

Planning for a Post-mining Economy

The application of Complex
Transformative and Adaptive Systems
in planning Just Transition Pathways
for Post-mining Economies

Prof Michael Solomon
Glenburn Lodge
Wednesday, 16-17 October 2024



SAIMM

ESG in the Minerals Industry: Challenges and Opportunities





	2024 Rm
Prepared on a headline earnings basis	
Revenue	30 880
Other net income	865
Gross value generated	31 745
Depreciation	(3 806)
Deferred tax	(51)
Value available for distribution to stakeholders	27 888
Distribution of value	
Labour and other	(15 814)
Cost of sales – other ² Direct Costs	(10 732)
IFRS 2 <i>Share-based Payment</i> charge ³	(1 144)
State royalties	(322)
Direct state taxes Rents	(398)
Finance costs	(84)
Dividends paid to shareholders	—
Diminution of value/(value retained in the business)	606



Mine Closure and Environmental Management Plans are often one and sometimes two-dimensional static constructs. They are designed to comply with regulations governing the rehabilitation of the physical environment. They seldom adequately address the socio-economic devastation that impacts mining-dependent communities on mine closure.

A different approach is needed whereby mine closure plans address the geographic and demographic impacts and respond dynamically to changing economic, social, political and environmental factors.

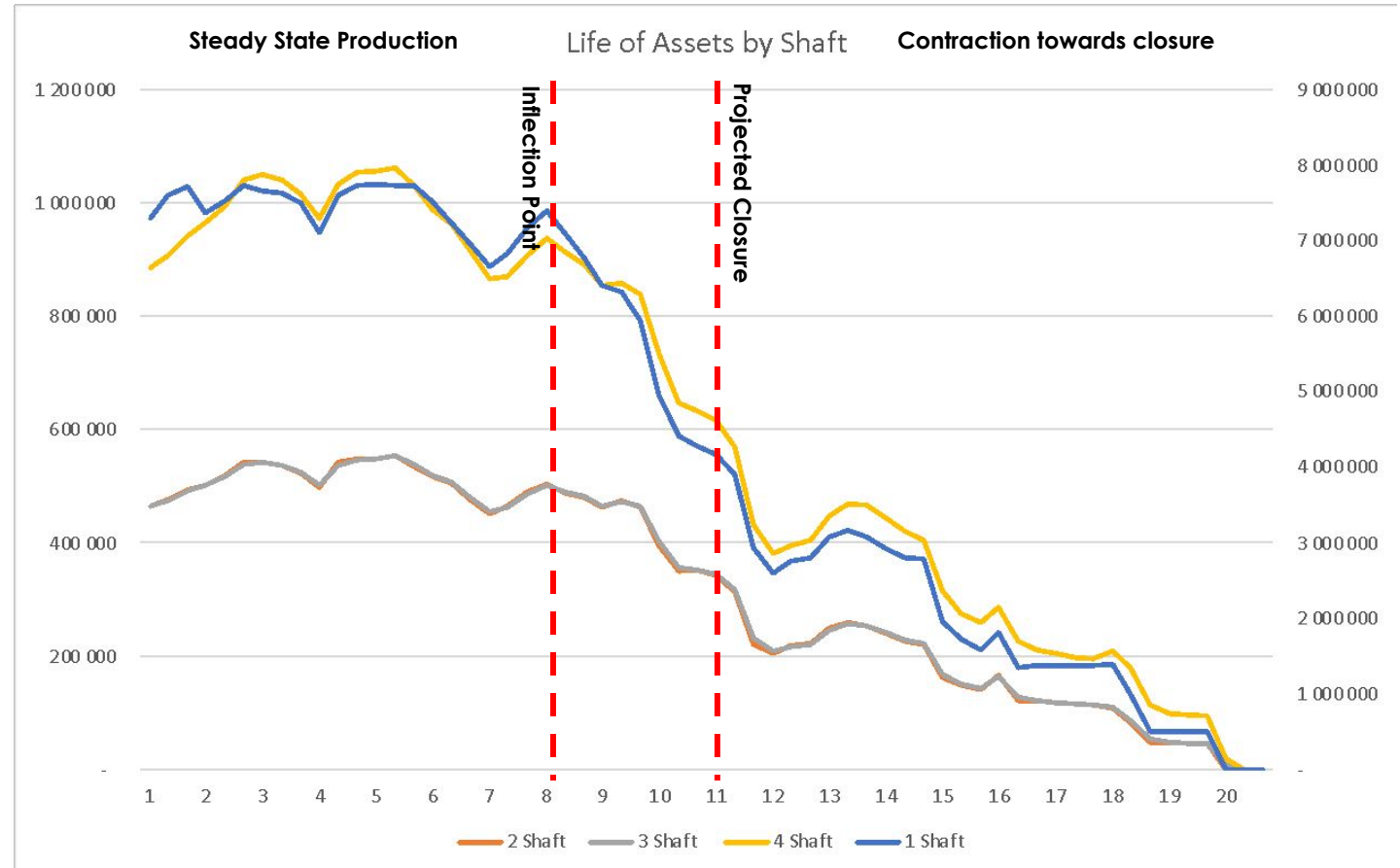
This is encapsulated in Complex Transformative and Adaptive Systems Modelling.

The first problem: The Life of Mine is elastic and responds to constantly changing economic variables

