Africa and Minerals 2.0

The implications of new technologies and innovation in Africa's mining sector

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African Natural Resources Center
African Development Bank Group

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Presentation outline

- Background on the African Natural Resources Center (ANRC)

- ANRC's policy, economics and analytical work on natural resource management (NRM)

- Case study: artificial intelligence (AI), robotics and mechanisation in gold mining

- Policy imperatives

- The AfDB and ANRC engagement agenda

- Conclusion

ANRC's strategic approach
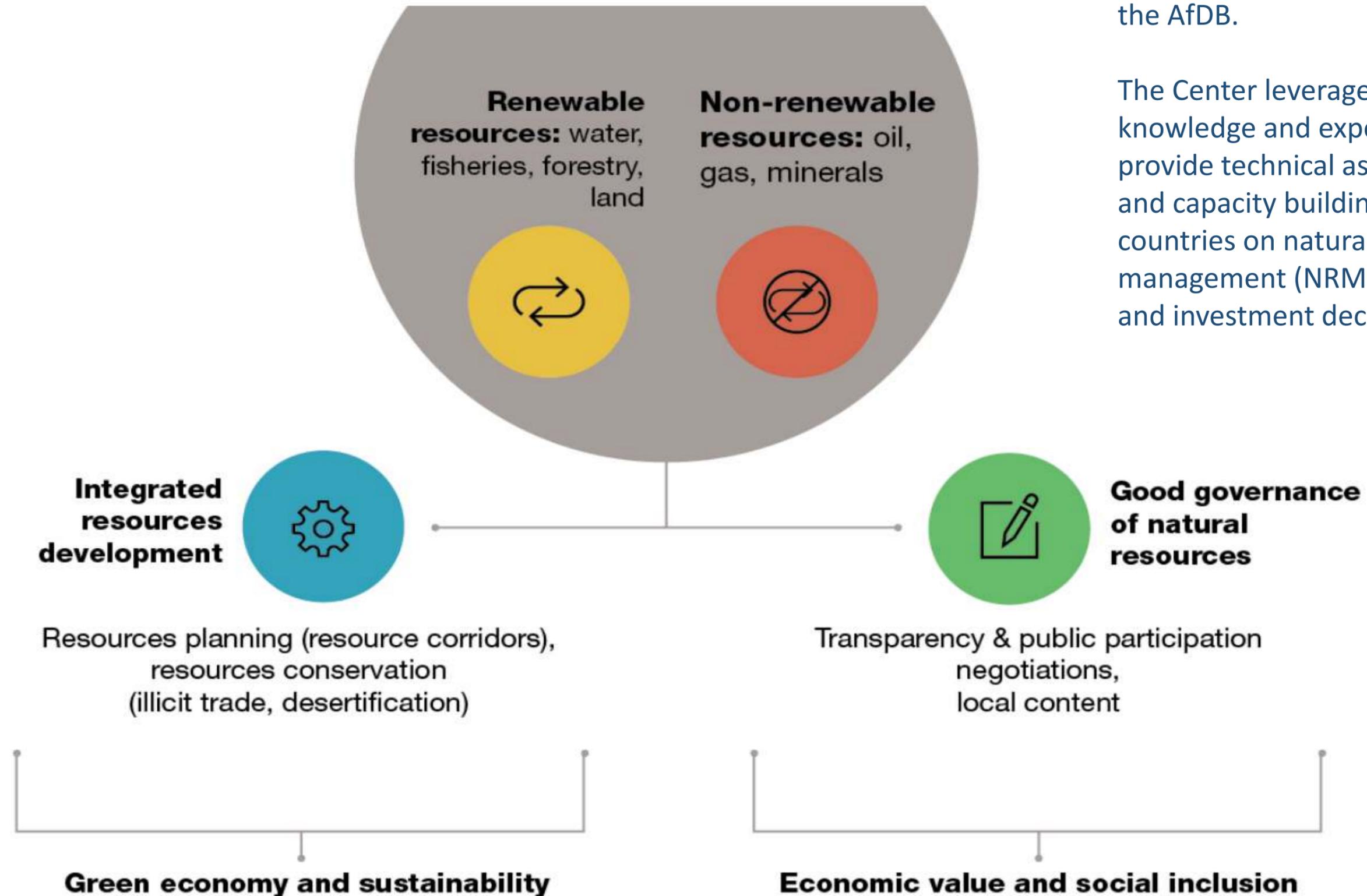
ANRC is a non-lending entity of the AfDB.

