

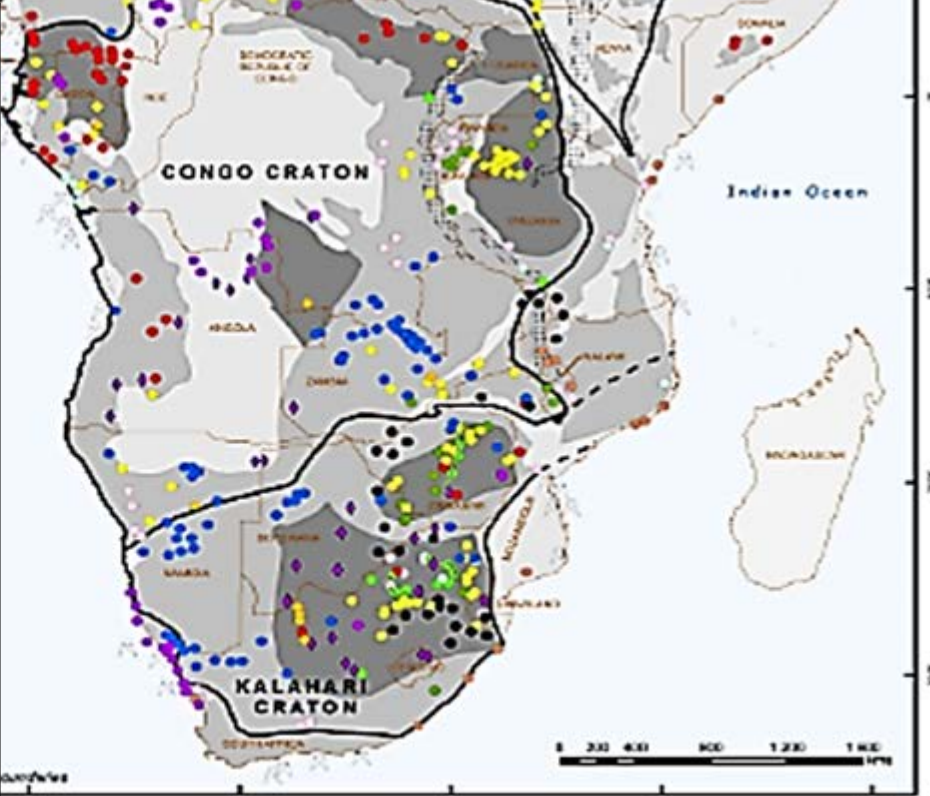
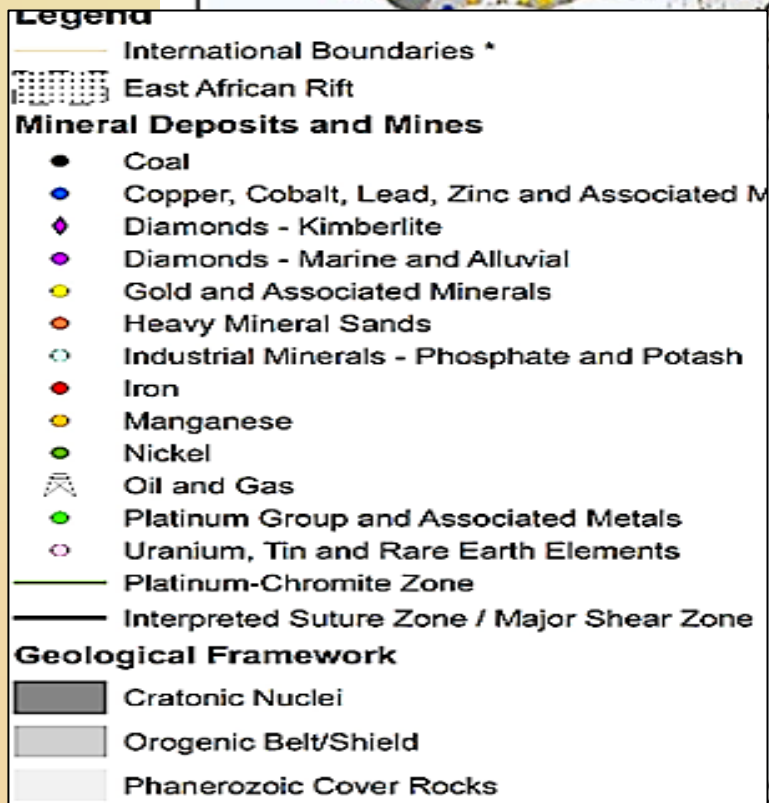
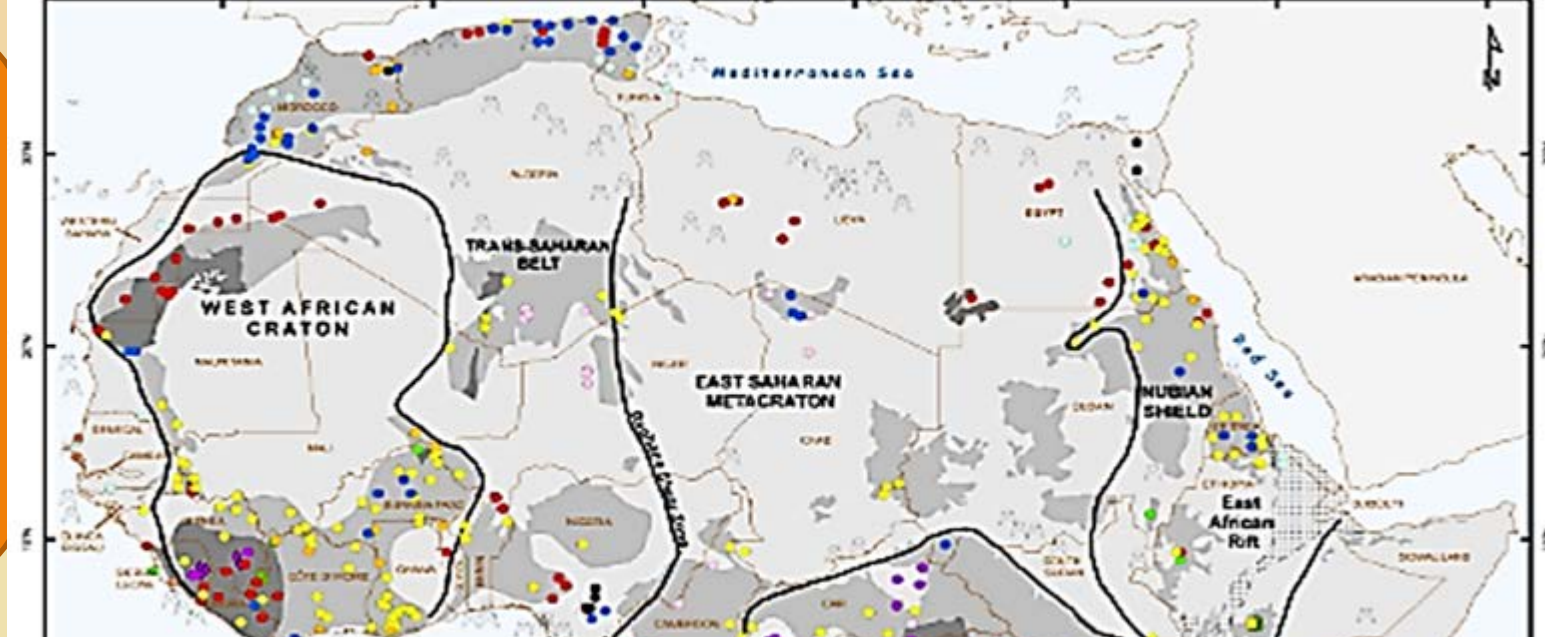


# The African Mining Vision:

## *Maximising South Africa's Mineral Endowment*

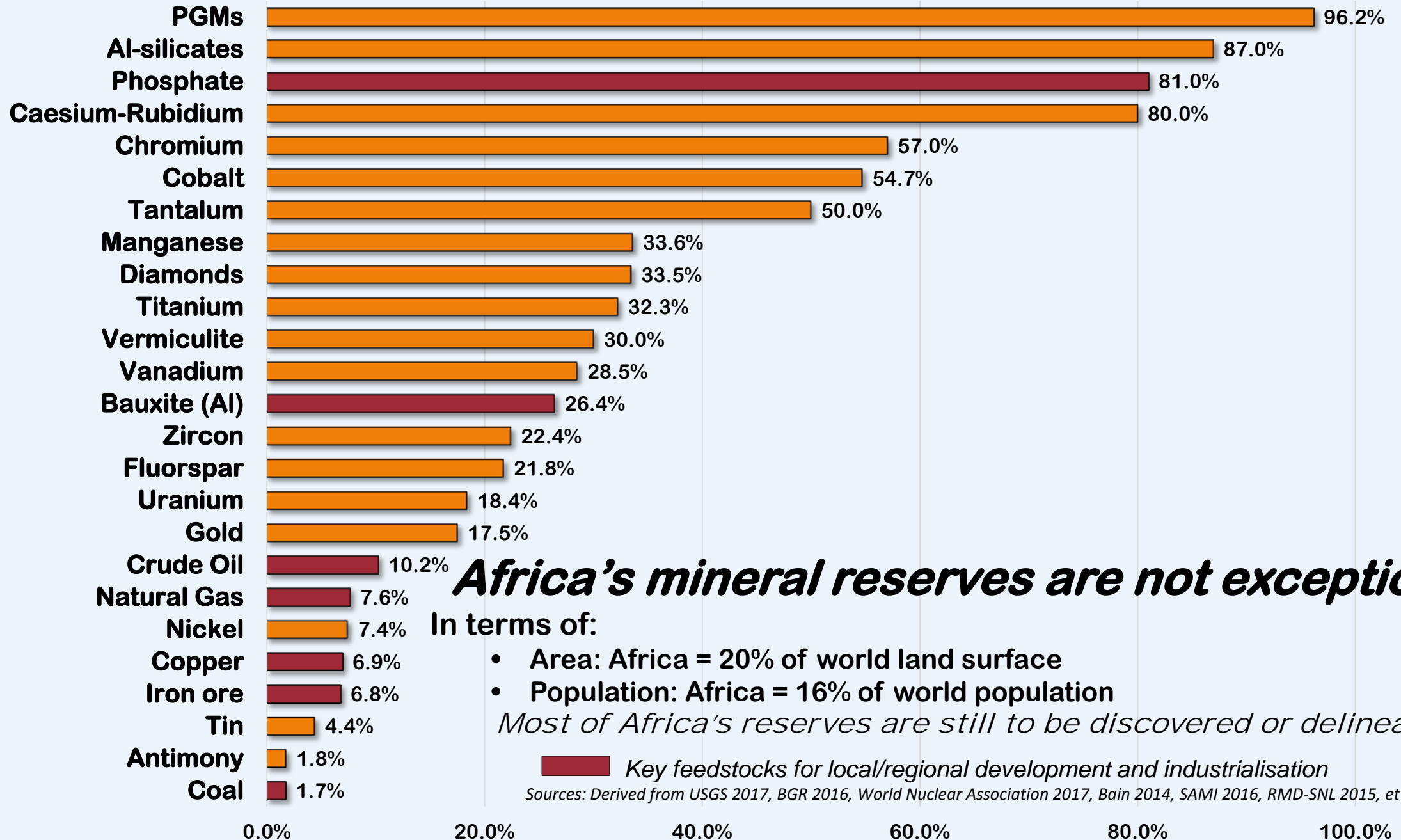
Paul Jourdan, CSIR, Tshwane, 2017

# Location of major mineral deposits in Africa





# Africa's Share of World Mineral Reserves 2016



***Africa's mineral reserves are not exceptional!***

In terms of:

- Area: Africa = 20% of world land surface
- Population: Africa = 16% of world population

*Most of Africa's reserves are still to be discovered or delineated*

■ Key feedstocks for local/regional development and industrialisation

Sources: Derived from USGS 2017, BGR 2016, World Nuclear Association 2017, Bain 2014, SAMI 2016, RMD-SNL 2015, et al.

