BRIEFING NOTE

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Challenging but promising: South Africa's transition towards a circular economy

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KEY FINDINGS

An economy-wide material flow analysis was compiled for South Africa for 2017. The picture of material flows that was developed gives rise to 5 key findings:

1. The economy is materially dominated by export-oriented extractives.
2. The economy is energetically dominated by fossil fuels, notably domestic coal supported by imported oil.
3. There is a low rate of domestic stock building of infrastructure (buildings, roads, etc.).
4. There are pockets of high circularity in the domestic economy and significant informal activity around cascade use, reuse and recycling, but the overall socio-economic cycling rate is very low at 2%.
5. Bio-based flows are sizeable at 17% of domestic extraction, but there are significant sustainability concerns about ecological cycling.

INTRODUCTION

The circular economy (CE) concept is gaining increasing traction as a comprehensive environmental-economic strategy in line with sustainable development imperatives. It however risks being empty talk if not grounded in firm evidence. For this purpose, systematic comprehensive empirical assessments are required, to understand the status-quo and to be able to develop robust guidance without simply shifting problems. A team at BOKU, Vienna, developed a suitable accounting and calculation framework to capture and describe the state of circularity of a national economy.

The Department of Science and Innovation, through the Waste RDI Roadmap contracted the University of Cape Town, in partnership with the BOKU team, to adapt this framework to the South African situation and to develop economy-wide indicators of circularity for the South African economy. The team chose the year 2017 as base year for the analysis, as this was the year with both the most recent and the most robust data in a variety of data sources.

METHODOLOGY

The objectives of this study were:

- To adapt the comprehensive economy-wide monitoring framework to the South African situation;
- To quantify all materials and energy use, as well as resulting waste and emissions;
- To derive policy-relevant indicators on the state of circularity of the economy;
- To present systems-level guidance for improving the sustainable circularity of the South African economy.

To achieve these goals, information was compiled for 82 materials, organized in 6 main categories and 12 sub-categories, tracking for each material domestic extraction, imports, exports, transformations into synthetic materials, additions to stock, demolition, generation of wastes, fate of wastes, all for the calendar year 2017.

MAIN RESULTS

South Africa's extraction of all food, feed, minerals, metal ores and fossil energy carriers (coal) amounted to 875 million tonnes in 2017 (see Figure 1). 66% of this extraction are metal ores and coal. Compared to this, imports are relatively small (32 Mt). Exports are large (170 Mt) and consist predominantly of refined metals and coal, while leaving the associated extractive waste in South Africa. Altogether, waste flows are relatively high. Solid and liquid outputs returned to nature are about 310 Mt of which 171 Mt are extractive waste from mining activities.

Emissions from technical processes, humans and livestock accounted as carbon amount to 175 Mt. If oxygen taken from air is included, this results roughly in 640 Mt of GHG emissions, of which 36% are of biogenic origin. These estimates are mass balanced for the study year, meaning that everything that goes into the South African economy has to be either a net-add to stocks or an output to nature. Numbers also include an estimate of informal flows like waste from un-serviced households.

The circular economy indicators were estimated as shown in Figure 2. The socio-economic cycling rate, which is the ratio between the sum of recycled and reused materials to the domestically processed materials, is just under 2%. Ecological cycling is significantly larger at 5%, but highly uncertain, with anything between one quarter and two thirds of the input biological materials that can be regarded as a sustainable harvest.

