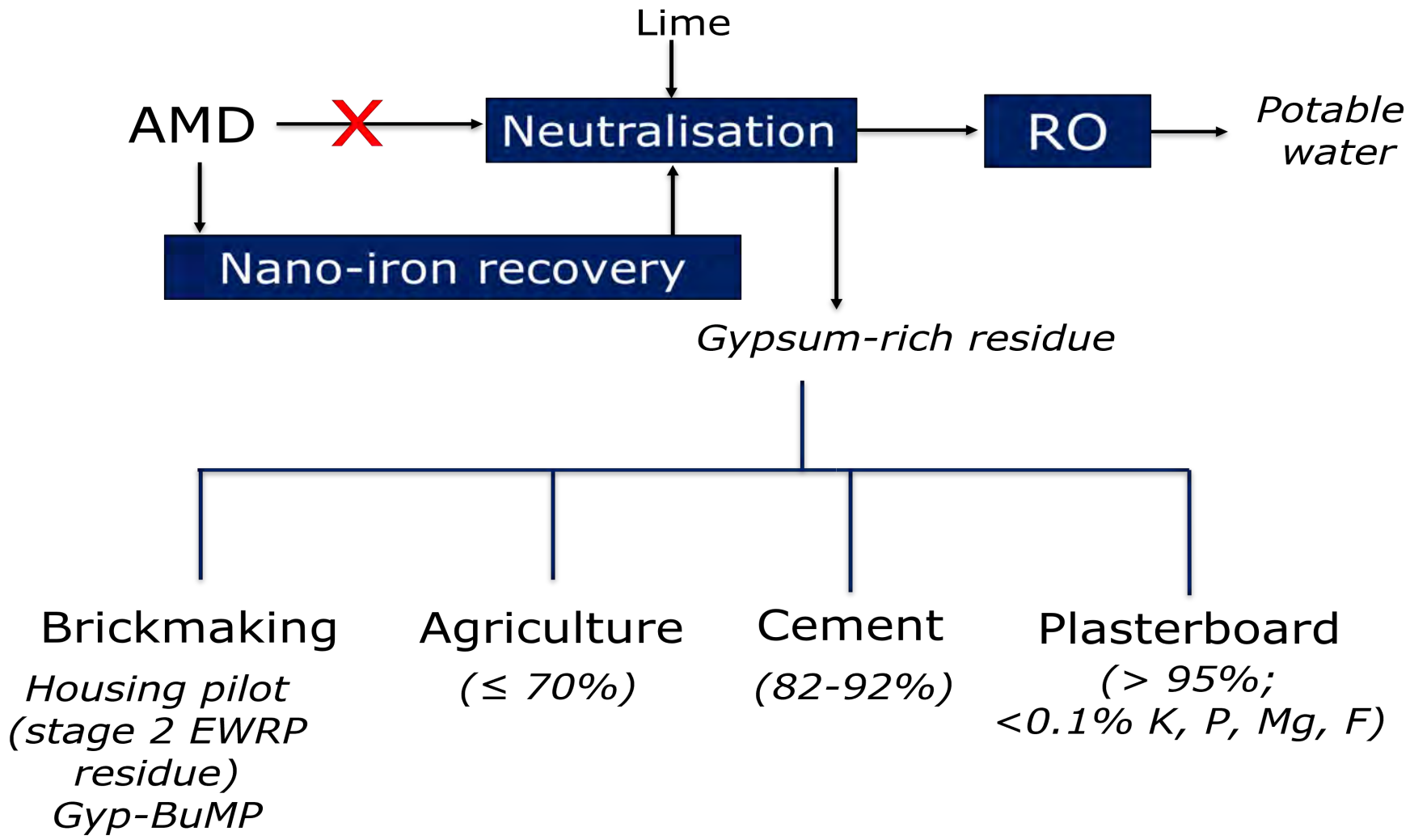
by C. Kazadi Mbamba*, J.-P. Franzidis*, S.T.L. Harrison*, and J.L. Broadhurst*