The Center leverages its knowledge and expertise to provide technical assistance (TA) and capacity building for African countries on natural resource management (NRM) policies, and investment decisions.

Renewable resources: water, fisheries, forestry, land

Non-renewable resources: oil, gas, minerals

Integrated resources development

Resources planning (resource corridors), resources conservation (illicit trade, desertification)

Green economy and sustainability

Good governance of natural resources

Transparency & public participation negotiations, local content

Economic value and social inclusion

Policy, Economics and Analytics on NRM
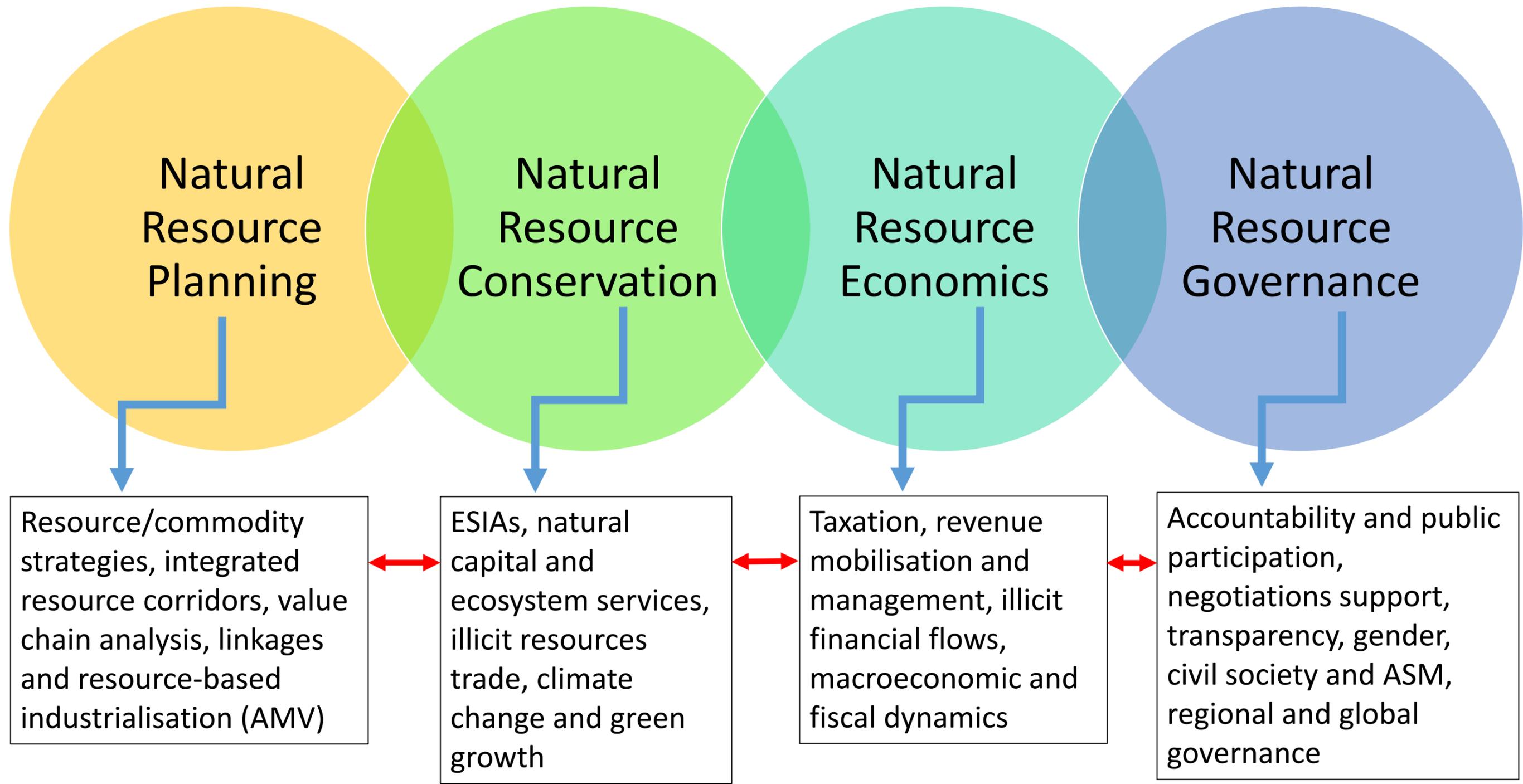
Case study: AI, robotics and mechanisation in gold mining *

