Energy system and economy-wide implications of a rapid transition to decarbonised energy in South Africa

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Introduction

As the goal of not exceeding a 2 degree world becomes harder to achieve, there is pressure on developed as well as developing countries to decrease emissions. South Africa currently produces around 7,7 tonnes of emissions per capita, with a global fair of emissions for a 2 degree world calculated at 1,5 tonnes per capita, South Africa may be under pressure to significantly decrease emissions. Given that South Africa is heavily dependent on coal and that non-energy emissions account for approximately 6% of total emissions, this would involve a rapid decarbonisation of the energy sector.

Results from South Africa's Deep Decarbonisation Pathway's report show that a significant reduction in emissions (14 Gt cumulative to 2050) is possible, although this reduction in emissions gets South Africa to 3,9 tonnes per capita requiring a further reduction in emissions for a 2 degree world. However, alternative economic pathways were explored and the emissions reductions that were achieved were achieved whilst also making strides toward sustainable development in South Africa.

As a developmental state, it is important to be mindful of a just transition to a low carbon future. This paper uses a linked energy and economic model to explore the socio-economic implications of South Africa undertaking a rapid transition to a decarbonised energy sector, with a focus on potential winners and losers, employment impacts and impacts on the welfare of households.

Rethinking development in DDPP

South Africa's current domestic policy system is one of lock-in and path dependency. It is clear that South Africa's current development pathway has failed at enabling sufficient development. This was the starting point for South Africa's Deep Decarbonisation Pathways Project team, where the team considered positive policy steps for achieving development in a low carbon world.

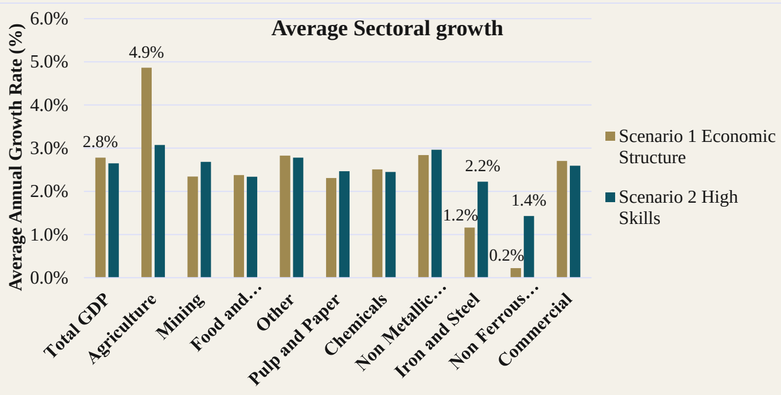
Sustainable development in South Africa is possible with sustained and decent employment. For a country with an unemployment rate of 27.1% (StatsSA, 2016), not including discouraged workers, job creation is of the highest priority.

Two economic pathways:

- **Economic Structure**
  This scenario presents a structural shift in the economy towards growth in sectors that are both low carbon and employment intensive. The main driver for growth is in the agriculture sector that harnesses growth from increased regional trade opportunities
- **High Skills**
  South Africa is constrained by the number of skilled workers in the labour force. This scenario presents an optimistic view of improvements in South Africa's education and therefore the number of skilled workers that enter the labour force to 2050.