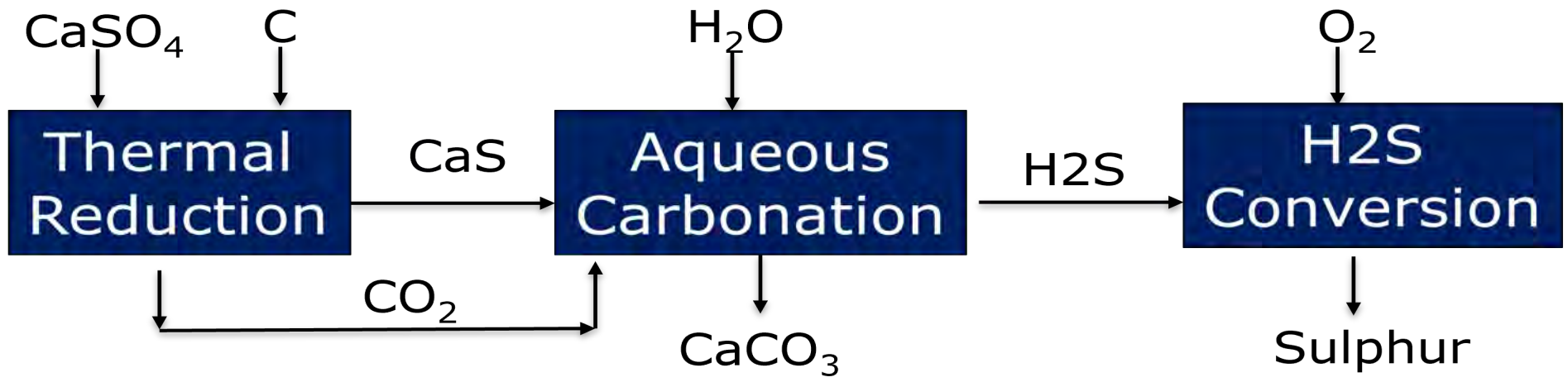
Opportunities for the Re-purposing of Fly-ash