- Gold mining has become increasingly mechanised, with approximately 50% of South African mines being marginal.

- As a result, large numbers of mining jobs will disappear in the coming decade in Africa and around the world.

- Employment generation in the mining sector will be most threatened by technological change in the coming years.

- The displacement effect will be substantial and will limit the employment creation effect of gold mining throughout the continent. This is true of both open-pit and underground mining.

- At their peak in the 1970s the gold mines of the Witwatersrand employed some 500,000 workers from countries all over southern Africa.

* Based on a forthcoming AfDB report on 'The Gold Value Chain: Opportunities for Value Addition in Africa'

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Employment trends in the mining sector
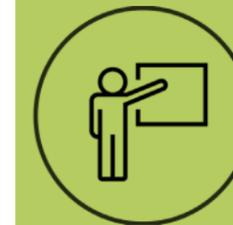
Table 1: Employment along the Gold Value Chain in South Africa

	2006	2016
Sector	Persons Employed	Persons Employed
Gold Mining	159,984	120,000
Gold Refining and Recycling	492	750
Gold Jewellery Manufacture	2,833	1,500
Gold Jewellery Wholesale and Retail	4,346	2,750
Gold Coin Manufacturing and Retailing	101	105
Other (Dental and Industrial)	200	175
Total	167,956	125,280

Source: Gold in South Africa 2007 and industry estimates in 2017.

Excerpt from a forthcoming AfDB report on *The Gold Value Chain: Opportunities for Value Addition in Africa*

Applications of AI in Gold Mining

- **Robotics**: Robotic devices powered by artificial intelligence can perform a range of tasks including drilling, blasting, loading, hauling, bolting mine roofs as well as ore sampling and rescuing trapped miners.

- **Autonomous Load Haul Dump** (LHD) vehicles using robotic technology have been developed by several research centers and technology companies including the Australian Centre for Field Robotics (ACFR), Sandvik Mining, and Atlas Copco.

- **Automated drilling**: allows the operator to carry out drilling from a remote location without entering hazardous areas. Sandvik has developed its AutoMine Surface Drilling system which is based on this technology.

Applications of AI in Gold Mining II

- Efficient **shaft and tunnel boring system**: Atlas Copco's modular mining machine can cut through extremely hard rock walls and tunnel to more than 10m a day, which is nearly twice the rate achieved through conventional methods.

- **Autonomous Haulage Systems** (AHS) provide fleet optimization without the need for truck operators, especially in complex mining operations. Rio Tinto has one such mine at Pilbara using AHS.

- **Remote operating and monitoring centers**: With a centralized system, the mines are operated, monitored and controlled from a remote location.

Benefits and Trade-Offs of New Mining Technologies

- The application of new technologies makes mining safer and more cost efficient.

- This will allow 24 hour mining, decrease operating costs, and increase substantially the recoverable ore from most bodies.

- However, there is a trade off with the social costs of unemployment.
  - E.g. autonomous haulage and robotics, which are taking over labour intensive jobs in the industry at a pace that would leave thousands unemployed in the near future.