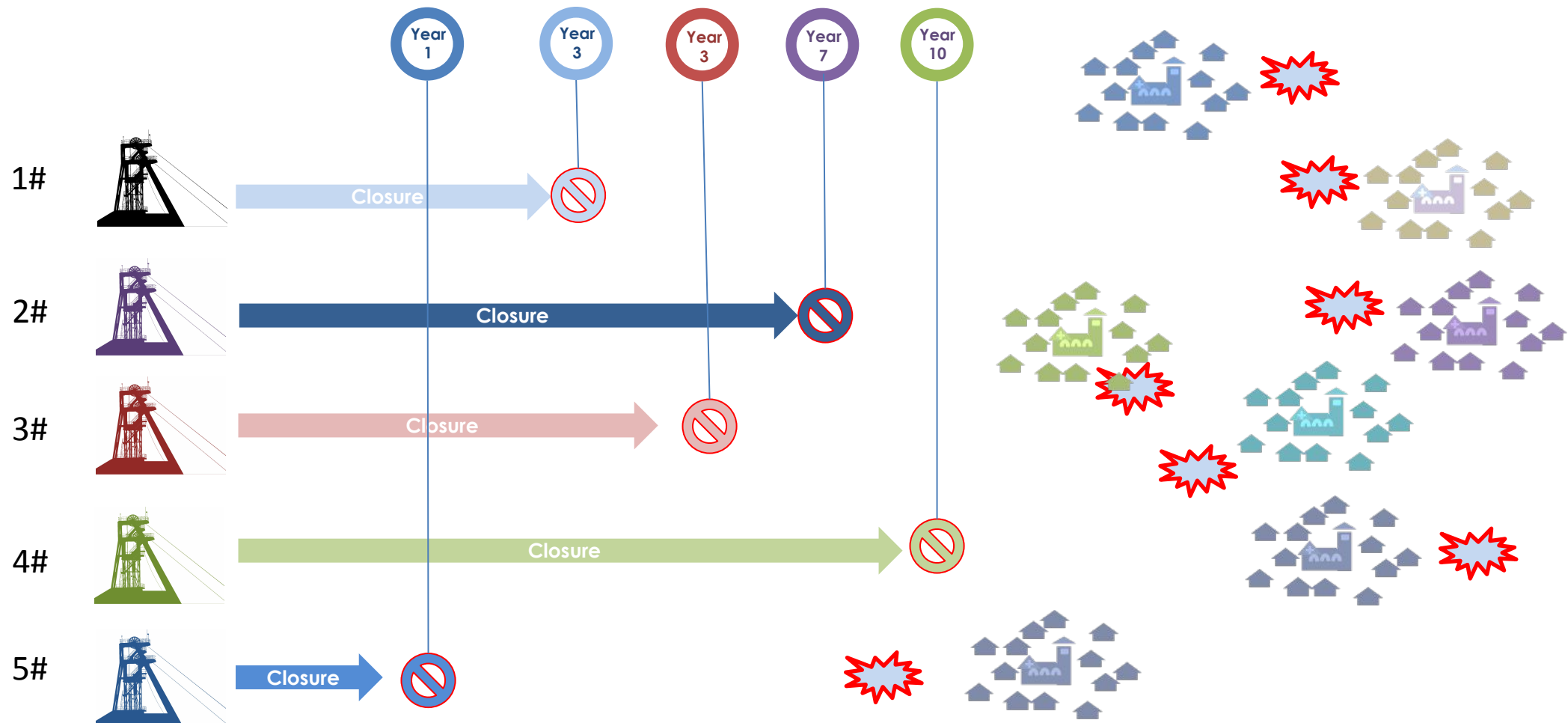


The chronology of mine development, contraction in production and ultimate closure is a function of:

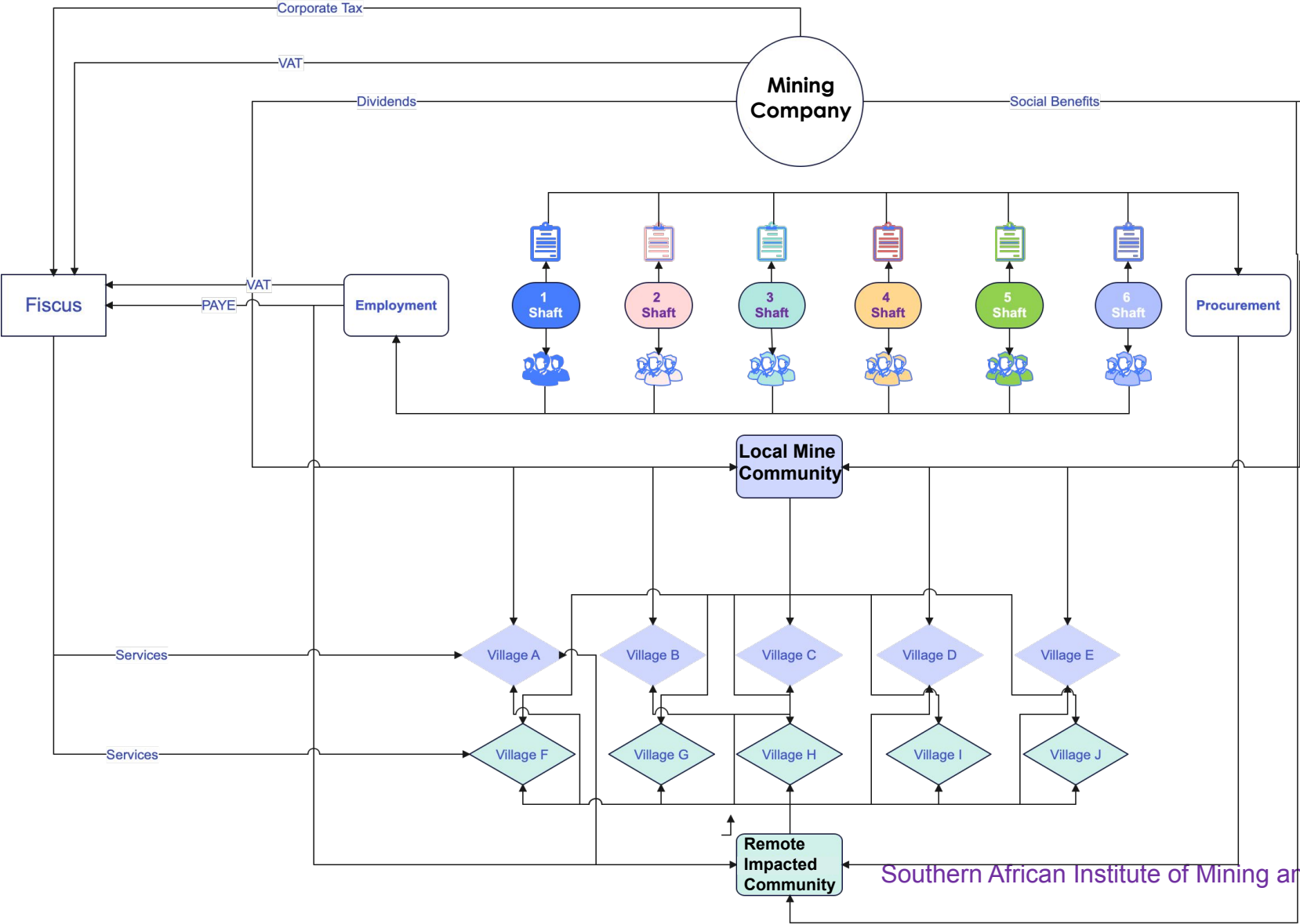
- Revenues contingent on commodity prices and exchange rates;
- the concomitant quantum and cost of fixed and variable costs;
- The dynamic linear changes in the direct costs of intermediate inputs and the non-linear elasticity of fixed costs; and
- the impact of these variable costs and revenues on the quantum of economically mineable reserves and hence the life of mine the life of mine which is in turn a function of these variable levels of production.