The eMalahleni Water Reclamation Plant

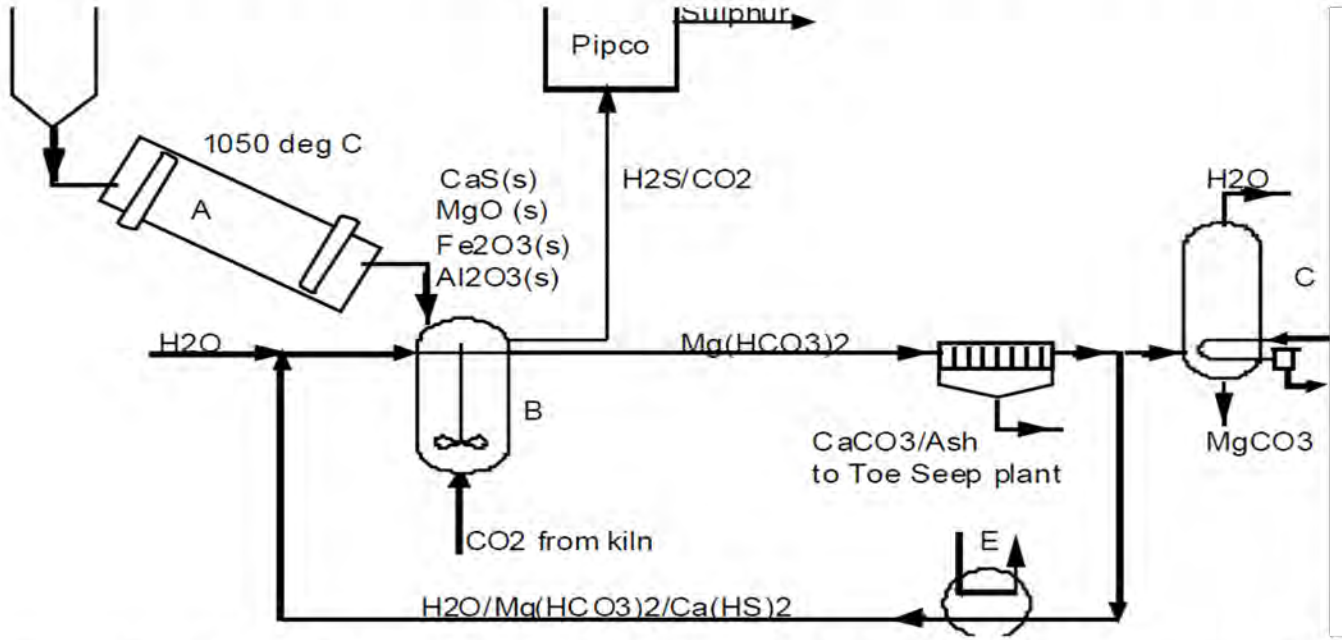


Recovery of Gypsum-Based Products





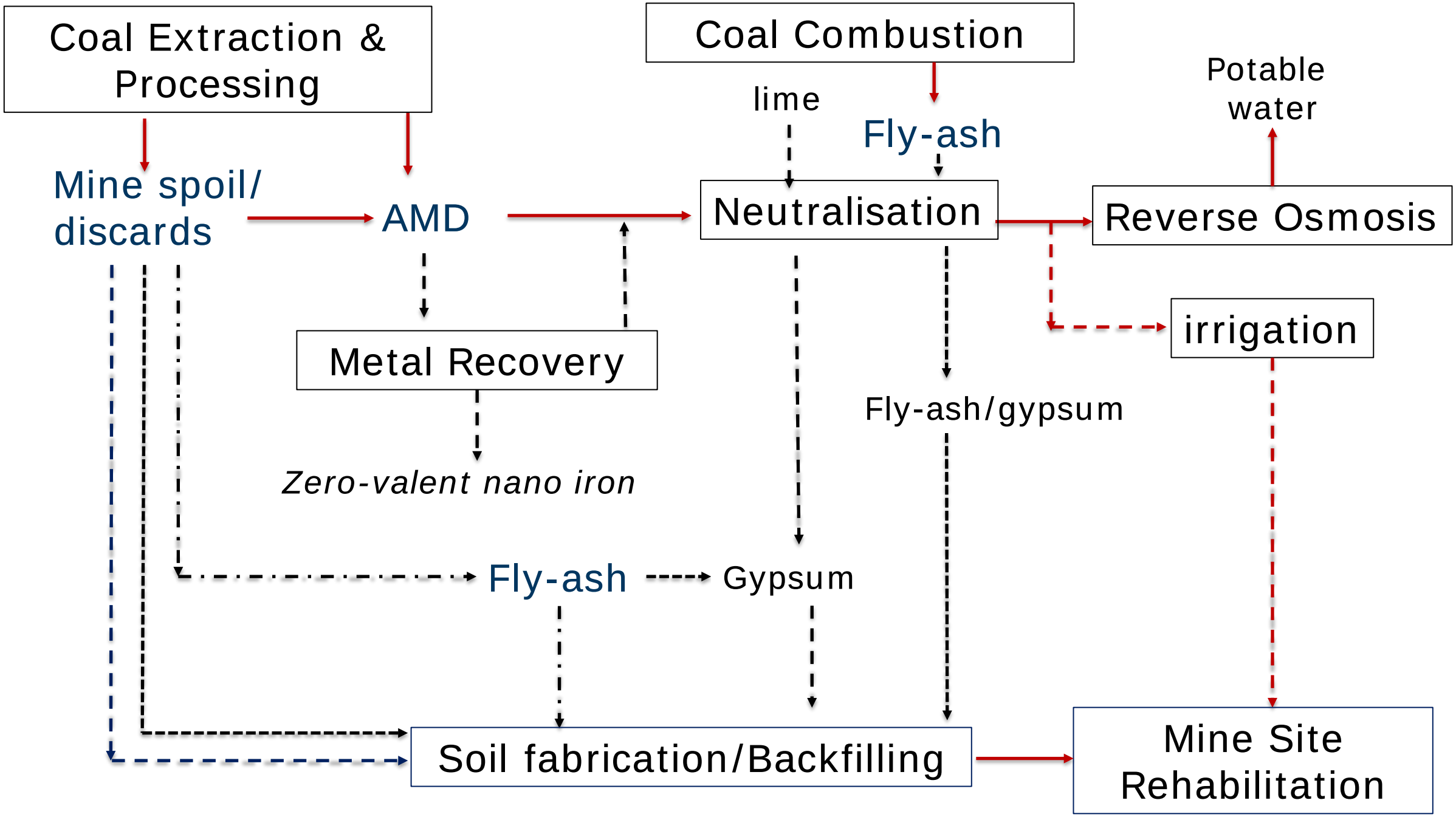
95-96% S and impure $CaCO_3$ from EWRP stage 2 residue



Gyp-SLIM: S, $CaCO_3$/metal ash and $MgCO_3$ from EWRP stage 1 & 2 residue

Barriers and Constraints

- Lack of profitability: Capital and transport costs
- Corporate strategies and culture inertia
- Lack of enabling legislation
- Environmental and health implications
- Technical risks: Unproven technologies, variability in waste compositions etc


Coal Extraction & Processing
Coal Combustion
lime
Fly-ash
Potable water
Mine spoil/ discards
AMD
Neutralisation
Reverse Osmosis
irrigation
Metal Recovery
Zero-valent nano iron
Fly-ash/gypsum
Fly-ash
Gypsum
Soil fabrication/Backfilling
Mine Site Rehabilitation