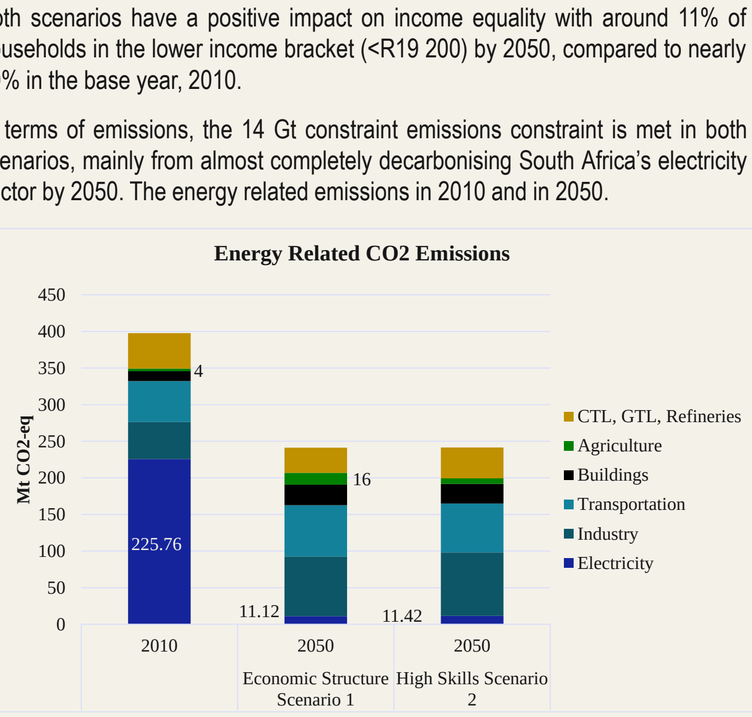
Where does that get us?

In terms of development, both the economic structure and the high skills scenario make great strides towards full employment and development in South Africa to 2050. Although unemployment remains high at 12% and 18% respectively in 2050. Growth is moderate with an average annual growth rate of 2.8% for the economic structure, although as the graph below shows, this growth is driven mostly by developments in agriculture. For the high skills scenario, growth in high-skills intensive sectors drives overall GDP growth.



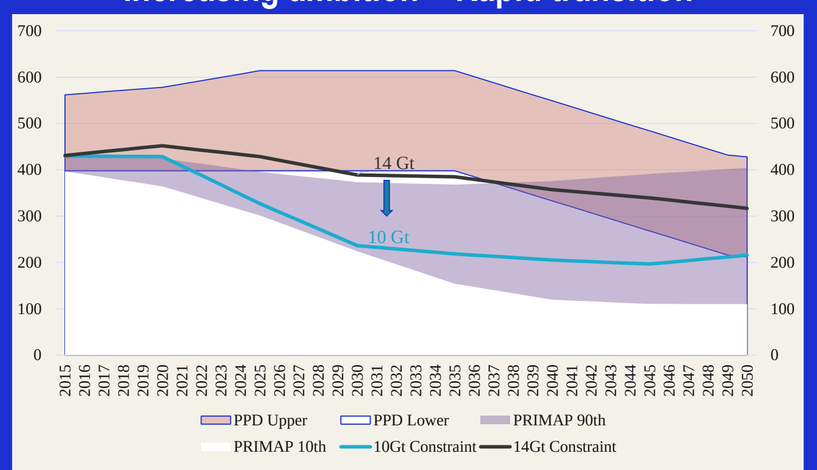
Both scenarios have a positive impact on income equality with around 11% of households in the lower income bracket (<R19 200) by 2050, compared to nearly 50% in the base year, 2010.

In terms of emissions, the 14 Gt constraint emissions constraint is met in both scenarios, mainly from almost completely decarbonising South Africa's electricity sector by 2050. The energy related emissions in 2010 and in 2050.



What are the socio-economic implications of an even more rapid transition to decarbonisation?