# Africa: Production of Selected Metals in 2013

Metal		Africa	Share of World	World Total
Aluminium	Bauxite (Mt)	18.4	7%	282
	Al Metal (kt)*	2,030.0	4%	56,400
Chromite (Mt)		14.1	41%	34.5
Cobalt, (kt, Co content)		70.1	63%	112
Copper (kt Cu content)		1,960.0	11%	18,100
Gold (tons)		531.0	19%	2,860
Iron ore (Mt)		115.0	4%	3,210
Steel (Mt)		16.8	1%	1,730
Lead (Mt Pb content))		70.3	1%	5,420
Manganese (Mt Mn content)		8.6	46%	19
Nickel (kt Ni content)		115.0	4%	2,630
PGMs	Platinum (tons)	150.0	82%	183
	Palladium (tons)	87.5	43%	203
Tantalum (tons, Ta content)		927.0	77%	1,210
Tin (kt metal content)		7.5	3%	294
Zinc (kt Zn content)		274.0	3%	13,400

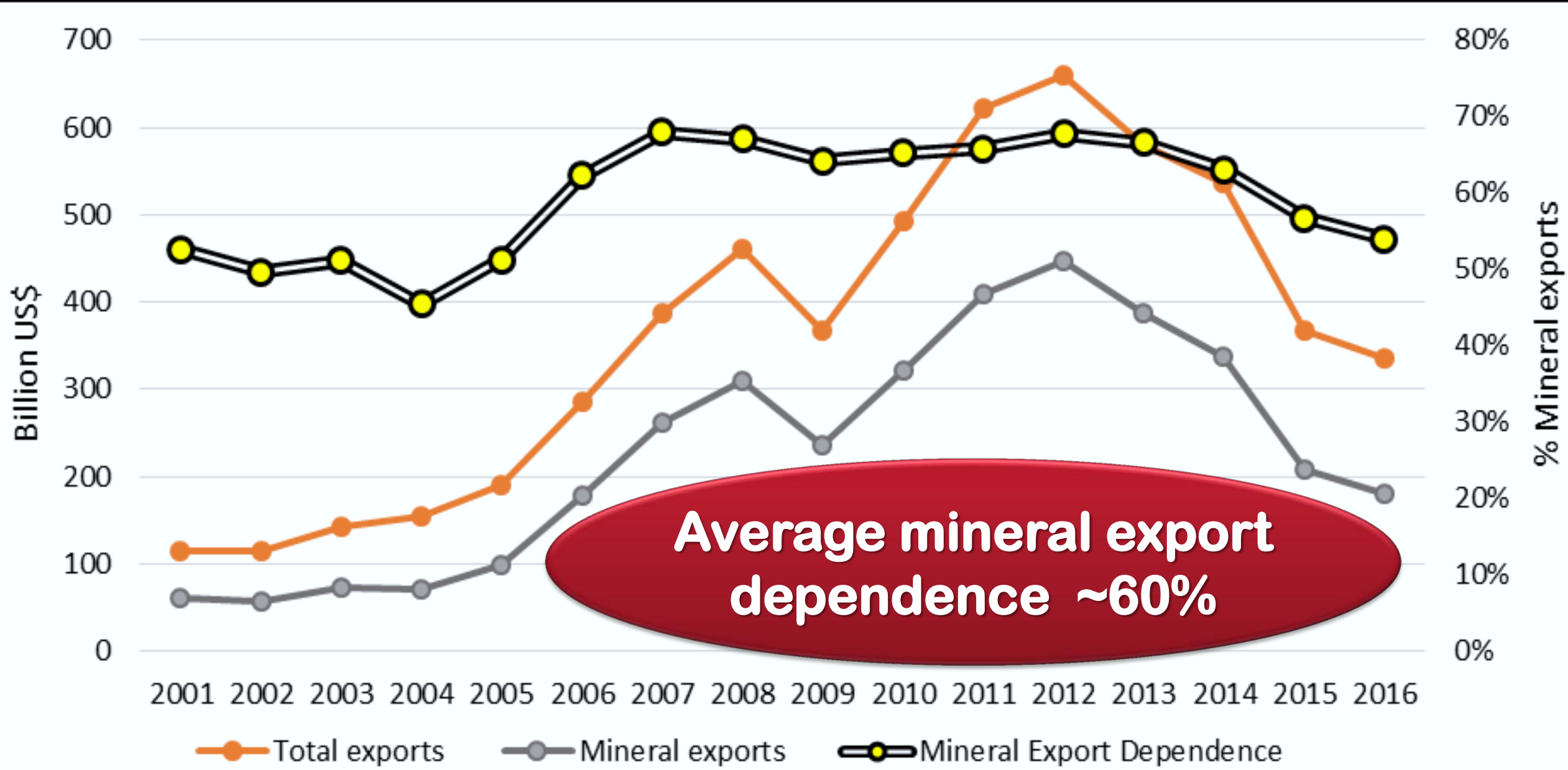
# Africa Production of Selected Industrial Minerals and Mineral Fuels in 2013



Commodity	Africa	Share of world	World total
Cement (Mt)	165	4%	4,090
Diamond (kcarats)	72,500	55%	131,000
Graphite (kt)	11	1%	1,100
Phosphate rock (Mt)	41	17%	243
Coal (Mt)	270	4%	6,860
Crude oil (Mbbl)	3,160	11%	28,500
Uranium (kt, U <sub>3</sub> O <sub>8</sub> )	12	17%	74

**African exports (bn US\$) & mineral export dependence 2001-16 (% total exports RHS)**

*Africa as a whole is a "minerals economy" as is South Africa!*



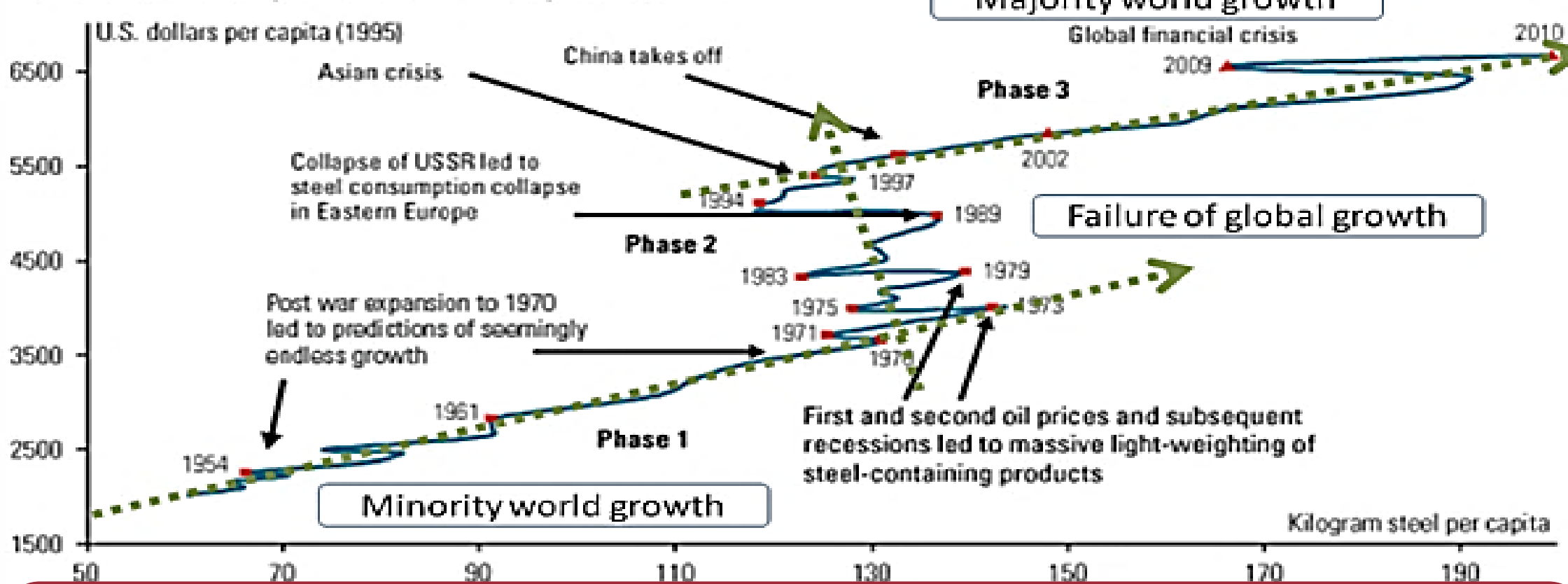


# Global Context (demand)

Global Minerals Intensity of GDP (steel proxy)

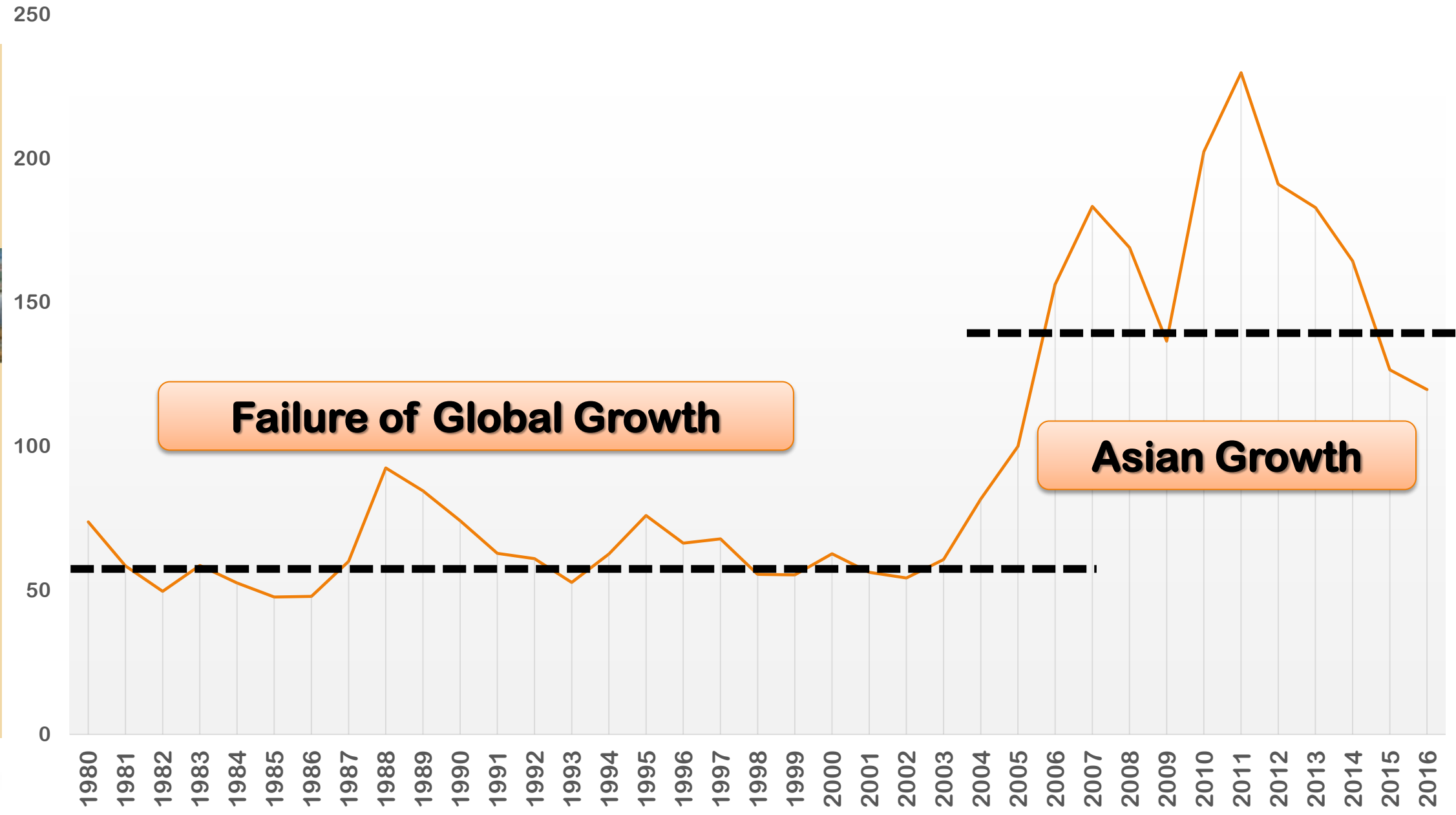
## How Global Steel Consumption Has Evolved Over the Past 50 Years

World Steel Consumption and GDP Per Capita, 1950-2010



**The population of India and China alone is more than double the OECD – Thus if they continue their growth, this could be a prolonged high intensity cycle, excluding growth in SE Asia, Latin America, Africa, etc.**

# Mineral Commodity Price Index (2005=100)





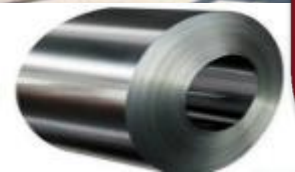
# *Sustainability in Mining?*

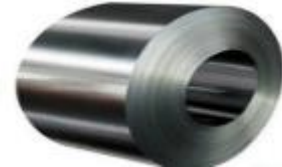
***Mining exploits FINITE national resources and accordingly can never be sustainable, in itself, in the longer term!***

However, Hartwick's rule for sustainability prescribes reinvesting resource rents, thus keeping the value of net investments equal to zero.

Hartwick's rule defines the amount of investment in *produced capital* (infrastructure, knowledge stocks, etc.) that is needed to exactly offset declining stocks of non-renewable resources. This investment is undertaken so that the standard of living does not fall as society moves into the indefinite future.