- The pressures to move from manual to mechanised mining have become overwhelming, especially in a low price setting.
  - It is estimated that an extra 500Mt of gold ore and 360Mt of PGM ore could be mined in South Africa through migration to mechanized mining

Technological disruption and mining jobs in Africa

- The increasing mechanisation of global as well as African gold mining now seems inevitable, not only for cost (profit) reasons but also for health and safety reasons (mechanised mines are considerably safer: less workers at the rock face).

- **Mechanisation could cause job losses of more than 200,000 mine workers in the SADC region alone.**

- However, mechanisation *could be job neutral, <u>provided that</u> all the capital goods, components, feedstocks, technology services (RDI), engineering services and associate support services are sourced from local/regional suppliers*.

- There will clearly be mine workers that cannot be reskilled to operate complex machinery, build machines and components, or to provide technical services to the capital goods value chain.

- The new jobs will be of a much higher skills intensity, meaning that strategies will have to be developed for the laid-off workers such as reskilling for other sectors and development strategies in the migrant worker sending areas (agriculture, agro-processing, tourism, etc.)

Policy Imperatives for Africa's Mining Sector

- The most imperative issue facing policymakers in Africa is how to ensure that the jobs in manufacturing and services gained through mechanisation and the application of AI are created locally and do not migrate abroad.
    - This will likely occur if there is no improvement in the business environment.

- Using the strategic approach of the AMV, the policy response should embody these components:
    - Regional strategies for mineral beneficiation and value addition (regional mineral value chains), further leveraging the African Continental Free Trade Area (AfCFTA)
    - Reskilling and training of impacted workers in the mining sector
    - Creating jobs in non-mineral sectors (agro-industry, manufacturing, tourism, services, etc.)
    - Increasing investments in RDI, STEM skills and TEVT
    - Reforms to improve the enabling environment for businesses and industry
    - Greater public-private dialogue and strategic partnerships

Elements of a regional mineral value chain strategy
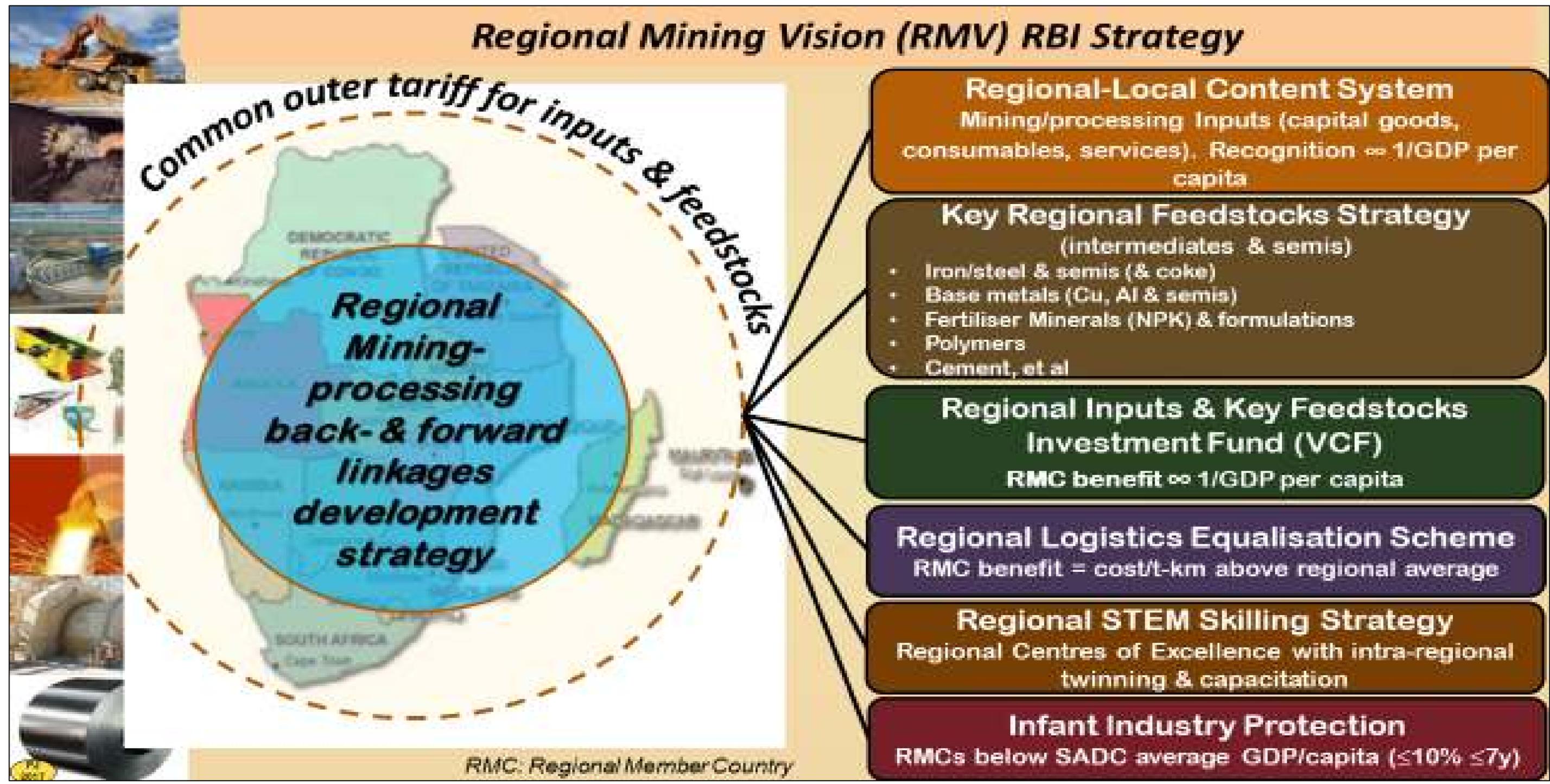
Source: Developed by Paul Jordaan and Roman Grynberg for ANRC Gold Value Chain Analysis, using SADC RMV framework