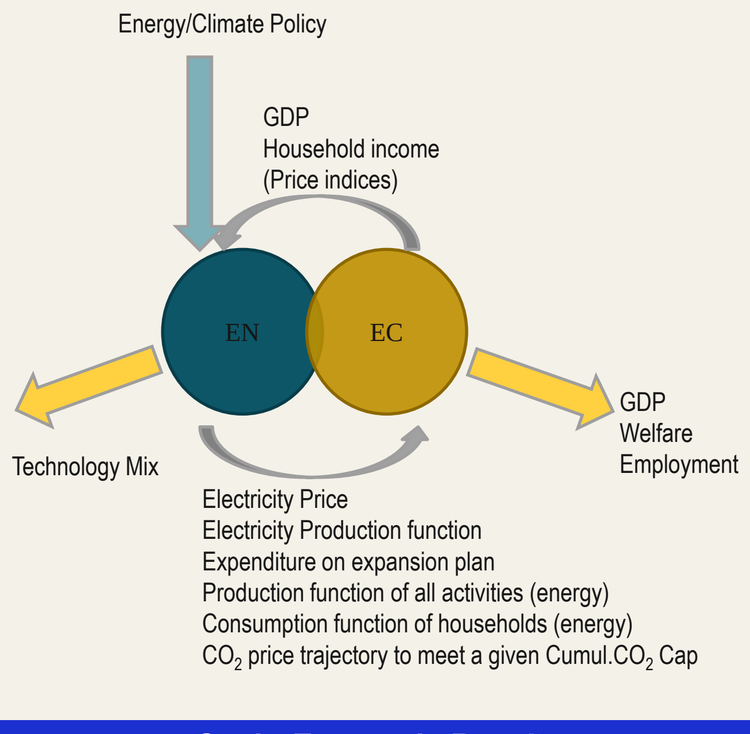
Increasing ambition = Rapid transition



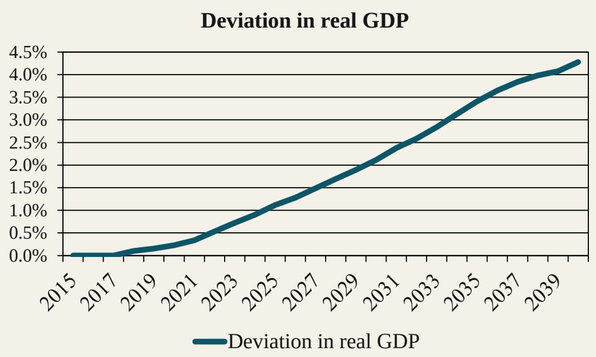
Modified from Burton et al. (2016)

Methodology

Linked energy model (SATIM) and economic model (eSAGE)