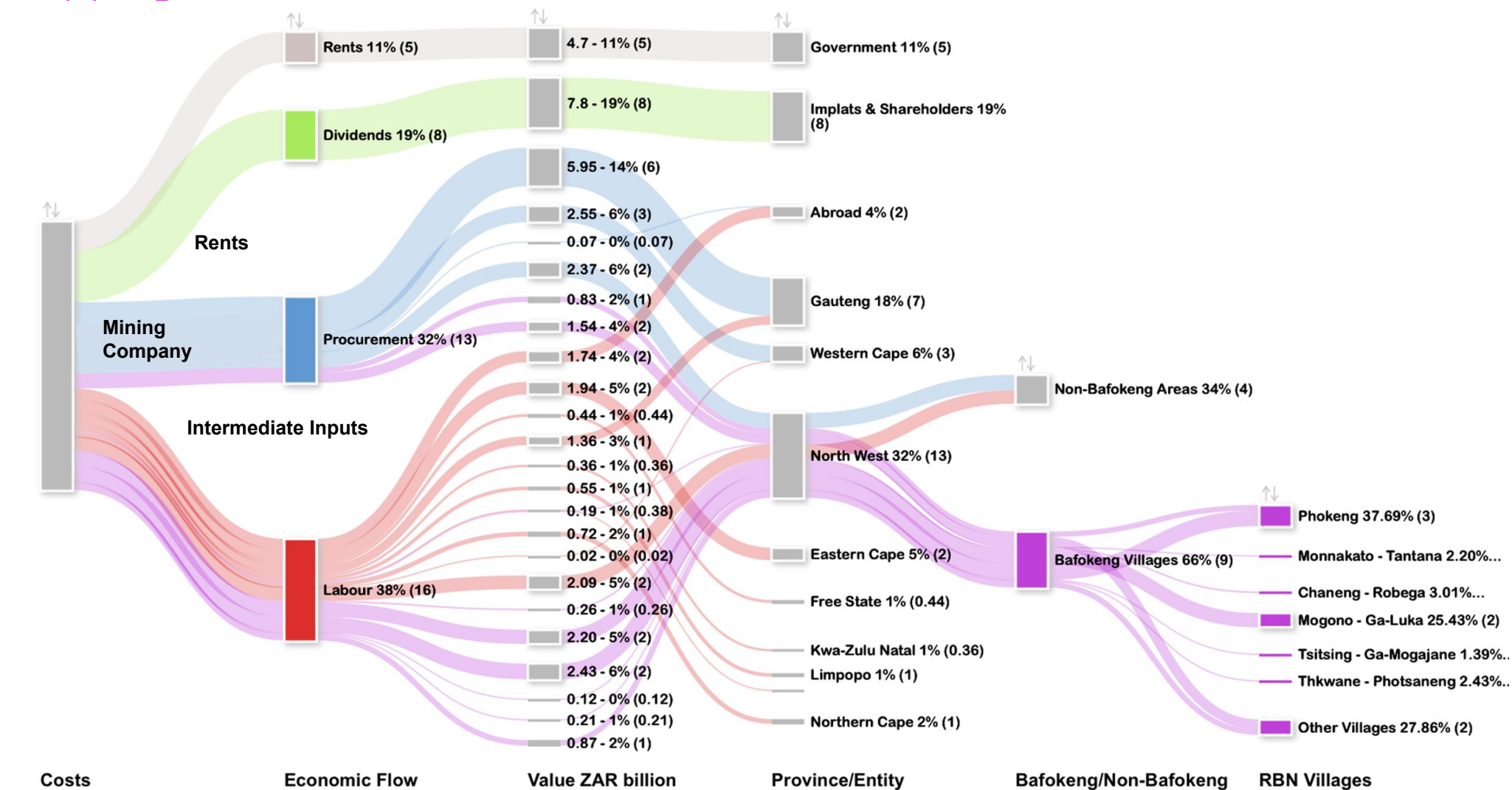
Juxtaposed complexity.... multiple mines closing at different times affecting multiple communities in many different ways.....



The only way to understand these impacts is detailed mapping of Mapping Economic Flows

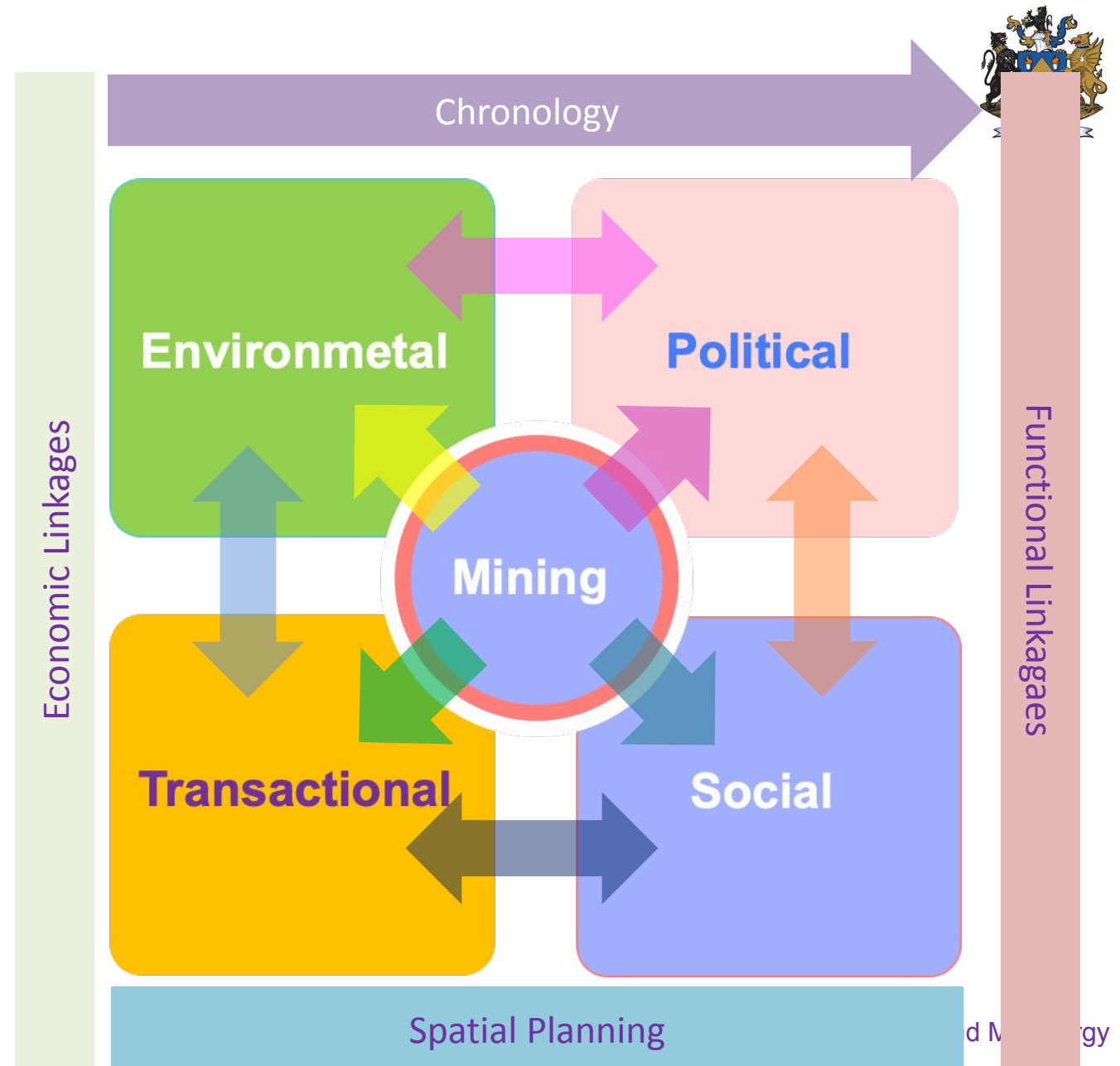


Mapping of Economic Flows



.... using this methodology describes the transactional pathways but ignores other critical impacts

Other interdependent pathways and their dynamic linkages need to be interrogated and understood, and these relationships provide for a highly complex, dynamic structure