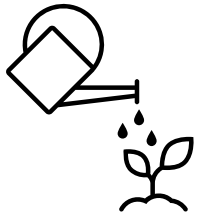
Mafube colliery trialling use of mining-impacted water for agriculture

Photo by Bloomberg
AMAZING EFFORT The first maize crop was irrigated with water from the Mafube pit and has since been harvested. The area yielded 14.5 t/ha, compared with 8t/ha from dryland crops

Change is happening…

GLENCORE The Impact Catalyst ICMM IMWCB

Regenerative Agriculture of Industrial Crops

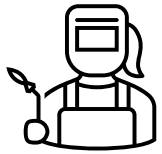


Cultivation & harvesting

Fabricated soil

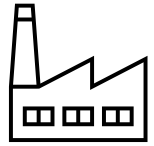
Plant biomass

Recycled/fit-for-purpose water

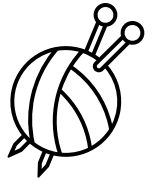


Metal recovery

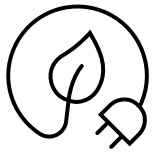
Recovered metals



Direct plant processing



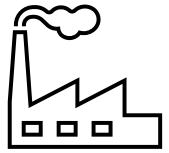
Plant-based products



Bioenergy

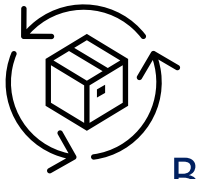
Residual plant biomass

Wastewater



Biorefinery

Recycled water



Bioproducts

Bast plant products

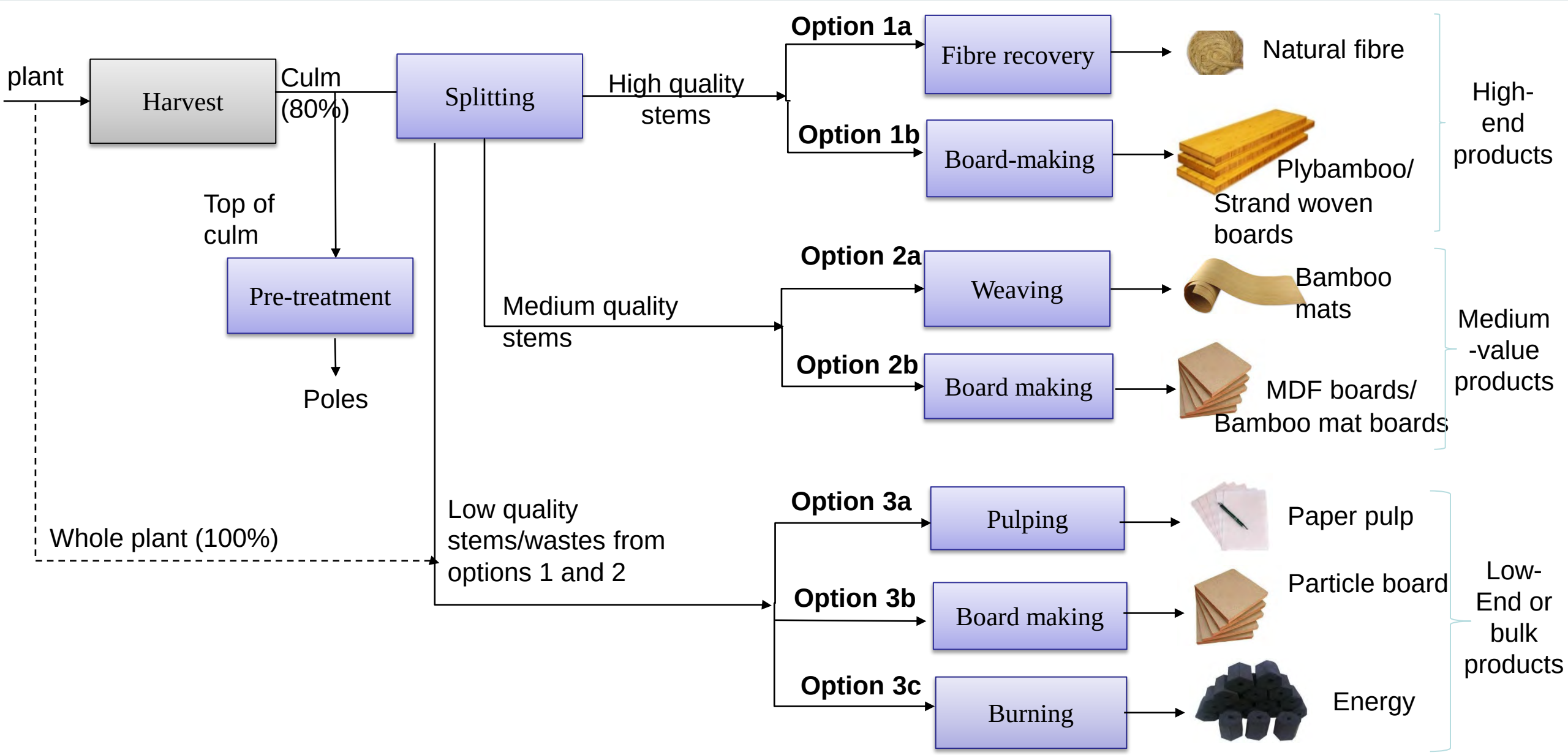