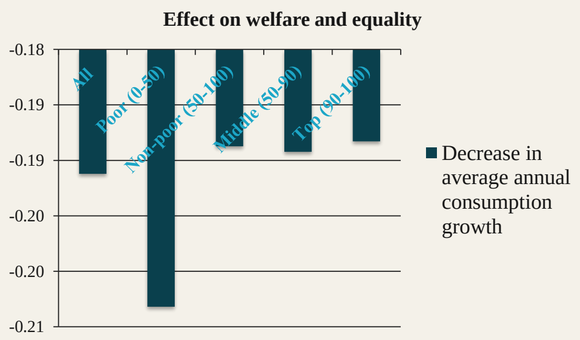


Socio-Economic Results

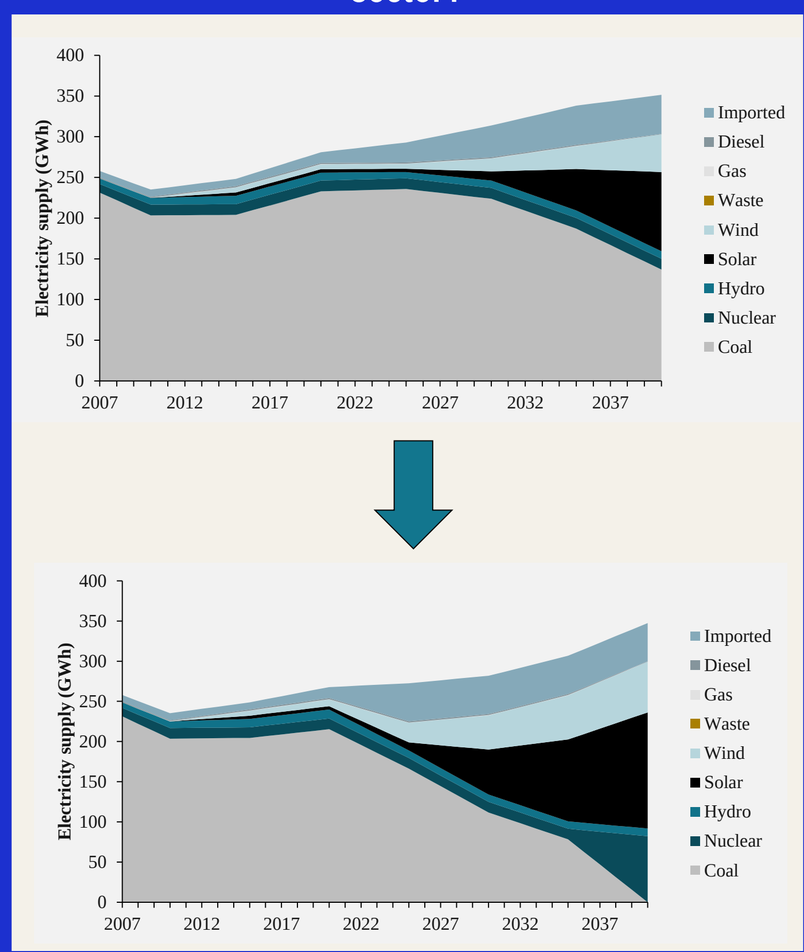


Effect on sectoral GDP	14 Gt	10 Gt	Deviation from 14 Gt
TOTAL GDP	2,85	2,71	-0,14
AGRICULTURE	3,25	3,08	-0,16
INDUSTRY	2,65	2,53	-0,11
Mining	2,76	2,59	-0,16
Coal mining	-1,14	-2,13	-0,99
Natural gas mining	4,42	4,47	0,05
Manufacturing	2,50	2,31	-0,19
Petroleum products	-0,61	-0,80	-0,18
Other industry	2,91	3,11	0,20
Electricity	2,59	3,57	0,97
SERVICES	2,93	2,77	-0,16

Employment Impact	2010	2050		
		14 Gt	10 Gt	Deviation
LABOUR	12 176	6 154	5 694	-460
Unskilled labor	5 698	5 216	4 756	-460
Primary	1 930	1 720	1 571	-150
Middle	3 768	3 496	3 185	-310
Skilled labor	6 478	938	938	-
Secondary	3 541	610	610	-
Tertiary	2 937	329	329	-
Electricity sector	35	11	21	9



What does this rapid transition mean for the energy sector?



Caveats and Future Work

The 10 Gt scenario presents a rapid transition in the energy sector, and requires almost immediate action to achieve. The ability for the energy sector to transition this rapidly needs to be assessed. In addition, available options to increase efficiency need to be explored at a more granular level.

The higher electricity prices caused by a rapid transition to decabonised electricity could cause both industrial users and households to move off-grid. This could pose a serious problem in terms of recouping investments in the electricity sector. This dynamic is not yet captured in our modelling.

Investing in low carbon and employment generating sectors could ease this transition, and increase development. It would be an interesting case for future work to analyse the impacts on alternative economic pathways.

There is huge uncertainty in energy and economic modeling, especially when modeling to 2050. Another area for future work would be to extend this analysis to a Monte Carlo simulation approach in order to assess the impacts under many areas of uncertainty.

Key messages

A rapid transition to decarbonised energy in South Africa is likely to have negative impacts, especially on lower income households. These households are impacted by both a rising electricity prices and job losses.

Further investments in fossil fuel infrastructure should be avoided as these could lead to further stranding of assets and a significant increase in mis-investments in South Africa.

The current structure of the economy is not adequately addressing development and the added pressure of decarbonisation is likely to result in negative welfare impacts. More should be done to incentivise growth in sectors that are both low carbon and employment intensive to hedge against these effects.

References

Burton, J., Caetano, T., Hughes, A., Merven, B., Ahjum, F., McCall, B. (2016) The impact of stranding power sector assets in South Africa: using a linked model to understand the economy-wide implications. Energy Research Centre, University of Cape Town. Cape Town.

Altieri, K., Trollip, H., Caetano, T., Hughes, A., Merven, B., & Winkler, H. (2015). *Pathways to deep decarbonization in South Africa.*

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