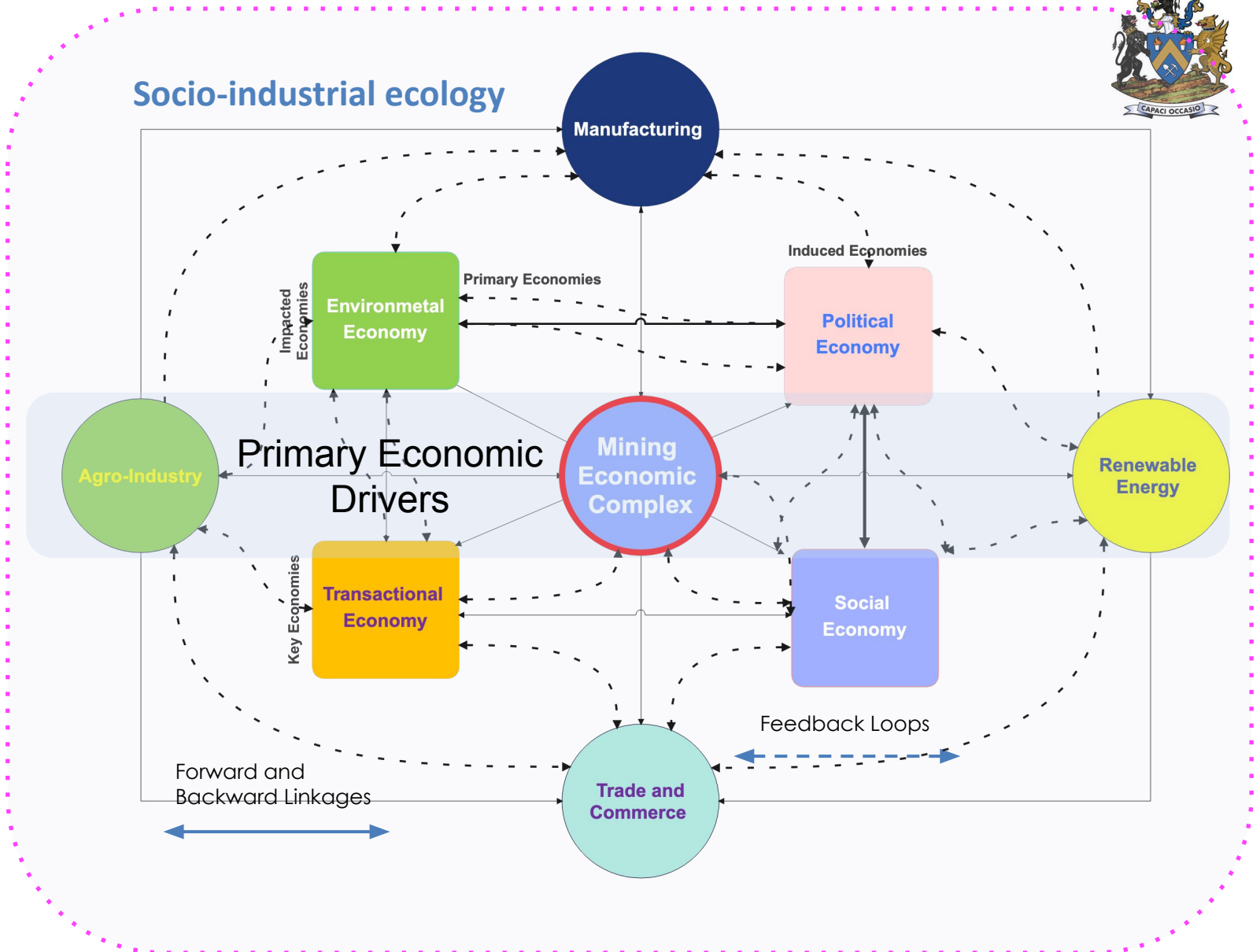




Southern African Institute of Mining and Metallurgy

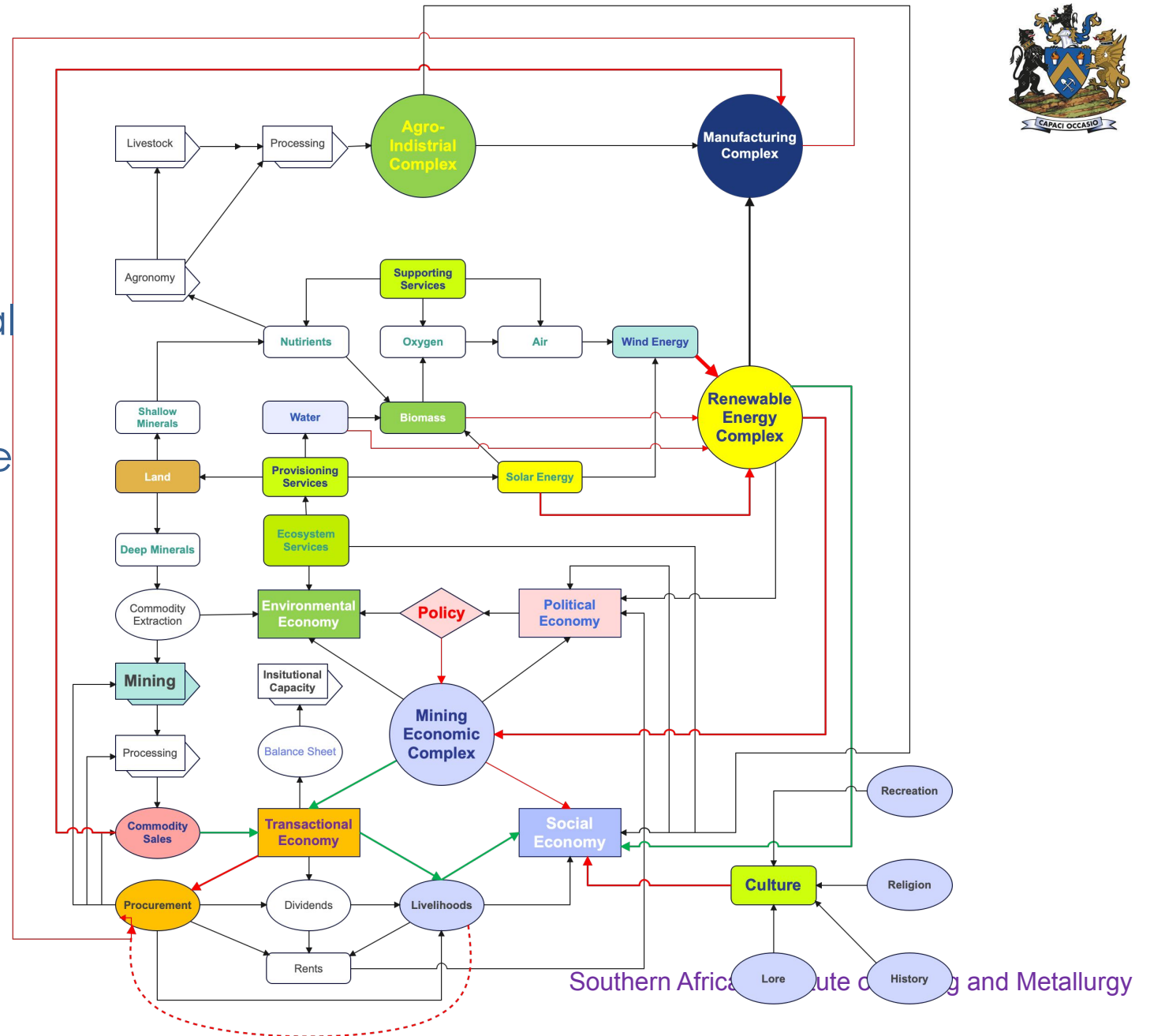
The mapping of logical functional and economic forward and backward linkages between these nodes describes an **socio-industrial ecology** which is the basis of the dynamic economic model....