***"What should each generation give back in exchange for depleted resources if it wishes to abide by the ethic of sustainability? ... we owe to the future a volume of investment that will compensate for this year's withdrawal from the inherited stock." (Solow, 1993, p. 170)***





# Beyond a hole in the ground: Resource Sustainability?

*Optimising the developmental impact of  
Africa's mineral assets:  
**The Africa Mining Vision***

*Linkages & Diversification crucial for indirect  
sustainability!*



# AU: Africa Mining Vision (AMV)

***“Transparent, equitable and optimal exploitation of mineral resources to underpin broad-based sustainable growth and socio-economic development”***

This shared vision will comprise: A knowledge-driven African mining sector that catalyses & contributes to the broad-based growth & development of, and is fully integrated into, a single African market through:

- **Down-stream linkages** into mineral beneficiation and manufacturing;
- **Up-stream linkages** into mining capital goods, consumables & services industries;
- **Side-stream linkages** into infrastructure (power, logistics; communications, water) and skills & technology development (HRD and R&D);
- **Mutually beneficial partnerships** between the state, the private sector, civil society, local communities and other stakeholders; and
- **A comprehensive knowledge of its mineral endowment.**

***AMV recognises the critical importance of establishing the seminal mineral linkages, whilst the resource is still extant!***



# AMV: Seminal Mineral Linkages

Maximise the 6 resource *linkages*

**1. FISCAL:** Capture & invest of resource rents (RRT) in long-term economic physical & human infra (inter-generational)

**2. SPATIAL**  
Puts in critical infrastructure to realise other economic potential & could stimulate LED

**3. BACKWARD**  
Inputs: Capital goods, consumables, services, (also export)

**4. KNOWLEDGE**  
Linkages (HRD & R&D):  
“Nursery” for new tech clusters, adaptable to other sectors

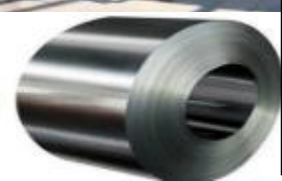
**5. FORWARD**  
Value-addition: (beneficiation)  
Export of resource-based articles

**6. CONSUMPTION**  
Linkages (wages spend- induced)

*Use depleting assets to underpin growth in sustainable sectors*

**HRD, R&D**

*If the linkages cannot be made, the people’s resources would be best left unexploited- Need to maximise the developmental & inter-generational impact whilst still extant!*





socio-enviro-political context

Consumption (induced) Linkages

RMCs

Infrastructure Linkages

(spatial) into regional economy

- **Transport:** roads/rail, ports, et al
- **Power & transmission**
- **Water & reticulation**
- **ICT, other**

Fiscal Linkages

- Levies, ground rents,
- Duties/tariffs/excise
- Royalties, dividends (equity)
- CIT, RRT, WHT, PAYE, et al
- SWFs, Stabilisation Funds, etc.

Knowledge Linkages

**Geo-knowledge**  
Systematic geo-survey & target development

**HRD**  
• Engineers & scientists  
• Technicians  
• Operators, etc

**RDI**  
• Universities  
• R&D entities  
• Firm RDI, et al

Forward/Downstream Linkages: Key feedstocks into regional/local economy

**Manufacturing**  
(Fe/steels, polymers, Cu/Al, et al)

**Agriculture**  
(NPK, conditioners)

**Construction**  
(Fe/steels, cement, Cu/Al, aggregate)

**Power**  
(fossil fuels: coal, oil & gas)

**Other Sectors**

Jobs/wages (also in backward, forward, knowledge and infrastructure linkages)



EXPORTS to world economy (into GMVCs)

Backward/upstream Linkages: Inputs into local/regional/global minerals sector

**Capital Goods**  
• Machinery  
• Equipment  
• Plant  
• Vehicles, et al

**Consumables**  
• Explosives/caps  
• Grinding media  
• Wear parts, spares  
• Chemicals/reagents  
• Fuels & lubes, et al

**Services**  
• Drilling/exploration  
• Finance, ICT  
• Labour/skilling  
• Engineering/Analytical  
• Logistics, catering, et al

**Other Inputs**  
• Construction,  
• Utilities,  
• et al

Lateral Linkages: products into other sectors of the local/regional/global economy

socio-enviro-political context

Consumption (induced) Linkages

RMCs

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(spatial) into regional economy

- **Transport:** roads/rail, ports, et al
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**Power**  
(fossil fuels: coal, oil & gas)

**Other Sectors**

# AFRICAN MINING VISION

*Realisation of ALL mineral linkages*

**Backward/upstream Linkages:** Inputs into local/regional/global minerals sector

**Capital Goods**

- Machinery
- Equipment
- Plant
- Vehicles, et al

**Consumables**

- Explosives/caps
- Grinding media
- Wear parts, spares
- Chemicals/reagents
- Fuels & lubes, et al

**Services**

- Drilling/exploration
- Finance, ICT
- Labour/skilling
- Engineering/Analytical
- Logistics, catering, et al

**Other Inputs**

- Construction,
- Utilities,
- et al

**Lateral Linkages:** products into other sectors of the local/regional/global economy

# The impact of FDI on linkages realisation

*In order to rapidly acquire the requisite capital, skills & technology, Africa mainly uses FDI (rather than relying on domestic capital). However, this could compromise the development of the crucial resources linkages:*

- 1) Fiscal linkages: Foreign companies have **more scope & incentive to transfer price** (tax evasion), especially FDI from "tax havens". + **FDI dividends leakage!**
- 2) Backward linkages: TNCs often have **global purchasing** strategies which are less likely to develop local suppliers; **Imports facilitate transfer pricing (over invoicing of inputs to minimise tax)**;
- 3) Forward linkages: TNCs tend to optimise their **global processing** facilities which can deny local downstream opportunities; **Export ores/concs for transfer pricing (opaque output prices)**;
- 4) Knowledge linkages: TNCs locate their **high level HRD and tech development (RDI) in OECD countries**, thereby denying Africa the development of these critical linkages; **Overseas RDI & HRD could also facilitate transfer pricing**
- 5) In the longer term there are clearly **political downsides** to prime national resources depletion being dominated by foreign capital.

**Nevertheless, these threats can all be overcome with appropriate extractives policies & strategies and the development of local mining capital!**

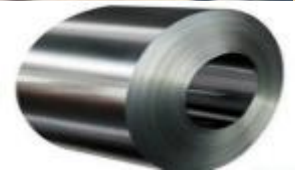


*“Every \$1 million of government investment to enhance the geoscience knowledge base will likely stimulate \$5 millions of private sector exploration expenditures, which, in turn, will result in discovery of new resources with an average in situ value of \$125 millions.”* (Boulton, 1999)

Overall, investment (funding) into geological survey departments in Africa has been in decline and most of the continent still lacks systematic geological mapping at 1:100,000 scale.

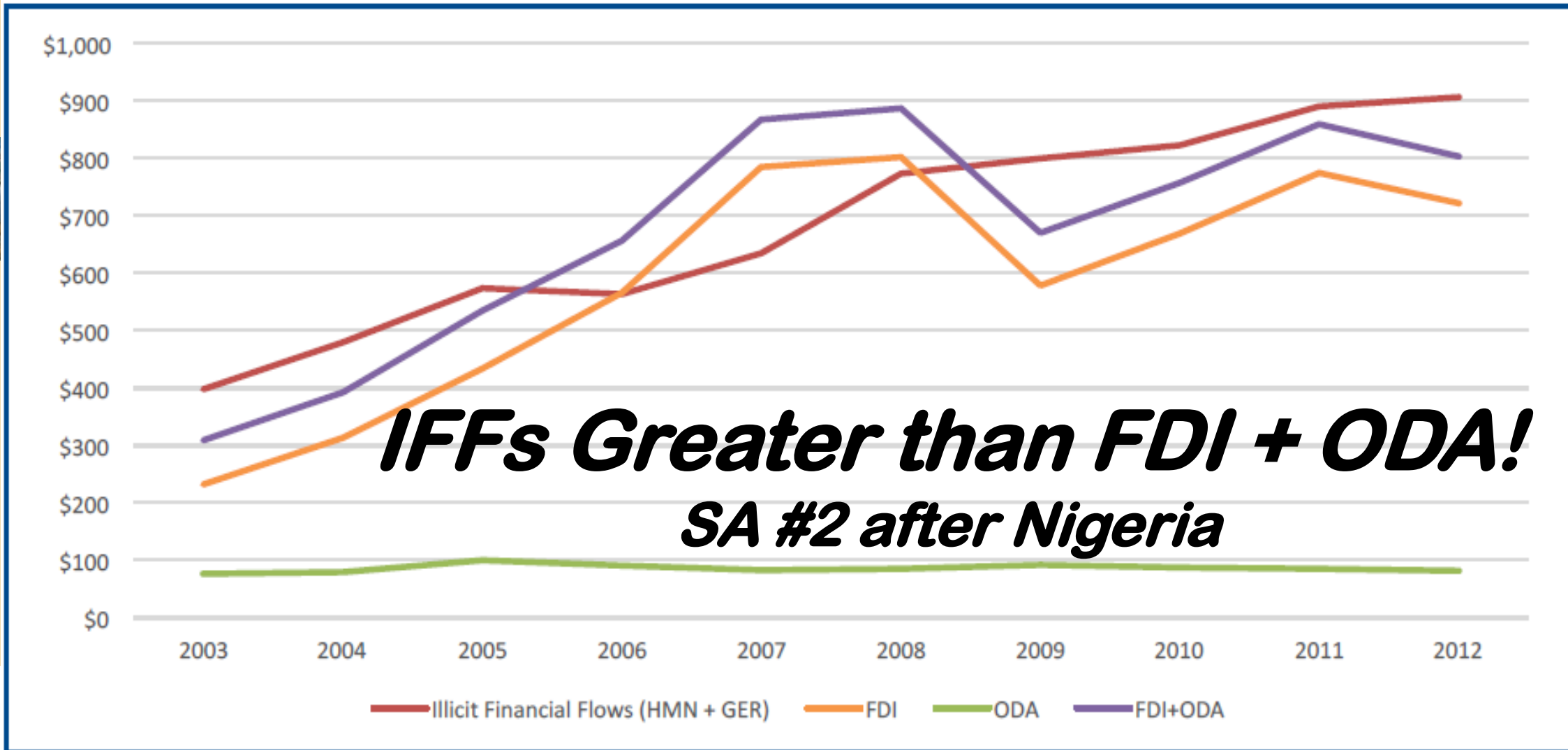
The more a RMC knows about the potential value of resources the greater will be its ability to strike equitable deals with investors on the division of future rents and benefits accruing from the exploitation of the resource.

It stands to reason that a small portion of revenues from the extraction of current finite resources needs to be reinvested in replenishing the resource stock by funding geological survey and the development of investment targets arising out of systematic investigations.





# Real Illicit Financial Flows (mispricing), Official Development Assistance, & Foreign Direct Investment 2003-2012 (constant 2010 US\$ bn)



# ***Forward Linkages: The Principal Mineral-Based Feedstocks for Local-Regional Growth, Development and Job Creation***

*Critical feedstocks into the local-regional economy-*

<b><i>Manufacturing:</i></b>	<b><u>Steel/alloys, polymers</u> (from coal, HCs), base metals (Cu, Zn, et al)</b>
<b><i>Energy (electricity):</i></b>	<b><u>Coal, oil &amp; natural gas</u> (and CBM, shale gas), radioactive minerals, limestone (emissions)</b>
<b><i>Infrastructure:</i></b>	<b><u>Steel</u>, copper, cement (from limestone, gypsum, coal)</b>
<b><i>Agriculture:</i></b>	<b><u>Nitrogen</u> (from coal, gas), phosphate, potassium and conditioners (e.g. limestone, sulphides)</b>

***Africa and SA have ample resources for the cost-effective production of all of these critical feedstocks for downstream job***

*Plus -*

<b><i>Producer power:</i></b>	<b>Finally, where Africa has potential producer power, there could be increased downstream (beneficiation) potential (e.g. <u>PGMs, cobalt, diamonds</u>)</b>
-------------------------------	---