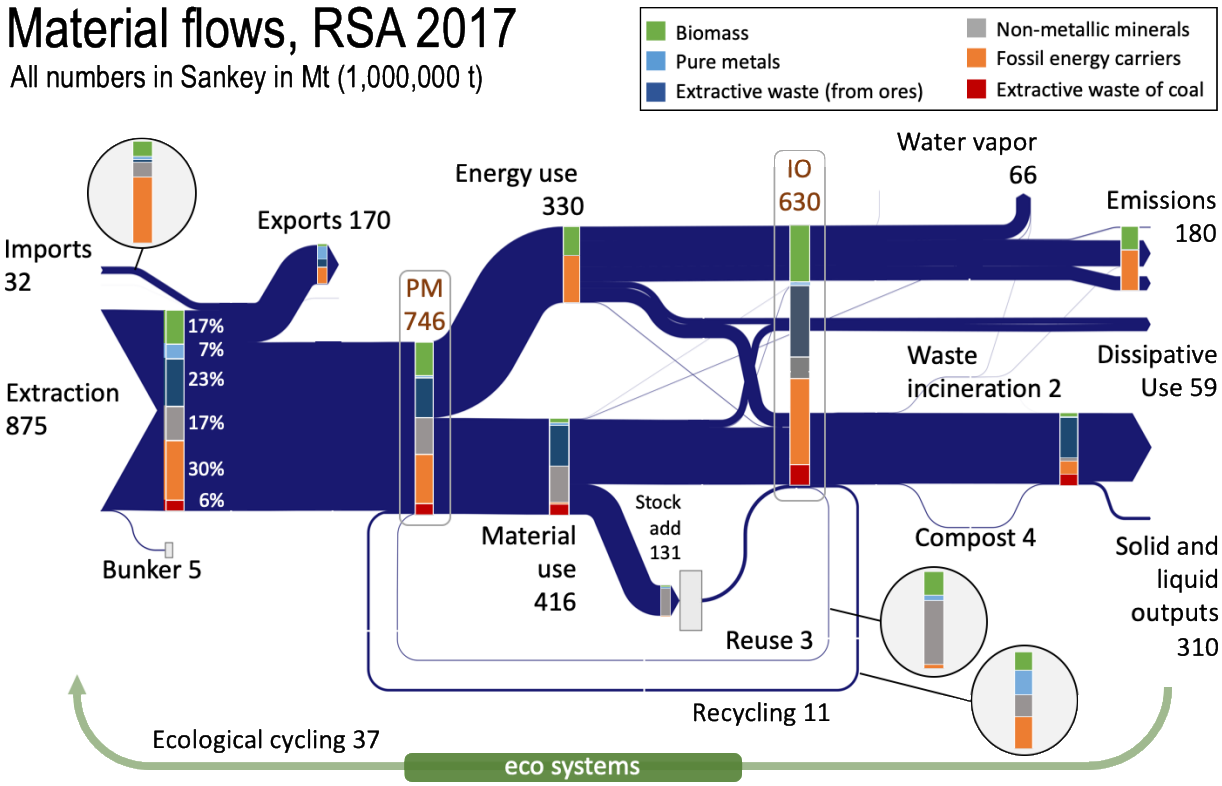
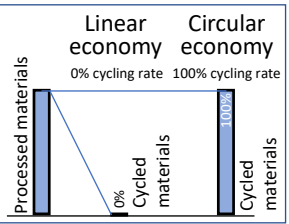


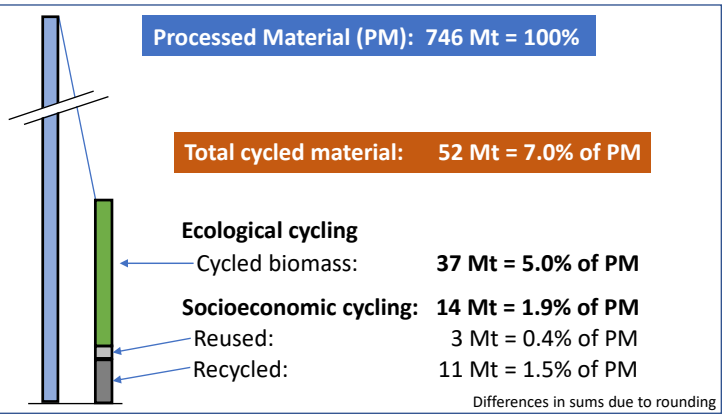
Figure 1: Estimate of material flows in South Africa in 2017. Width of arrows is proportional to flow size.

Circular Economy, socio-economic and ecological cycling

Definition and indicators

In an ideal Circular Economy, material flows are either made up of biological nutrients designed to re-enter the biosphere, or materials designed to circulate within the economy. The former we call ecological cycling with renewable biomass circulating via eco-cycles without deteriorating the regeneration rate of eco-systems. The latter we call socioeconomic cycling, which refers after long service lives to closing loops through reuse and recycling.





Uncertainty estimate

	Low range	High range
PM (Mt)	671	895
Total cycling	6.5%	14.6%
Eco-cycling	5.0%	11.3%
Socio-economic Cycling	1.5%	3.3%
Reuse	0.4%	1.4%
Recycling	1.1%	1.9%

Figure 2: Estimated cycling rates for South Africa, 2017.

FINDINGS AND OPTIONS FOR THE WAY FORWARD

Finding 1: An economy materially dominated by export-oriented extractives

- Global resource use is unsustainable. South Africa is implicated as it exports non-renewable resources that are unsustainably used in a mostly linear manner. By mass these exports are dominated by coal, iron ore and other ores needed for steel-making.
- Large volumes of extractive waste associated with these exports remain in South Africa, causing environmental and social harm.
- Sooner or later this growing global resource use will have to be downsized significantly due to intentional global policies or by looming disasters.

Strategic option: South Africa can anticipate these developments and the sooner it reacts to likely global policy effects, the larger the attractive option space for business, employment and reduction of inequalities.

Finding 2: An economy energetically dominated by fossil fuels, notably domestic coal supported by imported oil

- Domestic coal extraction and use for power generation is the largest linear flow in the current configuration of the economy, at 120 Mt/a.
- Oil accounts for 65% of all imports into South Africa.

Strategic options:

Coal: Reducing and phasing out coal-based power generation is not only the single largest measure to reduce GHG emissions, but would also result in improving circularity indicators. A back of the envelope estimate for abandoning coal use shows that this would improve socio-economic circularity from 1,5% to 2,6% (a 40% increase).