Any change of state (eg depletion of geological resources) or shock to the system (collapsing commodity prices) will create concomitant forward impacts and feedback loops on all the other nodes in the system contingent on the way in which these relationships which are empirically defined and described by algorithms.

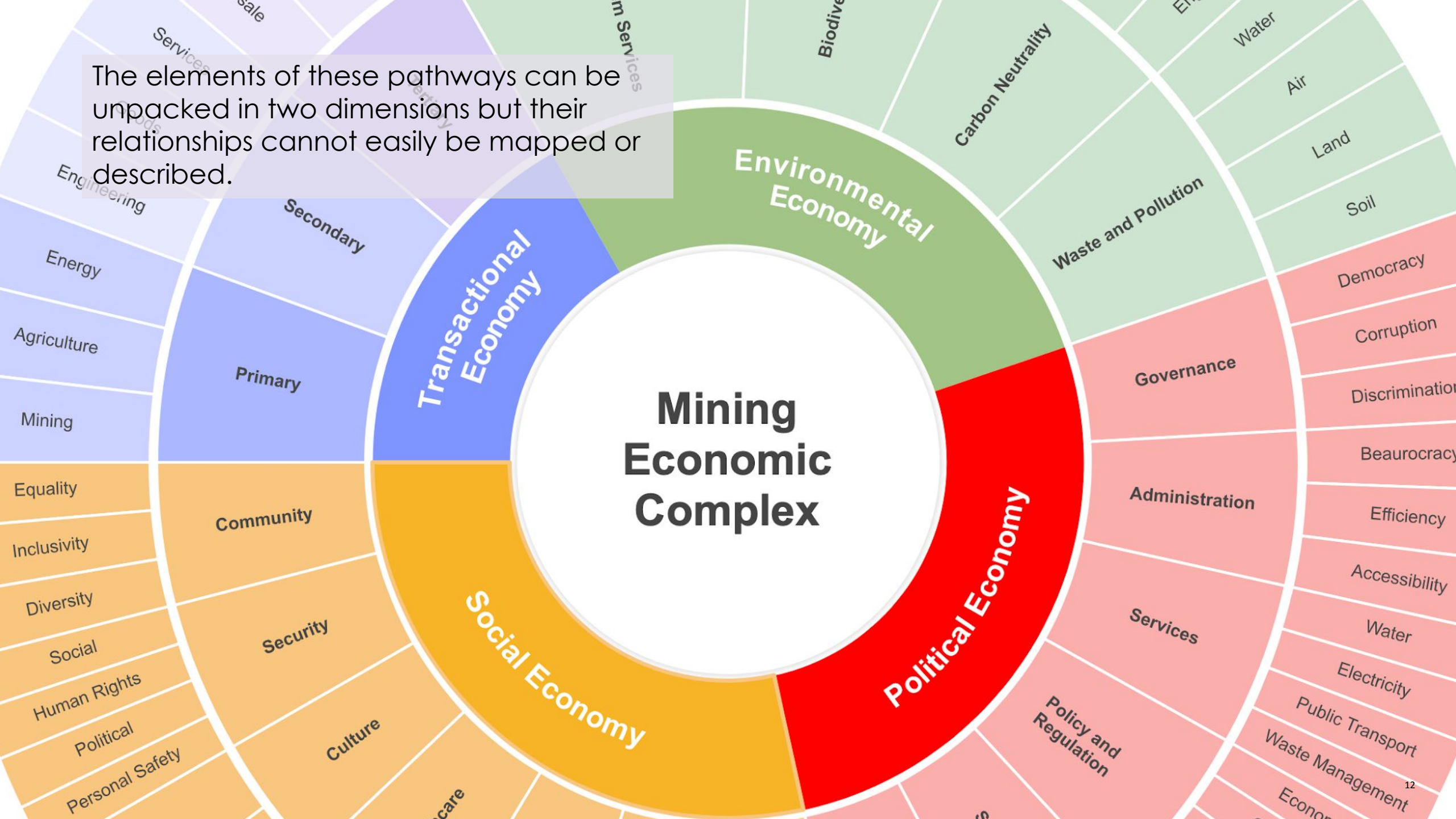


These dynamic relationships are described by Complex Transformative and Adaptive Systems Models

This allows a progressive logical expansion of the nodes and their dynamic functional and economic relationships can be described in forward and backward relationships, feedback loops and chronology result in a highly Complex Adaptive Systems Model...