# STRATEGIC REGIONAL MINERAL FEEDSTOCK VALUE CHAINS

UPSTREAM

MINING/MINERAL

STRATEGIC DOMESTIC FEEDSTOCKS

REGIONAL CONSUMPTION

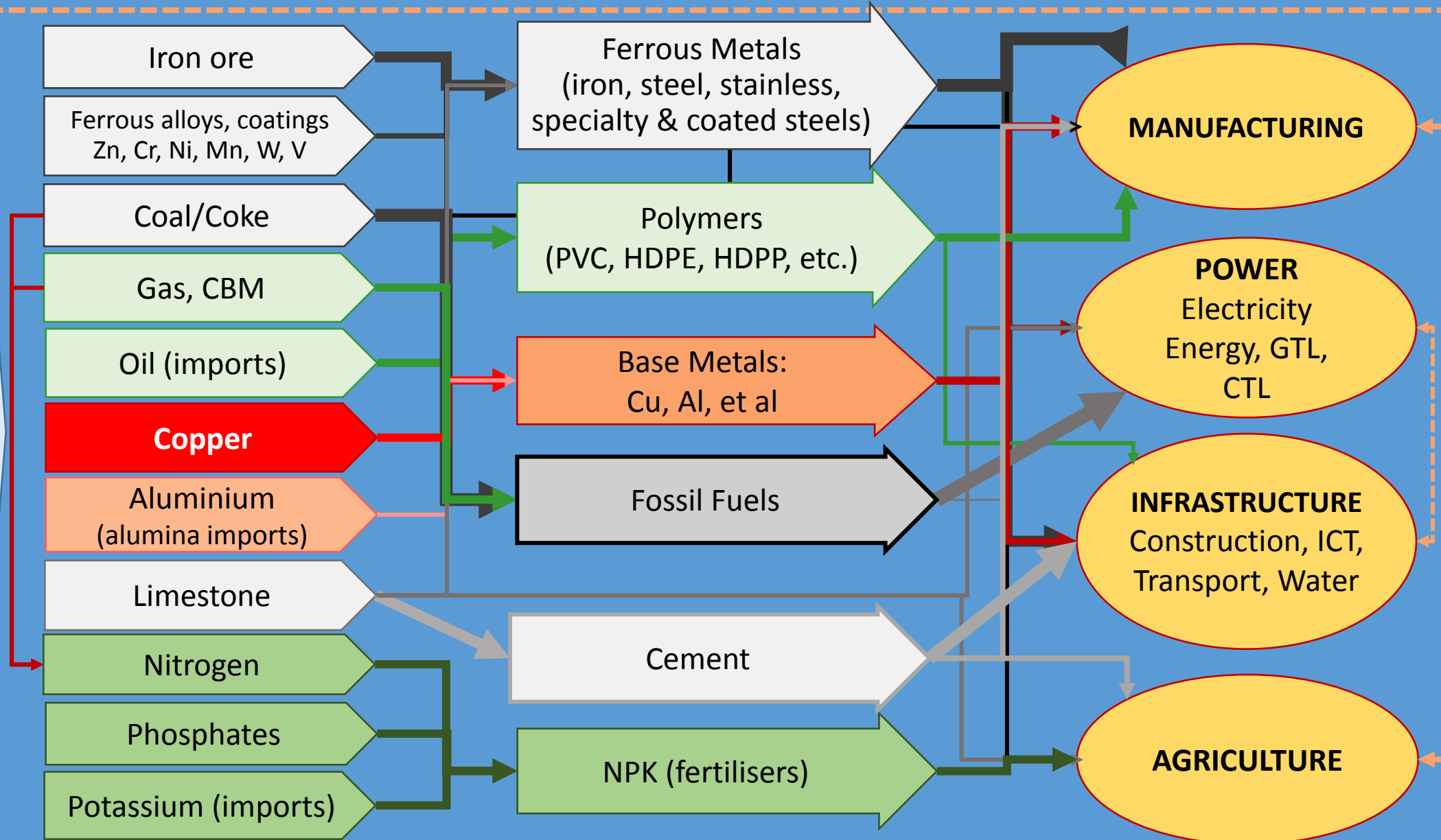
## Mining & Processing Inputs

**CAPITAL GOODS:**  
Machinery, plant, equipment, etc.

**CONSUMABLES:**  
Explosives, drilling steel, parts, grinding media, chemicals, etc.

**SERVICES:**  
Labour, analytical, financial, security, ICT, etc....

**Relatively large market!**  
**(SADC=2XEU)**



# STRATEGIC REGIONAL MINERAL FEEDSTOCK VALUE CHAINS

UPSTREAM

MINING/MINERAL

STRATEGIC DOMESTIC FEEDSTOCKS

REGIONAL CONSUMPTION

**Mining & Processing**

Iron ore

Ferrous alloys, coatings

Ferrous Metals  
(iron, steel, stainless, specialty & coated steels)

Polymers  
(PVC, HDPE, HDPP, etc.)

Base Metals:  
Cu, Al, et al

Fossil Fuels

Aluminium  
(alumina imports)

Limestone

Nitrogen

Phosphates

Potassium (imports)

Cement

NPK (fertilisers)

**MANUFACTURING**

**POWER**  
Electricity  
Energy, GTL,  
CTL

**INFRASTRUCTURE**  
Construction, ICT,  
Transport, Water

**AGRICULTURE**

**Critical constraint!**

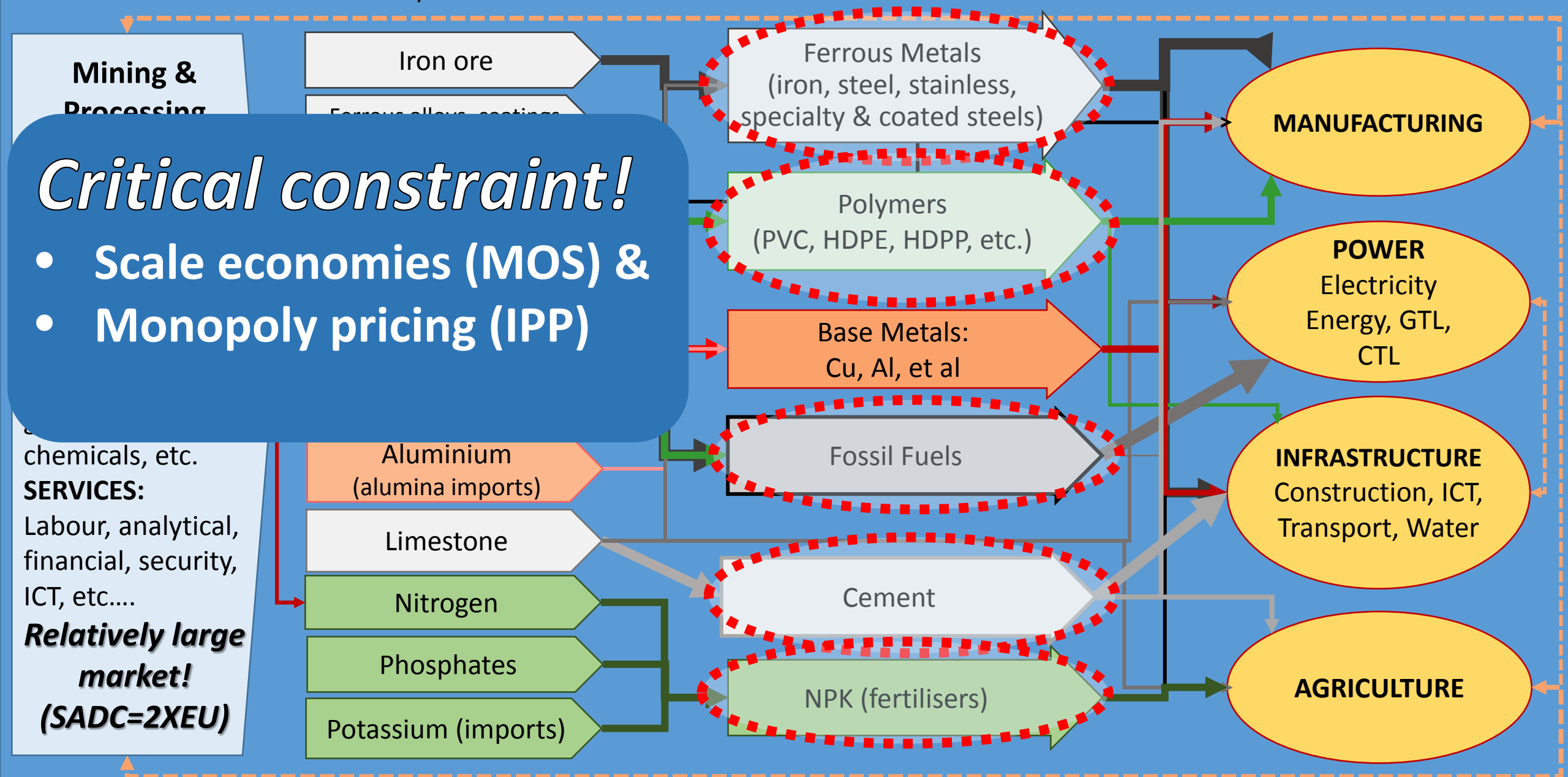
- Scale economies (MOS) &
- Monopoly pricing (IPP)

chemicals, etc.

**SERVICES:**

Labour, analytical, financial, security, ICT, etc....