Oil: A significant improvement here in terms of climate mitigation and circularity is only feasible, if a decisive greening of mobility is envisaged in which road mileage is considerably reduced, rail-bound traffic is refurbished and all urban planning for new developments is designed to shorten daily commutes allowing for walking, cycling and public transport. This improves health (less air pollution and more exercise), saves both resources for material-intensive roads and energy for transport activities. Further it ameliorates South Africa's monetary trade balance. As a clear second priority after active mobility and public transport, e-mobility can supplement such a strategy.

Finding 3: Low rate of domestic stock building

- The material used domestically for building and maintaining stocks like roads, buildings, dams, factories or artefacts needs to be critically discussed as to whether it is sufficient to deliver the required services to the population. By comparison: In per capita terms the EU's material consumption is just 10% higher than in South Africa, but building and maintenance of stocks is three times higher.

Strategic option: Sooner or later metal ore and coal mining activities will face sales problems in global markets due to international policies like on climate, sustainability and/or circularity. Phasing out these linear export-oriented activities offers the opportunity to reuse and refurbish stocks for communities in need of infrastructure, housing and durable consumer goods, thus stimulating alternative businesses. International examples for such a redistribution are promising, and with careful planning they can provide decent jobs (better than waste picking).

Finding 4: Pockets of high circularity in the domestic economy and significant informal activity around cascade use, reuse and recycling

- Recycling: Many post-consumption materials are recycled. Loops are relatively well developed for some metals, mainly lead, copper, aluminium and steel with recycling rates of 70% and above. Material recycling of paper products and container glass is well developed as well.
- Reuse: Container glass shows high reuse at significant scale, and it was estimated (but highly uncertain) that significant informal reuse of certain construction and demolition waste happens in the context of informal settlements.

Strategic options:

A few domestic recycling loops like the ones of some metals are already partly closed. This can be further improved and they can become learning models for other loop-closing initiatives (including industrial symbiosis). Learning can focus on the link between loop-closing and creating decent jobs.

In a circular economy, recycling activities are of a lower priority; well-managed nationwide reuse corners might be a better option. Such low hanging fruits can be used to make the circular economy more appealing.

In the transport sector, combined leasing and car sharing options could contribute to improving circularity, with service providers required by law to

maintain long service times and, as far as possible, closed loops for all car parts be it through reuse or recycling.

Finding 5: Sizeable bio-based flows at 17% of domestic extraction, but with significant sustainability concerns about ecological cycling

- Of the 146 Mt of extracted biomass about 57 Mt are crops (for food and feed), 51 Mt grazed biomass, 18 Mt residues, 16 Mt wood and 4 Mt cutting from greens.
- Despite biomass to be considered as a renewable resource, biomass use can interrupt geochemical cycles and impair quality of ecosystems (e.g. loss of species and landscape diversity, habitat loss).
- Estimating the sustainable fraction of biomass that qualifies for ecological cycling faces both lack of data and disagreement between different fields of science (agricultural sciences and ecology).

Strategic option: On a global level there is sufficient evidence that the biogeochemical nutrient cycle (of nitrogen and phosphorus) has already transgressed the planetary boundaries of a safe operating space for humanity. This has been caused by industrial and agricultural processes. Hence, an assessment of a system's capability to close the biological nutrient cycle and maintain the ecosystem's regenerative capacity is essential. The Natural Capital Accounts initiative is extremely important and other scientific assessments should help generate better evidence for tailor-made strategies to improve circularity and sustainability. Meanwhile, attention needs to be paid to sustainable farming practices especially for grasslands, livestock and primary crop farming.

Beneficial no-regret measures include: Improved manure management, less use of mineral fertilizer reduced, replaced by compost derived from organic waste treatment, and unsafe pesticides should be phased out. On the demand side food waste should be minimised and the separation of materials of biotic and abiotic origin should be improved to enhance the biodegradability of bio-based materials.

CONCLUSION

This study has shown that circular economy goes well beyond more recycling of end-of-life materials. Of the 875 Mt materials extracted, only 327 Mt eventually became waste and of these about 221 Mt are extractive wastes. So reuse and recycling can only target 106 Mt, which is 12% of what has been extracted. While improved waste management is essential, its reach to increase circularity is limited. For increased circularity it is key to reconfigure resource flows overall through the economy.

Thus, the South African economy needs to develop a new national development model which entails phasing out its extractive orientation of non-renewable resources for export and power generation. This would both make it more sustainable and prepared for changes on the world market to be expected due to unfolding effects of already existing global environmental policies. These global developments will increasingly limit the gains of the present economic orientation, which dominates South Africa's inherited resource use. Only such a pro-active strategy enables the country to seize the opportunities a circular economy potentially offers: new businesses in the service sector, decent jobs for all skill levels directed at a stronger domestic economy and lower environmental impacts. However, this means a substantial change mainly in mining, agriculture, transport, urban planning and power generation.

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