Bast fibre plant e.g. hemp

- Whole plant
  - Energy (e.g. bioethanol, biogas)
- or
- Stem
  - Bast Fibre
    - Long fibre
      - Conventional textiles
      - Bioplastics
      - Biocomposite textiles/ concrete
    - Short fibre
      - Cordage
      - Paper pulp
  - &
  - Woody tissue/core fibre
    - Construction composites
    - Insulation boards
    - Paper pulp
    - Bioethanol/biobutanol
    - Shives (animal bedding etc)
- &
- Seeds
  - Chemical extracts
    - Oil
      - Edible oil (e.g. hemp seed oil)
      - Personal products
      - Paint/varnish
    - &
    - Protein
      - Animal Fodder
  - or
  - Whole seed
    - Food
- &
- Leaves
  - Human food
  - Medicine

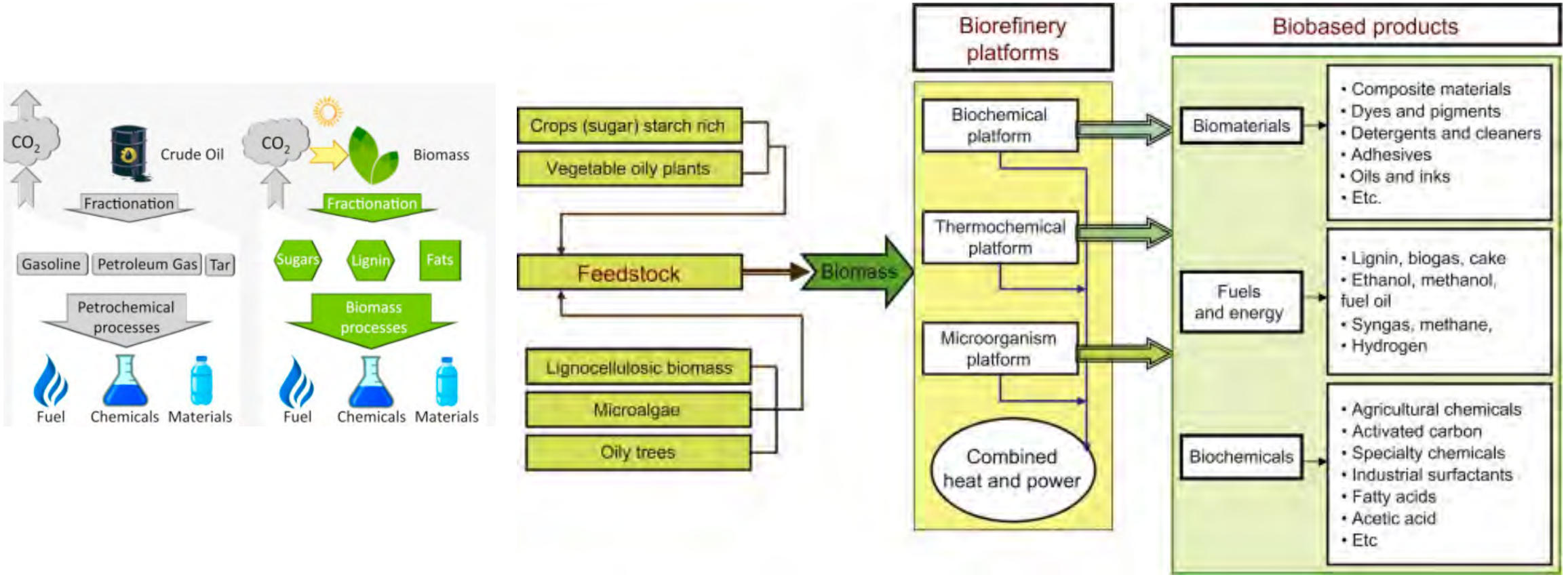
Part of plant | Intermediates | End-products

minerals to metals

Bamboo multi-product flowsheet scenarios



Extending benefits and opportunities – biorefinery concept



Dynamic multi-product system integrating regenerative agriculture and optimal land use with sustainable water and waste management