**Relatively large market!**  
**(SADC=2XEU)**





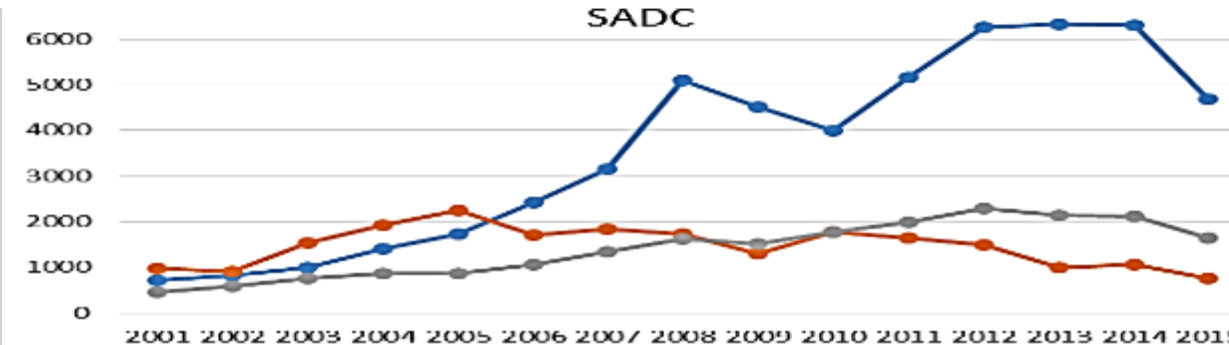
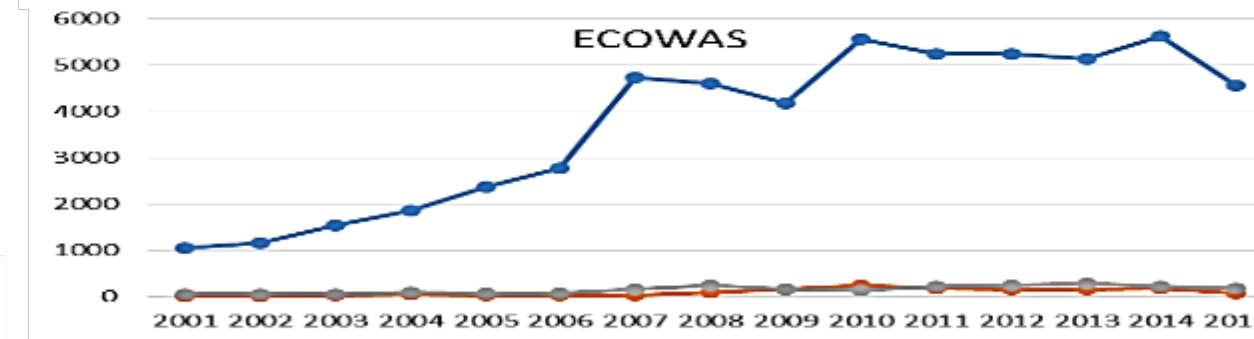
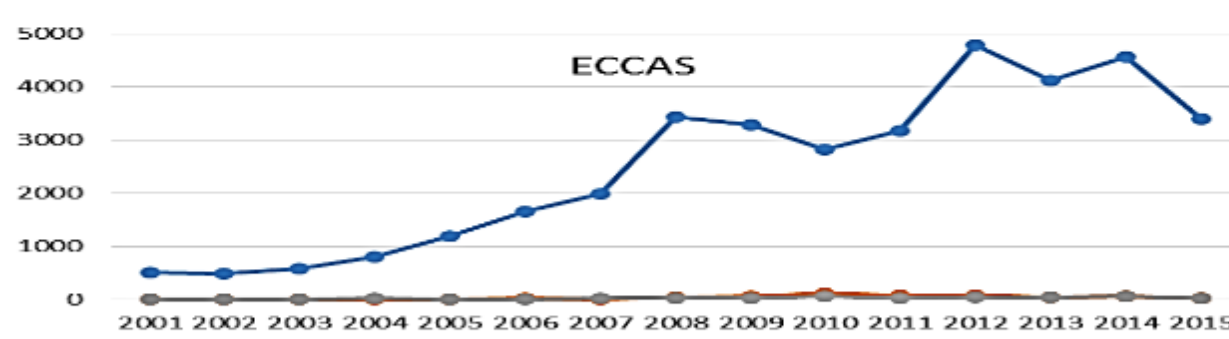
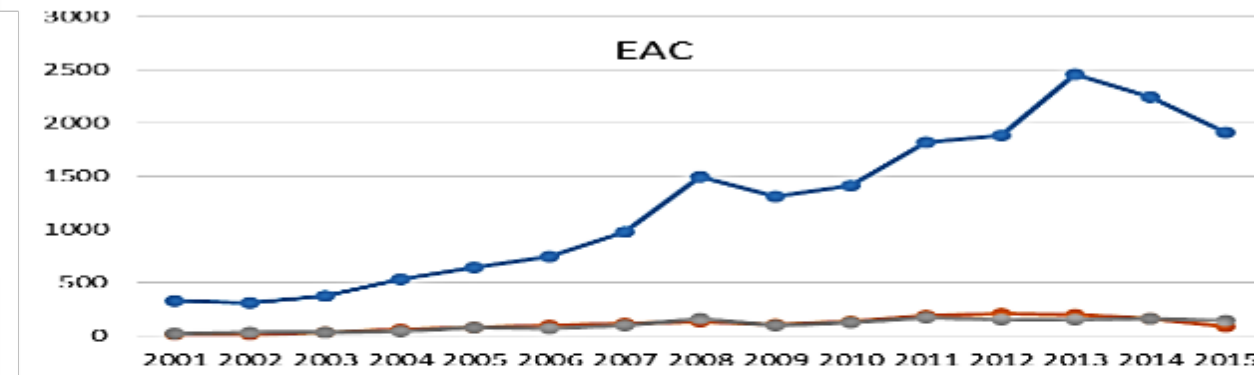
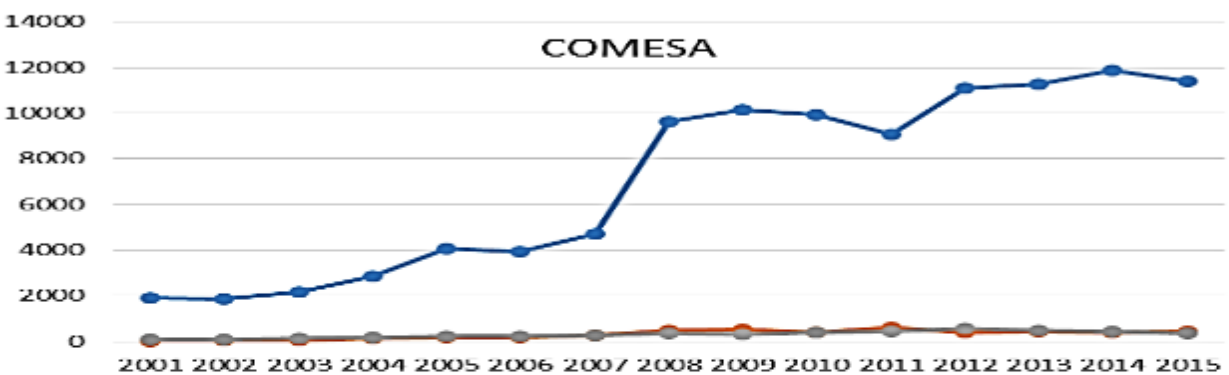
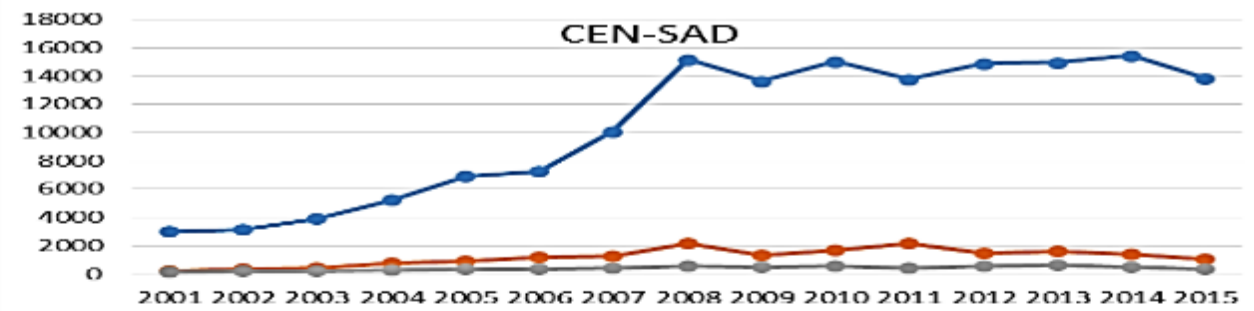
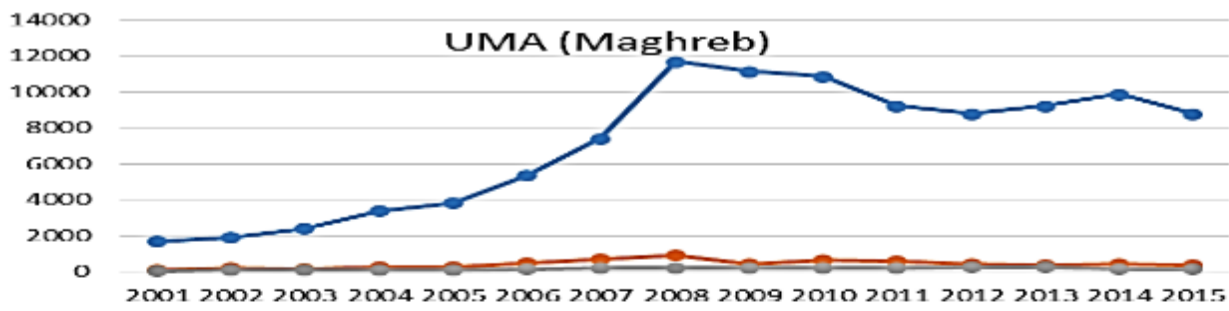
## ***Regional (REC) RBI strategies could overcome single RMC constraints:***

- increase market size and scale economies for both mining inputs and outputs, for both intermediates and semi-fabricated products (key feedstocks into local-regional development),
- access a much wider range, quality and size of mineral deposits for key strategic mineral feedstock requirements,
- widen and strengthen STEM skilling and RDI capacity and capability,
- improve regional geo-knowledge through cross-border collaboration in geological research,
- harmonise and align mineral regimes to create a uniform operating environment supportive of linkages development and avoid “the-race-to-the-bottom”,
- strengthen minerals sector oversight, auditing, revenue collection and deployment through collective self-reliance and regional best-practice;
- enhance infrastructure capacity and efficacy through harmonisation and alignment of transport, power and water systems and multi-RMC resource-based “development corridors,
- enhance local economic and social impacts of mineral projects through harmonised corporate social responsibility and investment mechanisms (and avoid “the-race-to-the-bottom),
- improve worker health and safety through alignment of codes based on regional “best practice”,
- improve environmental sustainability through alignment of codes/SEA/EIA, based on regional “best practice”,

## Regional (REC) RBI strategies could overcome single RMC constraints:

- increase market size and scope (through regional integration and trade agreements), for both intermediates and semi-fabricated products (development),
- access a much wider range of mineral resources (including strategic mineral feedstock requirements),
- widen and strengthen regional trade links,
- improve regional infrastructure (roads, ports, rail, air, sea),
- harmonise and align regional policies and standards to facilitate trade and investment development and economic growth,
- strengthen mineral sector governance and regulatory frameworks through collective self-reliance and regional cooperation,
- enhance infrastructure (roads, ports, rail, air, sea) and energy (power and water supply) support,
- enhance local economic development and job creation through corporate social responsibility and investment promotion,
- improve worker health and safety standards (aligned with international "best practice"),
- improve environmental sustainability through regional standards/SEA/EIA, based on regional "best practice",

**Need to develop  
customised  
Regional Mining  
Visions (RMVs) for  
Africa's RECs**



## African REC Steel Trade (US\$m)

- Imports from RoW
- Exports to RoW
- Internal Trade

*Adequate demand for integrated mills in most RECs*

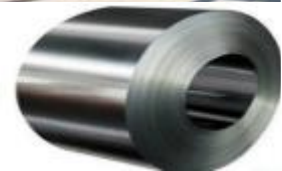
## Managing REC “Variable Geometry”

African RMCs are at widely varying levels of development impacting profoundly on their ability to benefit from Regional RBI strategies that realise the regional market for key mineral feedstocks and inputs. Consequently robust instruments need to be developed to manage variable geometry and “level the playing field” for weaker economies, less able to reap the benefits of a regionalised mining vision.

- ***Regional-local content recognition at inverse of GDP/capita to grow REC minerals inputs industries (capital goods, consumables, etc.);***
- ***Regional Development Funds (VCFs) to invest in new backward (inputs) & forward (key feedstocks) projects (PFS, debt & equity);***
- ***Logistics equalisation mechanism for mineral sector inputs and key feedstocks to assist RMCs with higher logistics costs to participate;***
- ***Infant industry protection ( $\leq 7y$ ) for new investments into mining and mineral processing inputs and key feedstocks industries***



## Example of a REC (SADC) indicative weighting using the inverse of GDP/capita



RMC	GDP/cap 2015 (\$)	50-90%* Local content recognition	10-90% VCF PFS funding VCF debt funding	10-50% VCF equity
Angola	4102	73%	56%	33%
Botswana	6361	63%	35%	23%
Congo, Dem. Rep.	456	90%	89%	50%
Lesotho	1034	87%	84%	47%
Madagascar	412	90%	90%	50%
Malawi	381	90%	90%	50%
Mauritius	9117	50%	10%	10%
Mozambique	525	89%	89%	49%
Namibia	4696	70%	50%	30%
South Africa	5692	66%	41%	26%
Swaziland	3155	66%	41%	26%
Tanzania	865	77%	65%	37%
Zambia	1308	88%	86%	48%
Zimbabwe	890	86%	82%	46%
Seychelles	15476	50%	10%	10%
Other African States	NA	50%	NA	NA

\*host RMC 100%; Note: Seychelles zeroed due to GDP/cap outlier and lack of minerals/linkages sector

# Proposed REC VCF for Mining Inputs and Key Feedstock Manufacturing Projects

## *RAMVADA: Regional African Mining Value Addition Development Agencies*



**Capitalisation**  
50% -All RMCs (% share of REC Mining VA X GDP/cap?)  
DFIs, Pension Funds, et al

50% - REC Mining Companies;  
Inputs Suppliers? Plus, Multilaterals, Donors, et al

**RAMVADA**  
Development of Inputs and key feedstocks projects:  
PFSs, Equity & Debt inversely proportional to GDP/capita  
(1/GDP/cap)


PFS Funding:  
0 -100%  
1/GDPpc

Debt Funding:  
0-90%  
1/GDPpc

Equity :  
0-49.9%  
1/GDPpc

Debt at LIBOR plus; Equity return target  $\geq 10\%$

# Conceptual intra-REC Mineral Inputs/feedstocks Logistics Compensation Scheme?



Regional average  
cost/t-km for  
regional inputs  
(>65% R-LC\*) into  
resources inputs  
and feedstocks  
suppliers (ASIC)

**REC Mining  
Inputs Supplier  
& Key Feedstock  
Supplier  
(>65% R-LC\*)**

Regional average  
delivery cost/t-km  
for regional inputs  
(>65% R-LC\*) to  
REC customers  
(ASDC)

**REC mines &  
downstream  
industries**

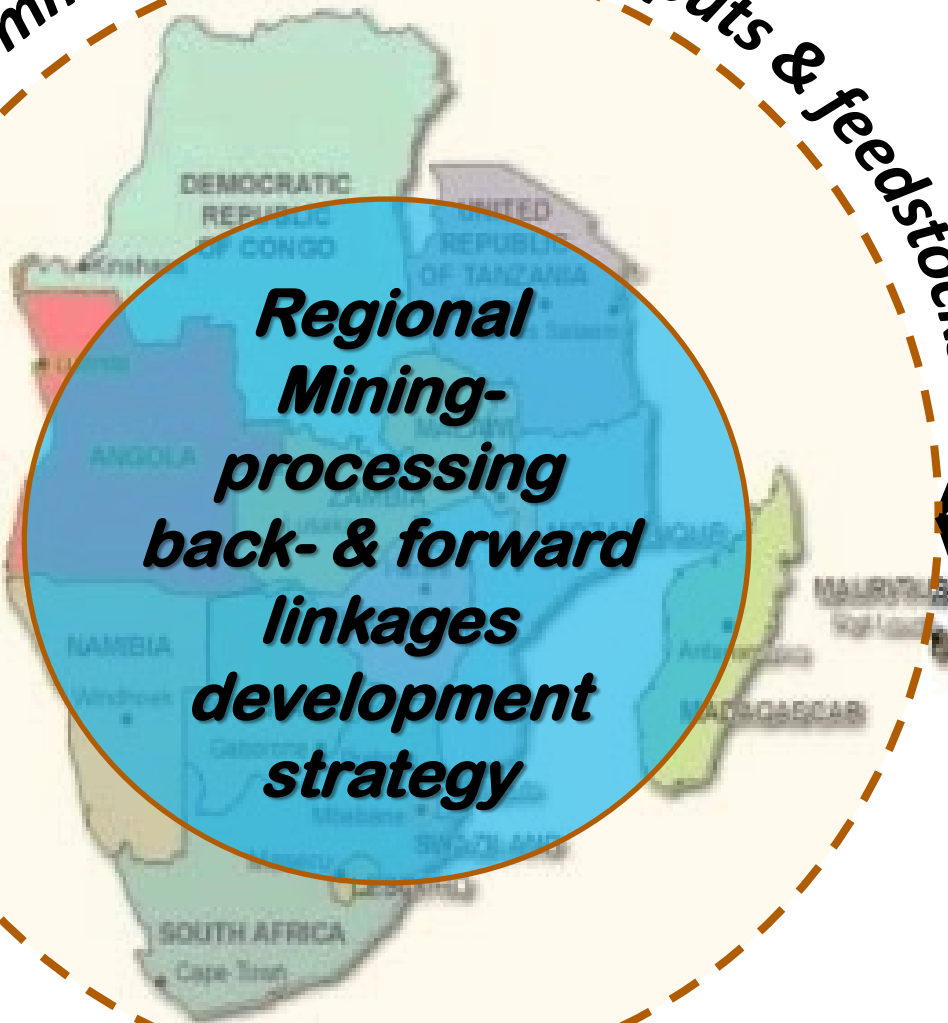
**Compensation: RMC  
avg. cost per t-km minus  
ASIC**  
(Average Suppliers Inputs Costs)