Building Resilience in Africa's Extractive Economies

- Sustainable management of Africa's *natural capital*: Africa has the second largest wealth concentration in natural assets, after the Middle East. 36% of the continent's wealth is comprised of natural capital (*The Changing Wealth of Nations, 2018*).
  - Climate change and the risks of extractive-based (carbon-intensive) development.

- High concentration in natural wealth without (local) value creation is neither sustainable nor strategic for African countries.

- The advent of new technologies in mining creates opportunities for **diversification** to more sustainable, green economies.
  - Leveraging regional mineral strategies for a diversified, broad-based industrial structure

- **Diversified economies** in Africa will be better positioned to manage the adverse impacts of technological disruption in the mining sector.

What is the AfDB doing in this area?

- **Knowledge generation**: value chain analysis, linkages and diversification; impact of new technologies on mining; climate change and mining; macroeconomic analysis of carbon risk.

- **Technical Assistance** (TA) for African countries: institutional, sector and regulatory reform; AMV implementation; regional mineral strategies and resource corridors; climate change and mining; linkages and diversification.

- **Advocacy**: on climate change and mining; resilience and mineral-based diversification; mineral sector governance; ASM; decarbonisation and green growth.

- Building **partnerships** with regional and global donors; multilateral institutions, the private sector and civil society to support climate-smart mining, mineral-based diversification and sustainable development.

Conclusion

Downside risks:

- Infrastructure: Africa has to finance an infrastructure gap estimated at between $68-$108 billion each year (AfDB, 2018).

- Macroeconomic and fiscal policy management: in a sustained low price context. Signs of renewed economic fragility.

- Managing variable geometry between countries: political negotiations and brinkmanship required for regional mineral strategies.

- **It's all in the *value*** - technological disruption, and its impact on mining, is inevitable. The challenge is how to create more resilient and diversified economies. This requires new thinking and innovative policies…

Thank you for listening!

Merci pour votre attention!

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