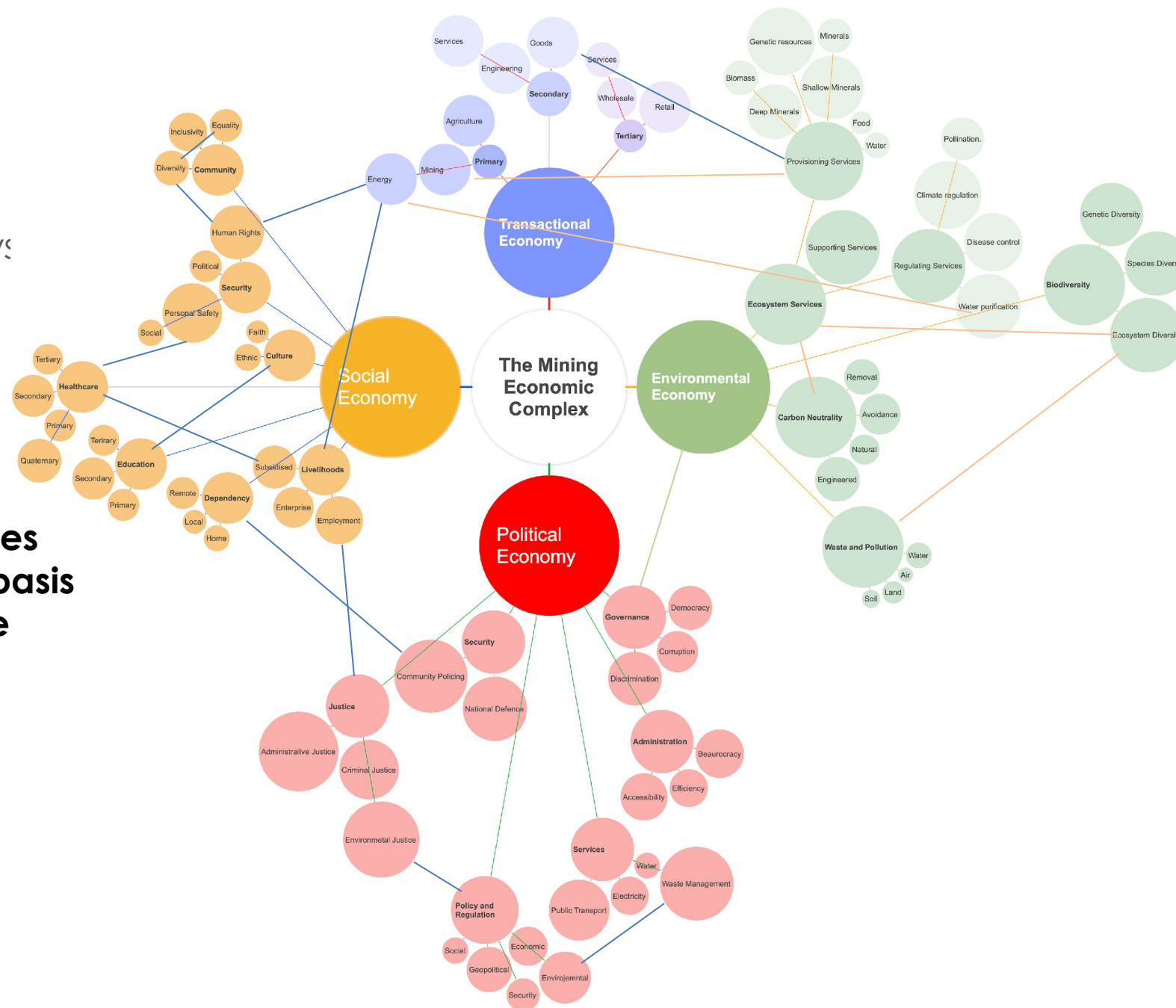


The elements of these pathways can be unpacked in two dimensions but their relationships cannot easily be mapped or described.

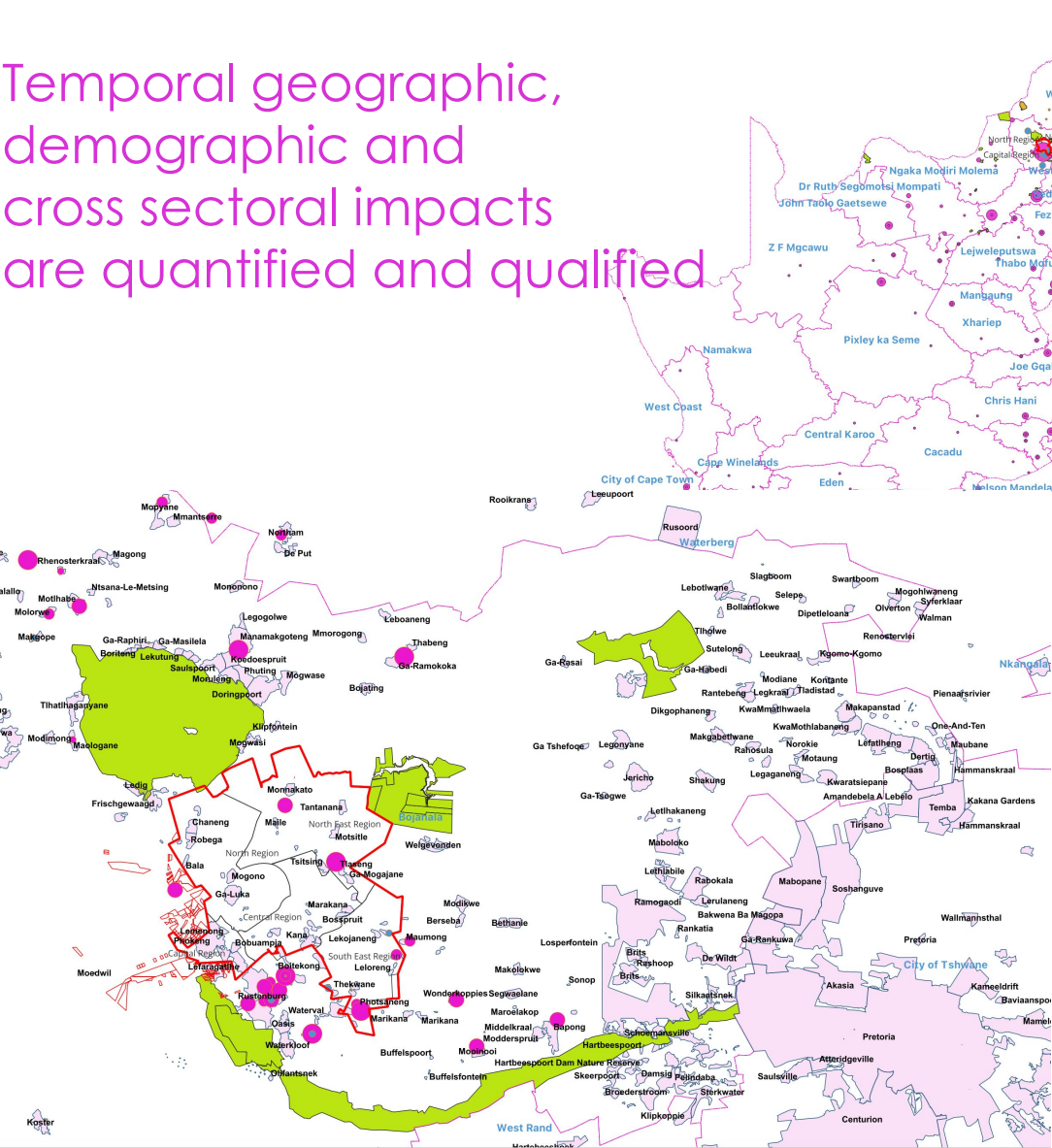


The expansion of the two-dimensional model into three dimensional nodes allows for the multidimensional mapping of complex linkages.