**Compensation: RMC  
avg. cost per t-km  
minus ASDC**  
(Average Suppliers Delivery Costs)



# Regional Mining Vision (RMV) RBI Strategy

*Common outer tariff for inputs & feedstocks*



**Regional-Local Content System**  
Mining/processing Inputs (capital goods, consumables, services). Recognition  $\propto$  1/GDP per capita

- Key Regional Feedstocks Strategy**  
(intermediates & semis)
- Iron/steel & semis (& coke)
  - Base metals (Cu, Al & semis)
  - Fertiliser Minerals (NPK) & formulations
  - Polymers
  - Cement, et al

**Regional Inputs & Key Feedstocks Investment Fund (VCF)**  
RMC benefit  $\propto$  1/GDP per capita

**Regional Logistics Equalisation Scheme**  
RMC benefit = cost/t-km above regional average

**Regional STEM Skilling Strategy**  
Regional Centres of Excellence with intra-regional twinning & capacitation

**Infant Industry Protection**  
RMCs below SADC average GDP/capita ( $\leq 10\% \leq 7y$ )

RMC: Regional Member Country



Catalyse other Sectors & areas (agri, tourism, etc.)

# AMV Linkages Recap:

Infrastructure: transport, energy, skills (SDP)

Exploitation  
capital goods  
e.g. plant  
aff

Processing

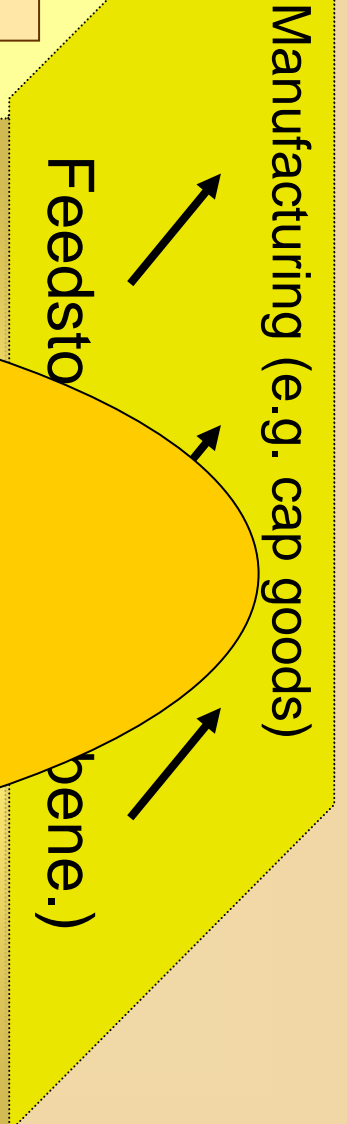
Intermediates

**BEYOND COMMODITIES?**  
Use our regional mineral endowments to catalyse REC integrated Resource-based Industrialisation (RBI) Strategies

Exploitation  
services:  
e.g. financial, technical,  
consumables, logistics,  
energy, skills, etc.

Processing  
services

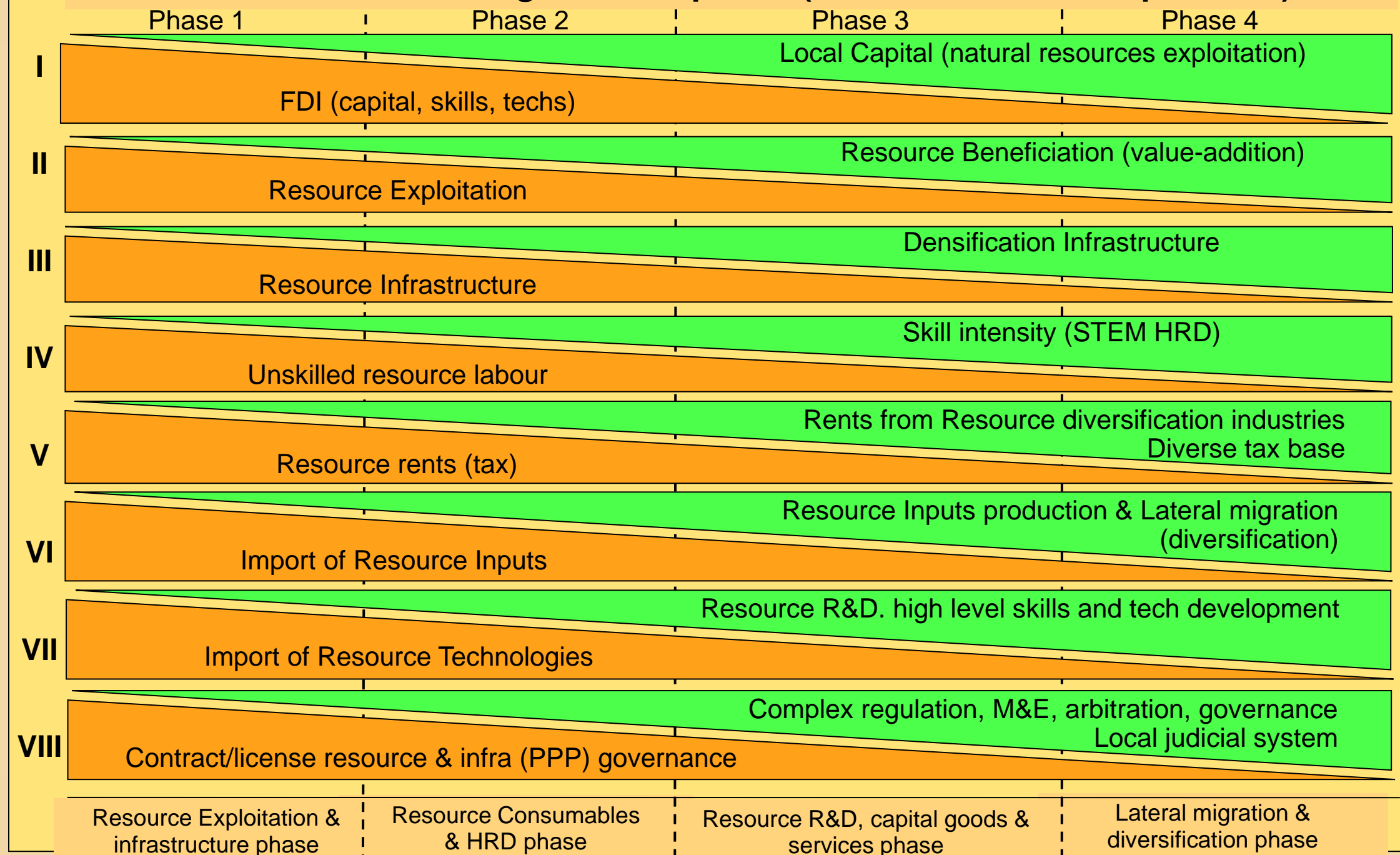
Intermediates  
services



Resource inputs key to diversification (e.g. Nordics)



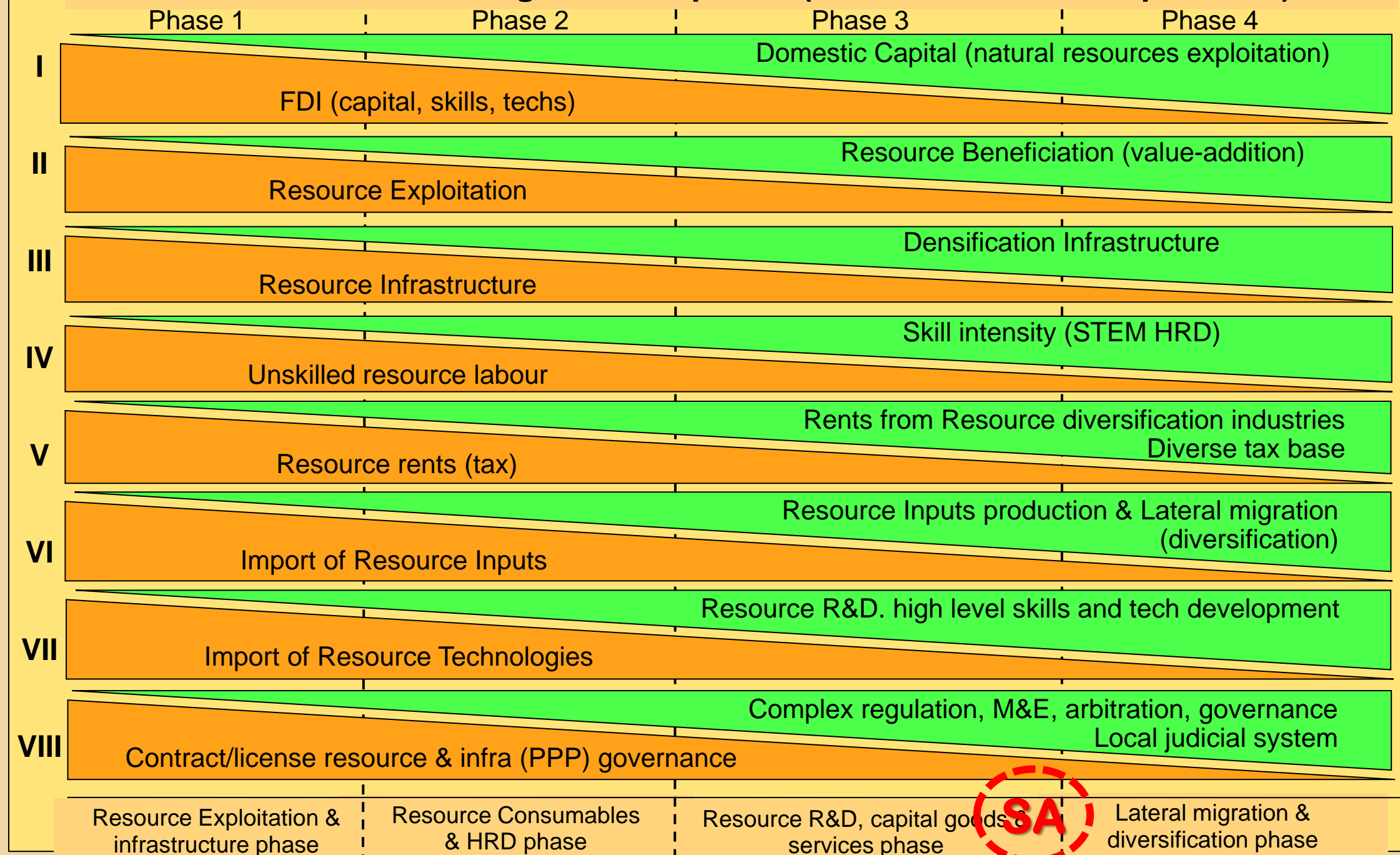
# Schematic AMV Linkages Development (relative economic importance)







# Schematic AMV Linkages Development (relative economic importance)





# Conclusion

SA & SADC's significant and diverse mineral resources and production, together with its regional markets and the ingenuity and energy of its diverse peoples, provides a powerful combination to realise *regional resources-based equitable growth and development* and contribute to Africa's industrialisation strategies as well as inter-generational equity.