Extending benefits and opportunities – biorefinery concept

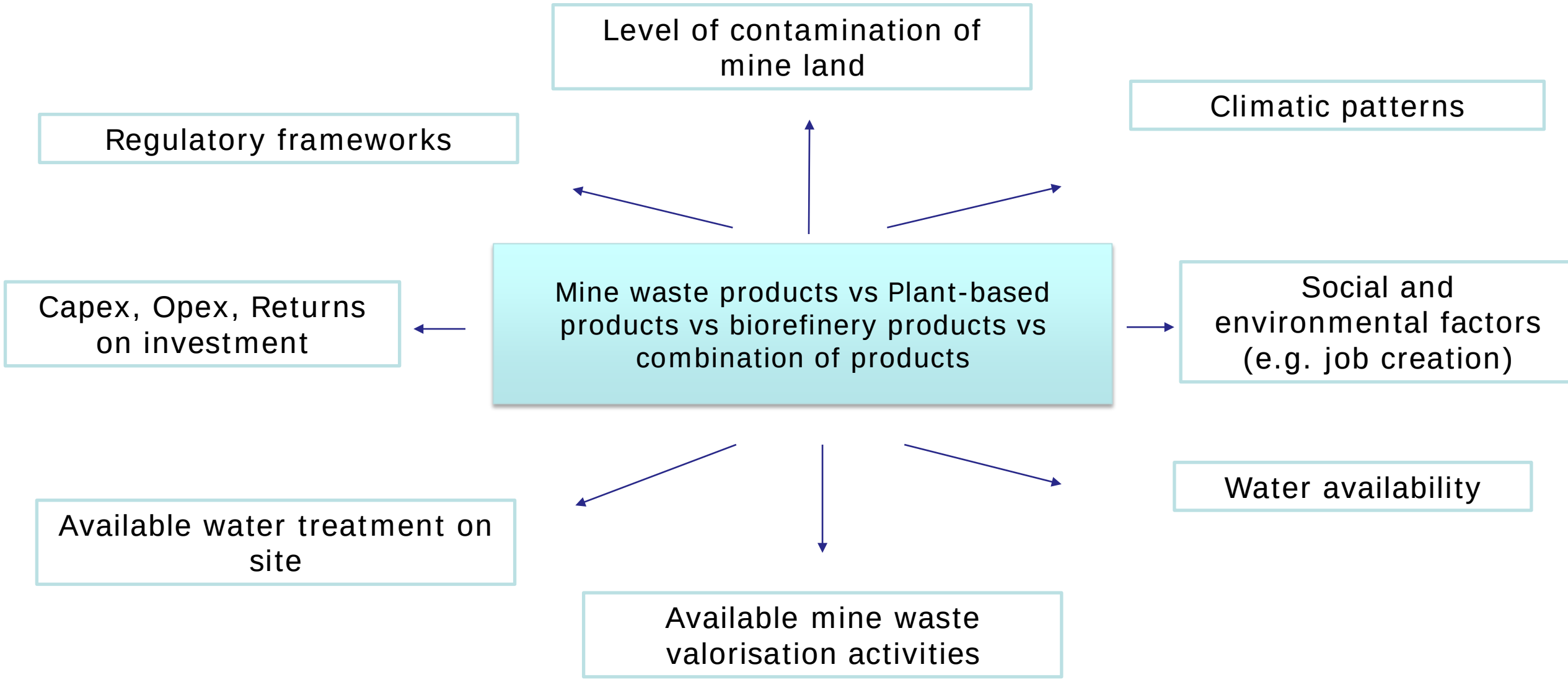
Traditional linear approach of valorising coal mine waste	Multi-product and integrated biorefinery system - regenerative agriculture
Business-level strategy (single market/industry) - Limited products - Limited economic returns and return of investment - Limited timeframe and long-term opportunities - Limited job prospects for communities - Lack of incentives for investors - Negative environmental and socio-economic outlook	Corporate-level strategy (multiple markets/industries) - Portfolio of products tailored to market demands - High profit margins for products such as biochemicals - Staggered business model for value chain optimisation - Different levels of skills requirements (from agriculture to specialised process operators) - Positive outlook for investors interested in green products and high ESG standards

Piloting

- Pilot case study in the West Wits goldfields, using kenaf and bamboo
- Resilient Futures CoP Phase 2