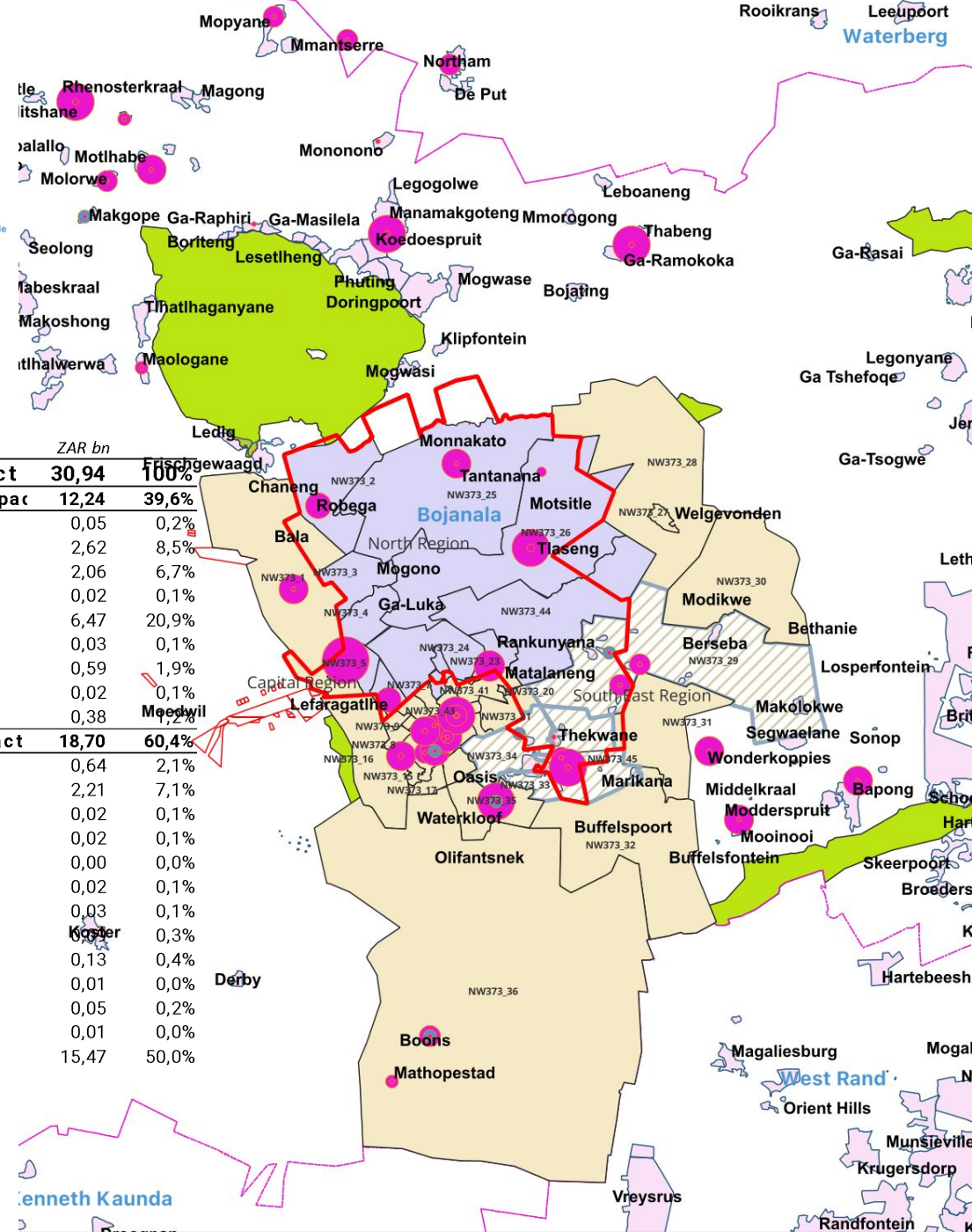
These multidimensional linkages of these nodes constitute the basis of the Complex Transformative and Adaptive Systems Model.



Temporal geographic, demographic and cross sectoral impacts are quantified and qualified



ZAR bn		
Total Economic Impact	30,94	100%
Mine Local Economic Impact	12,24	39,6%
Duipkuil	0,05	0,2%
Kanana	2,62	8,5%
Lefaragatlhe	2,06	6,7%
Leloreng	0,02	0,1%
Phokeng	6,47	20,9%
Photsaneng	0,03	0,1%
Tantanana	0,59	1,9%
Thekwane	0,02	0,1%
Tlaseng	0,38	1,2%
Regional Economic Impact	18,70	60,4%
Mankwe	0,64	2,1%
Rustenburg	2,21	7,1%
Northam	0,02	0,1%
Thabazimbi	0,02	0,1%
Zondereinde	0,00	0,0%
Delareyville	0,02	0,1%
Waterberg	0,03	0,1%
Bakgatla Ba Kgafela	0,13	0,3%
Bapong	0,01	0,0%
Boons	0,05	0,2%
Mooinooi	0,01	0,0%
Koster	15,47	50,0%
Other		



In summary....

We need a step change in the way we understand and plan for the complexities of mine closure....

- Mine closure plans need to be dynamic and to adapt to changing economic and environmental factors;
- The focus should not be on the physical rehabilitation as specified in most authorized EMPRs and Mine Closure Plans but on the contribution that these operations can make towards alternative economies and post-mining economies;
- Regulations need to adapt to be more flexible with regard to dynamically changing environmental management plans and mine closure plans; and
- Complex, transformative and adaptive systems models provide a tool whereby mining companies, governments and mining impacted communities can better understand the chronology, nature and extent of progressive programmes of mine closure.





Thank
You





SAIMM
THE SOUTHERN AFRICAN INSTITUTE
OF MINING AND METALLURGY

130
Years
OF TECHNICAL EXCELLENCE

ESG IN THE MINERALS INDUSTRY CHALLENGES AND OPPORTUNITIES

DATE: 16-17 OCTOBER 2024

VENUE: GLENBURN LODGE AND SPA,
MULDERSDRIFT

*ECOSA Validated CPD Activity, Credits = 0.1 points per hour attended.
SACNASP validated CPD activity.*



Final Programme

Keynote – 35 mins (Including Q & A)

Speaker – 20 mins (Including Q & A)

Conference Day 1 - Wednesday, 16 October 2024

Plenary Session

08:00-08:30 **Registration and Early Morning Refreshments**

08:30-08:35 **Welcome and Opening Address**
G.L. Smith, *Conference Chairperson*

08:35-08:40 **Safety Briefing**
Venue Official

Session Chair : G.L. Smith, *South Africa*

08:40-08:55 **SAIMM Presidential Address**
E. Matinde, *SAIMM President*

08:55-09:30 **Opening Keynote Address**
M.I. Mthenjane, *Minerals Council, South Africa*

09:30-09:50 **A framework for applying LCA and industrial ecology philosophy to support renewable energy value chains to drive the just transition**
D. Viljoen¹, J.M. Kruger¹, M. Solomon¹, J. Browne¹, and P. Mtemeli¹
Carbon Neutral Energy Systems (Pty) Ltd, South Africa

09:50-10:10 **Unpacking ICMM water stewardship maturity framework**
L. Shand, *SRK Consulting, South Africa*

10:10-10:20 **SAIMM and the UCT mineral resources and sustainable development council**
J. Broadhurst, *University of Cape Town, South Africa*

10:20-10:40 **Mid-Morning Refreshments**

Parallel Sessions

Parallel Session 1

Session 1: Environment

Session Chair: L. Shand, *SRK Consulting, South Africa*

10:40-11:15 **Keynote Address: The impact of climate change on the mining industry**
A. van Zyl, *SRK Consulting, South Africa*

11:15-11:35 **Refinery effluent water reduction and treatment**
Z. Ndabezimbi, S. Pule, E. Cupido, and A. Hefer, *Rand Refinery, South Africa*

11:35-11:55 **Value recovery from mine water treatment**
Q. Palse, *Sibanye-Stillwater, South Africa*

11:55-12:15 **Environmental liability pollution – a risk blindspot on most mines**
J. Brice, *EY, South Africa (Online Presentation)*

12:15-12:35 **Back to the future: Reverse engineering TSFs for the end land use**
J.M. Walls, *SRK Consulting, South Africa*

12:35-12:55 **Water stewardship at Kumba Iron Ore**
T. White¹, N. Mkhize², and G. McGavigan³,
¹Anglo American, ²Kumba Iron Ore, ³Kumba Iron Ore, *South Africa*