***This can only be achieved through the realisation of all the mineral linkages, within the guiding framework of Regional Mining Visions, for the upliftment of all of its citizens.***

***The opportunity is ours for the taking, we only need to grasp it to embark on a more prosperous and equitable African future.***

## Mineral Resources Governance for Sustainability: State Capture by rent-seeking pseudo-entrepreneurs

*“Despite the primacy of the state, all power does not rest with government officials and institutions. Rather, the ruling elite comprises individuals and groups both within and outside government who together assert a monopolistic control of wealth. In particular, a “class of rent-seeking pseudo-entrepreneurs” enjoys an umbilical relationship with the state.*

*These business elites are intertwined in the state capture of resource rents and prove to be entrenched obstacles in the face of transformative measures.*

*Together with this rent-seeking dynamic between political and economic elites, the intrusion of the state in the economy - as a result of its control over natural resource sector activities - blurs the distinction between public and private”*

*(Rents to Riches p49).*

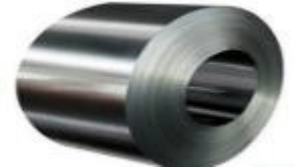




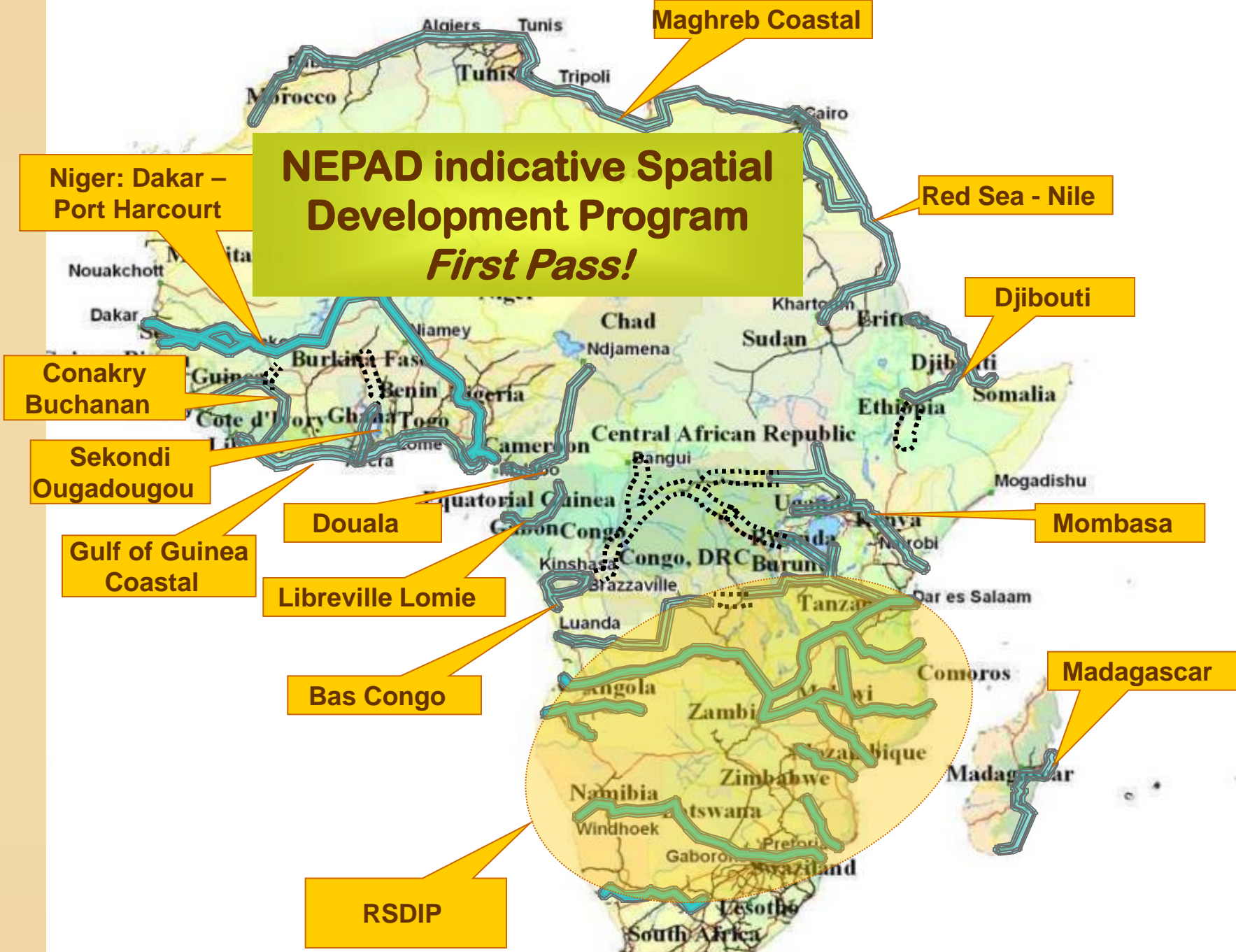


# Thank You

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# Supplementary Slides



**NEPAD indicative Spatial Development Program**  
*First Pass!*

Niger: Dakar – Port Harcourt

Maghreb Coastal

Red Sea - Nile

Djibouti

Conakry Buchanan

Mombasa

Sekondi Ougadougou

Douala

Gulf of Guinea Coastal

Libreville Lomie

Bas Congo

Madagascar

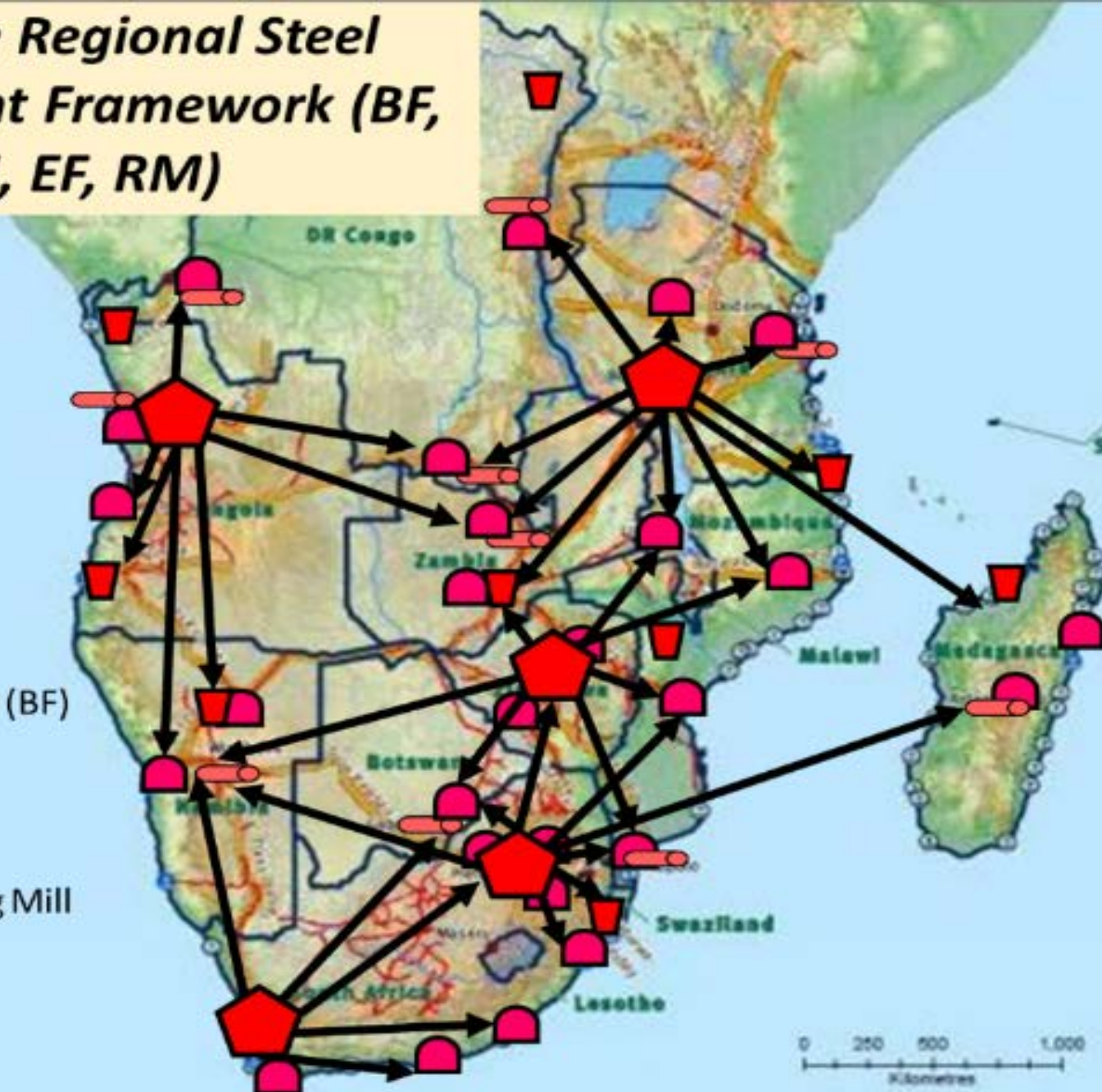
RSDIP



## Indicative Regional Steel Development Framework (BF, DRI, EF, RM)



-  Integrated Mill (BF)
-  DRI/S-R plant
-  EAF/IF
-  Rolling/coating Mill




- SADC**
-  Significant Port
  -  Other Port
- Roads**
-  Primary Route
  -  Secondary Route
  -  Tripartite Transport Corridors (SADC, EAC and COMESA)



**Large (economies of scale) regional petrochemicals complexes:**

- Liquid fuels
- Monomers
- N – fertilise

 *Polymer manufacturing plants*

 Hydropower Dams

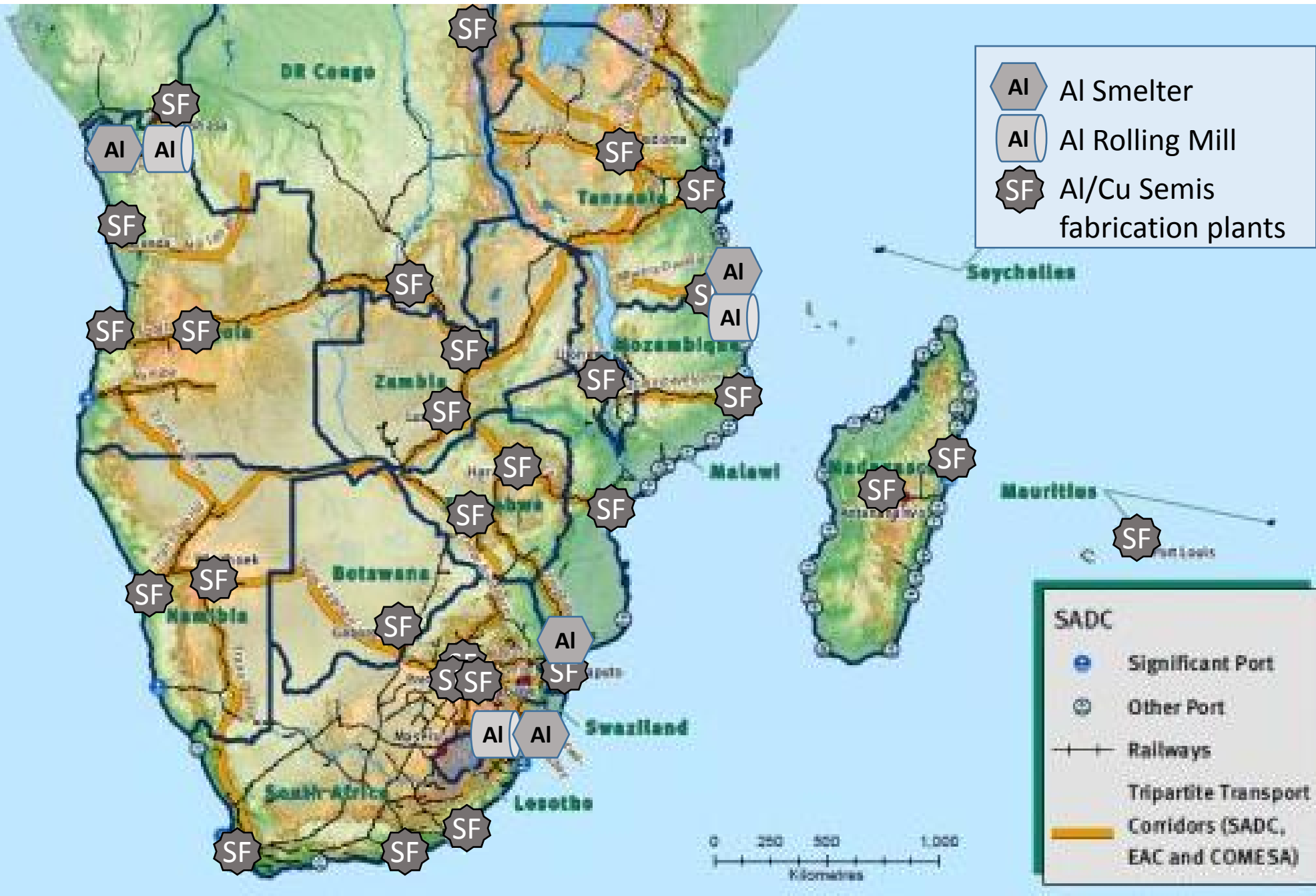
Power Interconnectors and Transmission Lines