Applying the Multi-disciplinary Industrial Policy Approach (MMIP) to identify a set of frontier products or diversification opportunities, including bioproducts and energy transition materials from South Africa's natural resources

Decision points for biorefinery system



Legal Processes

Prohibitive

Enabling

Barriers

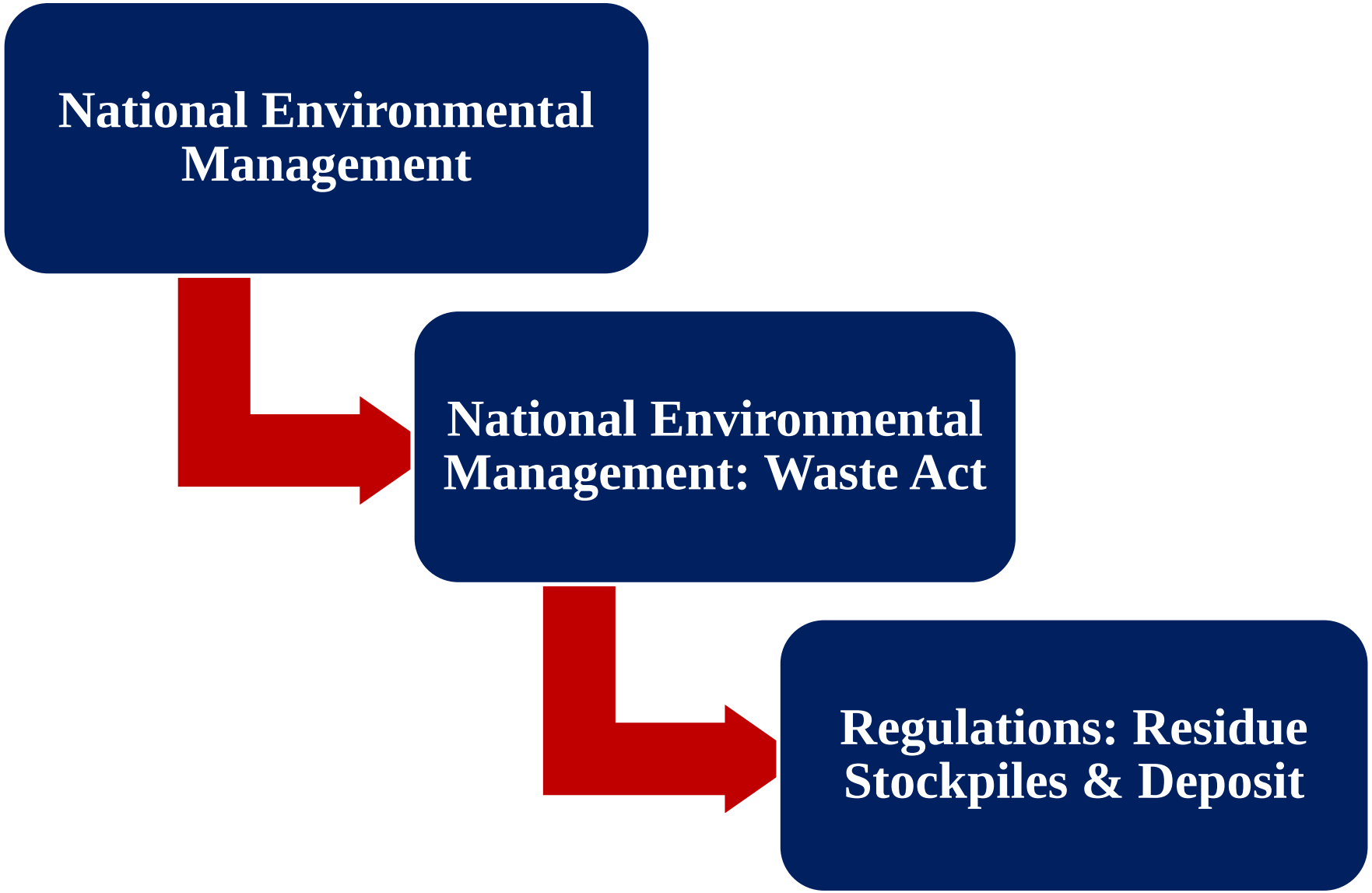
Lack of enabling legislation

Lack of policy

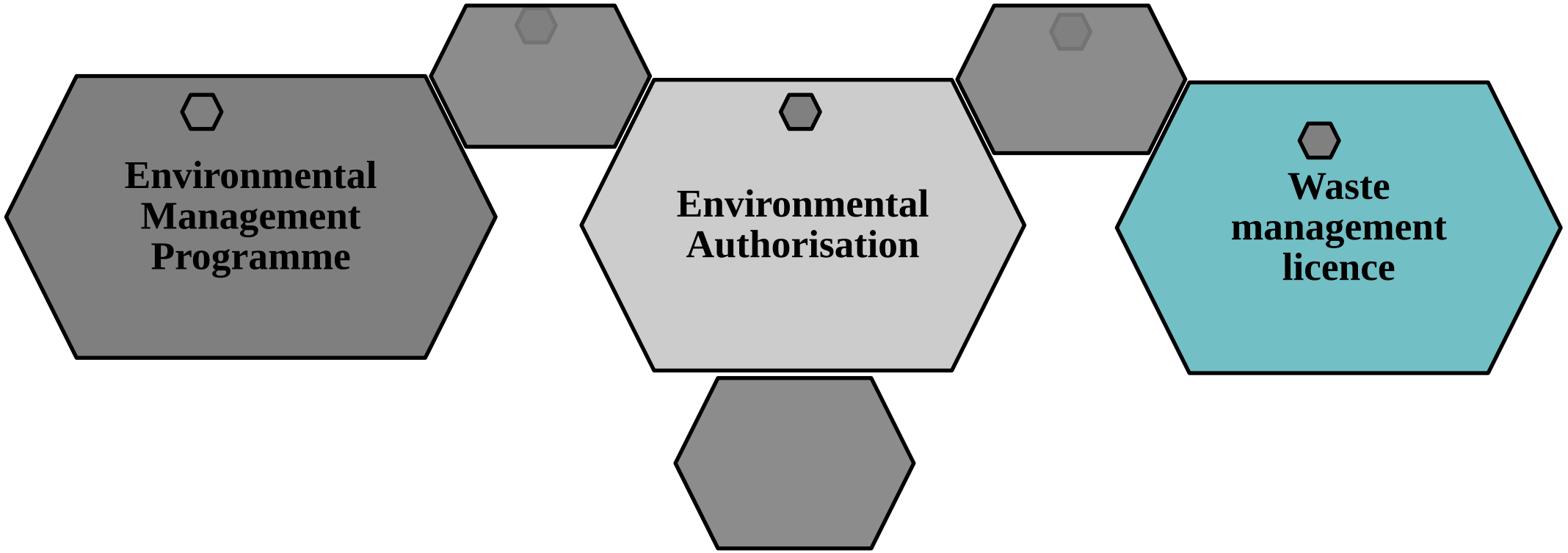
No public-private partnership

No direct role of interested parties

Current Framework



National Environmental Management: Waste Act: Regulations: Planning and management of residue stockpiles and residue deposits from prospecting, mining, exploration or production operation



Reduction, re-use, recycling and recovery of waste

S17(1) NEMWA:

“...any person who undertakes an activity involving the reduction, re-use, recycling or recovery of waste must, before undertaking that activity, ensure that the reduction, re-use, recycling or recovery of the waste-

(a) uses less natural resources than disposal of such waste; and

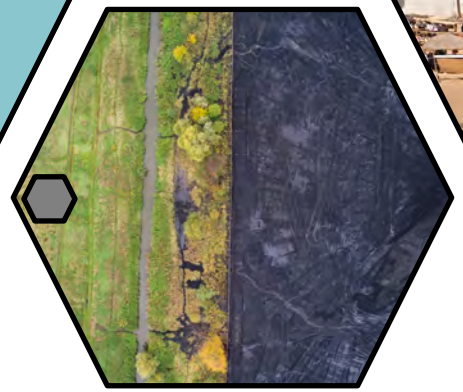
(b) to the extent that it is possible, is less harmful to the environment than the disposal of such waste.”

Pollution

Health & Safety

Water use

Land use



National Environmental Management Laws Amendment Bill

Residue stockpiles and residue deposits to be excluded from NEMWA and regulated under NEMA

Regulations pertaining to the management of residue deposits and residue stockpiles ... remain operational and shall be deemed to have been made under the National Environmental Management Act, 1998

Concluding Remarks

- Downstream application of coal wastes and mine land provides the opportunity to mitigate post-closure environmental impacts and diversify the local economy.
- There is a need to urgently commence the development and implementation of these opportunities as part of the “Just Transition”
- This will require a consolidated and collaborative effort to overcome “innovation hesitancy”
  - ✓ Effective partnerships
  - ✓ A R&D programme to demonstrate technical feasibility (pilots!)
  - ✓ A sound business case
  - ✓ Enabling legislative framework
  - ✓ A will……

Thank you for your attention

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