12:55-13:15 **An application of a pollution index and multicriteria decision tool in quantifying the hazards of historic mine sites for their repurposing**
Z.M. Dzegere¹, I. Watson², and S.E. Mhlongo²,
¹University of Witwatersrand, *South Africa* and ²University of Venda, *Limpopo*

13:15-14:15 **Lunch**

Parallel Session 2

Session 2: Social

Session Chair: D. Limpitlaw, *Limpitlaw Consulting, South Africa*

10:40-11:15 **Keynote Address: Just transition**
M.H. Solomon, *University of Cape Town, South Africa*

11:15-11:35 **Making the energy transition just: Assessing vulnerability of mining communities**
M.J. Cole, *University of Cape Town, South Africa*

11:35-11:55 **Leave no one behind: Climate change-just energy transition trajectory exclusion scenarios. A case study of Kriel and Carolina in Mpumalanga, South Africa**
T. Chidzungu and A. Wafer, *University of the Witwatersrand, South Africa*

11:55-12:15 **Transparency reporting on tailings dams: The case of the six largest listed mining companies**
C. Crous and L. Marais, *University of the Free State, South Africa*

12:15-12:35 **Investigating strategies for involving host mining communities in mine closure planning: An integrated stakeholder engagement in the West Rand, South Africa**
K. Majela¹, M. Mpanza², and J.R.C. von Holdt¹
¹University of Cape Town and ²University of Johannesburg, *South Africa*

12:35-12:55 **Community assets and services provided by coal mines: How do we ensure that these are not lost in the energy transition?**
T. Ledger, *Public Affairs Research Institute South Africa, South Africa*

12:55-13:15 **Environmental, social, and governance impacts lens dashboard**
V. Mahadeo¹, G. Sihlali², S. Gruber², W. Botha³, T. Swettenham¹, J. Pelders⁴, and S. Ramparsad⁵,
¹The Research Institute for Innovation and Sustainability, ²Business Science Corporation Global, ³Enterprises University of Pretoria, ⁴The Council for Scientific and Industrial Research and ⁵Mandela Mining Precinct, *South Africa*

13:15-14:15 **Lunch**

Conference Day 1 - Wednesday, 16 October 2024

Parallel Sessions

Parallel Session 1 <i>(continued)</i> Session 1: Environment Session Chair: P. Burmeister, <i>SRK Consulting, South Africa</i>	Parallel Session 2 <i>(continued)</i> Session 2: Social Session Chair: M. Cole, <i>University of Cape Town, South Africa</i>
14:15-14:35 From pit to port W. Mostert, <i>Anglo American, South Africa</i>	14:15-14:35 Modern mines and the modernisation of community engagement and benefit-sharing in South Africa N. Coulson and I. Watson, <i>University of the Witwatersrand, South Africa</i>
14:35-14:55 Opportunities to improve the wellbeing of the most affected communities by reducing emissions from sources other than mining and industry - case study from work undertaken by SRK in air quality offsets V. Reddy, <i>SRK Consulting, South Africa</i>	14:35-14:55 A case study on local community employment and skills challenges in South Africa that has broad applications to the mining industry as a whole D. Wessels, <i>Anglo American, South Africa</i>
14:55-15:15 Opportunities for surface water management in the Wonderfontein spruit, West-Wits Gold Fields, for sustained deep-level gold mining B. Govender ¹ , M. van Biljon ² , and N. Haripursad ¹ , ¹ <i>Sibanye Stillwater</i> and ² <i>SLR Consulting (Africa), South Africa</i>	14:55-15:15 Managing mining project impacts on a community in the context of high levels of biodiversity and the presence of established ASM – a case study from West Africa D. Limpitlaw ¹ , F. Cessford ² , and J. Njuma ³ , ¹ <i>University of the Witwatersrand, South Africa</i> ² <i>SRK Consulting, UK</i> and ³ <i>Pasofino Gold Ltd, Canada</i>
15:15-15:35 Mid-Afternoon Refreshments	15:15-15:35 Mid-Afternoon Refreshments

15:15-15:35	Mid-Afternoon Refreshments	15:15-15:35	Mid-Afternoon Refreshments
15:35-15:55	Developing an interactive web-based risk assessment framework from the mine waste atlas: A pilot study in the Northern Cape B. Koovarjee, J.R.C. von Holdt, M.J. Cole, and M. Becker, <i>University of Cape Town, South Africa</i>	15:35-15:55	ASM – reducing risks in rapid response swing producers of climate critical minerals D. Limpitlaw and P. Mitchell, <i>Limpitlaw Consulting, South Africa</i>
15:55-16:15	Understanding and mitigating mine dust impacts: Lessons learned through multi-stakeholder engagement J.R.C. von Holdt, S. Adams, and J. Broadhurst, <i>University of Cape Town, South Africa</i>	15:55-16:15	The role of artisanal and small-scale mining in poverty alleviation and rural development A. Mufamadi, <i>Mintek, South Africa</i>
16:15-16:35	Biodiversity offsets in mining: Contributing to global targets whilst reducing regulatory delays, contingent liabilities and future compliance costs J. Manuel, M. Theart, C. Eb, and K. Maze, <i>SANParks, South Africa</i>	16:15-16:35	Environmental, social, and governance considerations and sustainable development goals contributions in the minerals industry: A complementary perspective S. Phakathi, <i>Mjaji Research and Development, South Africa</i>
16:35-16:55	Low emission technologies (focus on vehicles), opportunities, challenges and options available K. Jeebodh, <i>Epiroc, South Africa</i>	16:35-16:55	Piloting towards sustainable mining initiative in South Africa D. Naidoo, <i>Minerals Council, South Africa</i>
16:55-17:15	Zero waste to landfill by 2030 – a mining case study M. Bornman, <i>Sibanye-Stillwater, South Africa</i>	16:55-17:15	Reimagining social licence to operate in South Africa’s mining sector: Empowering communities through governance, sustainability, and digital inclusion C. Thekiso, <i>Thekvest Group, South Africa</i>
17:15-17:20	Day 1 Conference Closure	17:15-17:20	Day 1 Conference Closure
17:20-19:00	Network Cocktail Function Sponsored by  cnes	17:20-19:00	Network Cocktail Function Sponsored by  cnes

Conference Day 2 - Thursday, 17 October 2024

Plenary Session

- 07:30-08:15 **Registration and Early Morning Refreshments**
- 08:15-08:20 **Welcome and Opening Address**
G.L. Smith, *Conference Chairperson*
- 08:20-08:25 **Safety Briefing**
Venue Official
- Session Chair :** M. Solomon, *University of Cape Town, South Africa*
- 08:25-09:00 **Keynote Address: ESG in the minerals industry – challenges and opportunities**
G.L. Smith, *Conference Chairperson*
- 09:00-09:35 **Opening Keynote Address: The role of mining and metals in driving just and sustainable economic development in Africa**
R.S. Arp, *Carbon Trust, South Africa*
- 09:35-10:10 **Keynote Address: Responsible mining**
R. Dhawan, *ICMM, UK* (Online Presentation)
- 10:10-10:30 **Strategic enviro-social stakeholder engagement: An environmental toolkit for effective mine community engagements**
P. Ramphisa, *Sibanye-Stillwater, South Africa*
- 10:30-10:50 **Mid-Morning Refreshments**