 Existing

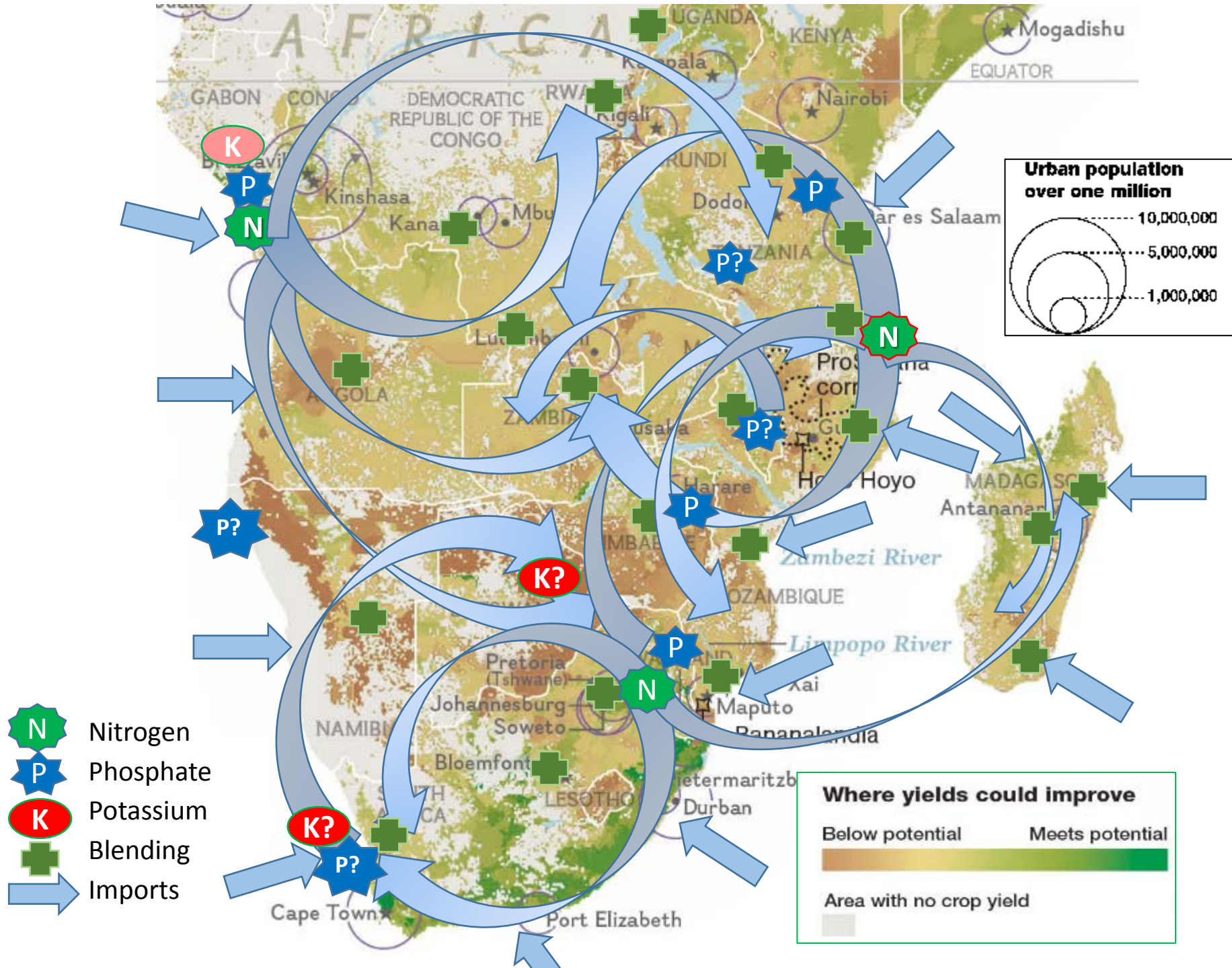
 Proposed











A F R I C A

Mogadishu  
EQUATOR

GABON CONGO DEMOCRATIC REPUBLIC OF THE CONGO RWANDA KENYA  
Kinshasa Kigali Nairobi  
Dodo... Dar es Salaam

K P N P P?

Kina... Mbu... ZAMBIA

ANGOLA ZAMBIA Lusaka

P? P? P? N

Harare Harare Hoyo MADAGASCAR Antananarivo

Zambezi River K? P P

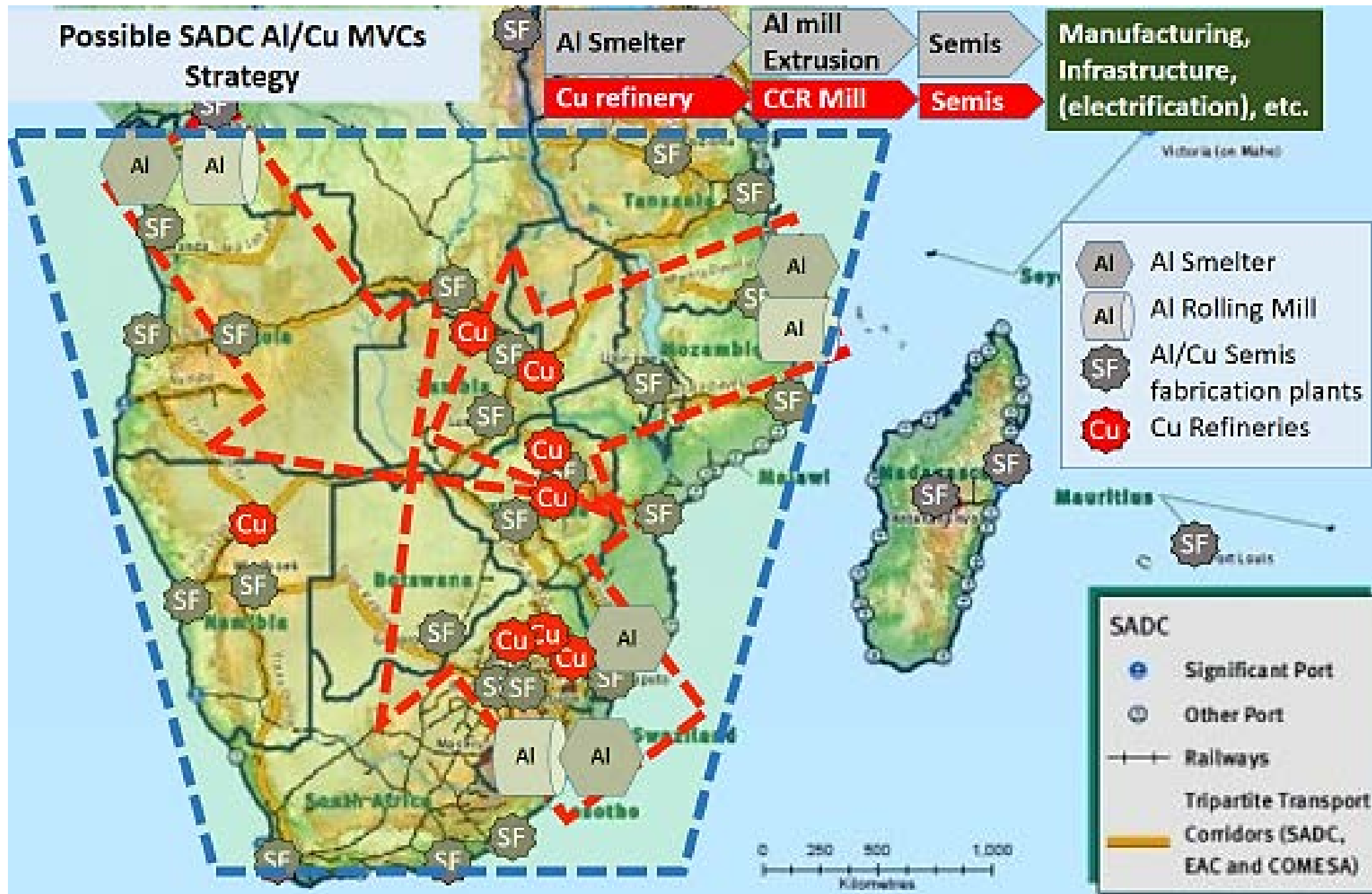
Limpopo River Pretoria (Tshwane) Johannesburg Soweto

NAMIBIA Bloemfontein LESOTHO Durban

K? P? Cape Town Port Elizabeth

Maputo

# Conceptual Example of a Regional Copper & Aluminium Value Chains Framework for Southern Africa

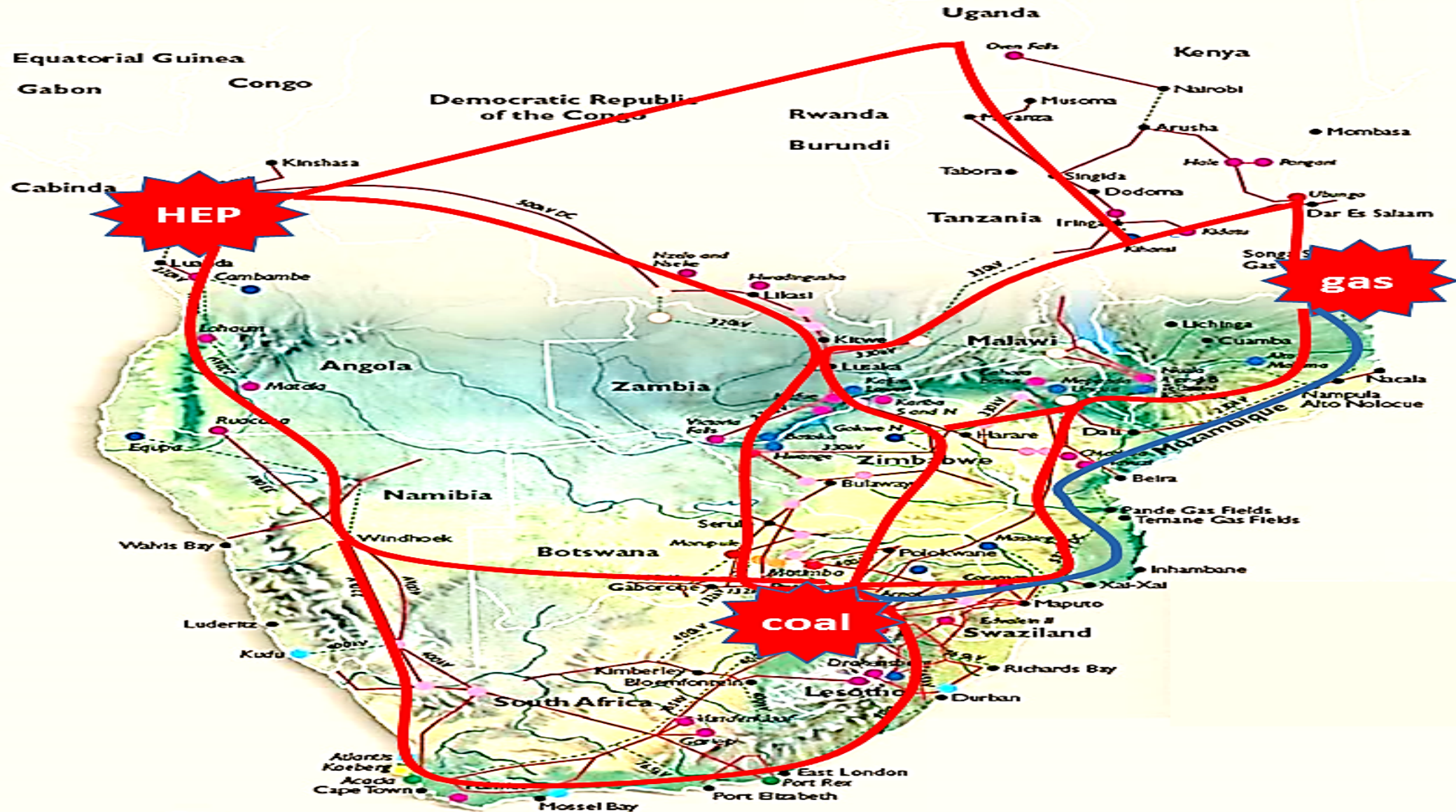


# Conceptual Example of a Regional Petrochemical Feedstocks Supply and Downstream Manufacturing Framework





# Conceptual Example of a Regional HEP, Gas and Coal Base Load Electricity System for Southern Africa (SADC)



## Key

- Existing grid system
- - - Possible future grid system
- Future hydroelectric power station
- Future thermal power station
- Hydroelectric power station
- Interconnection substation
- Thermal power station
- Future interconnection substation
- Nuclear power station
- Future gas station
- Gas power station
- Town

The map indicates the South African power network and interconnections with neighbouring countries.

## Potential Regional Producer Power MVCs (fabrication for export)

