Quantifying the Macro- and Socio-Economic Benefits of a Transition to Renewable Energy in South Africa

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SA-TIED
Southern Africa – Towards Inclusive Economic Development

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
IFPRI

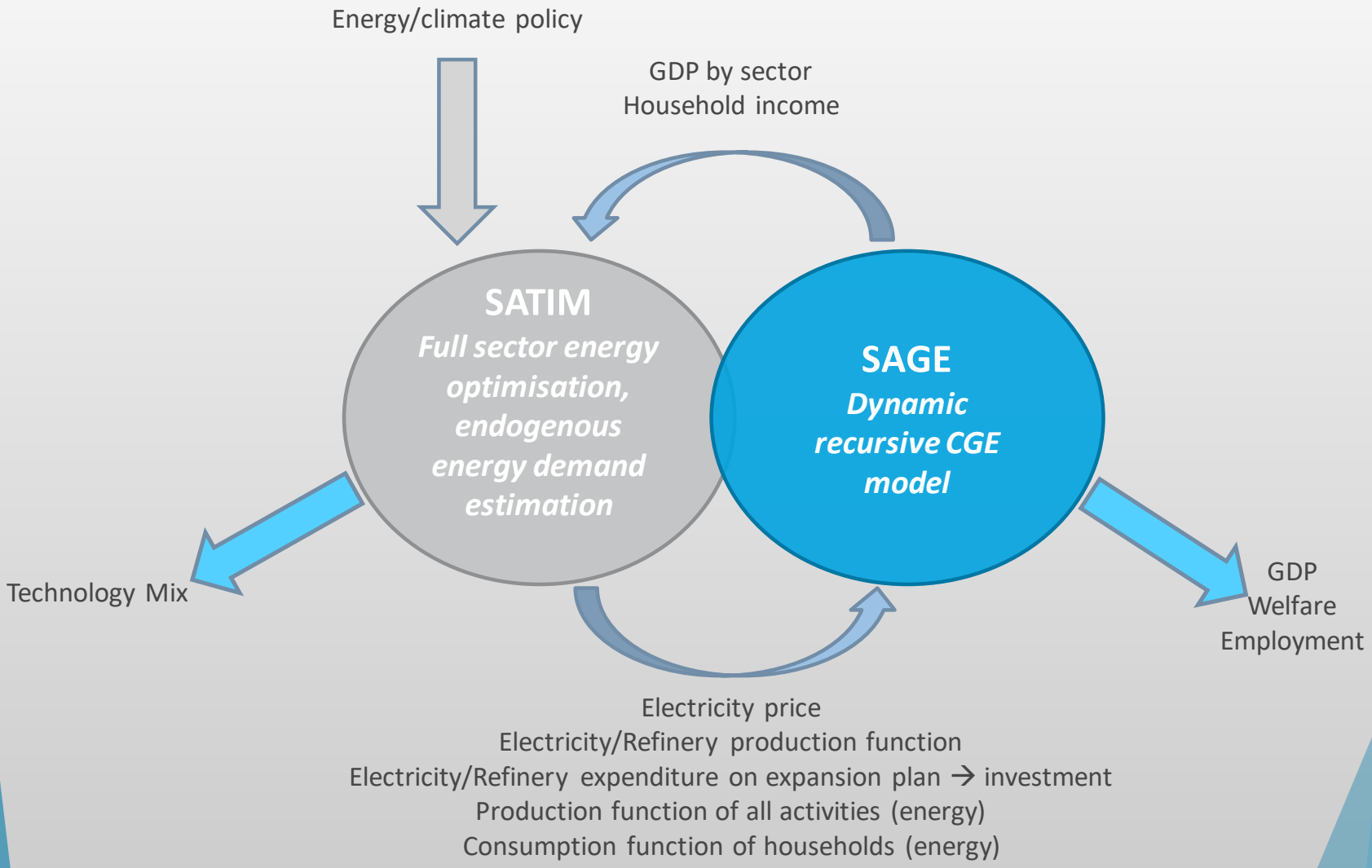
University of Cape Town · iYunivesithi yaseKapa · Universiteit van Kaapstad

sanedi
South African National Energy Development Institute

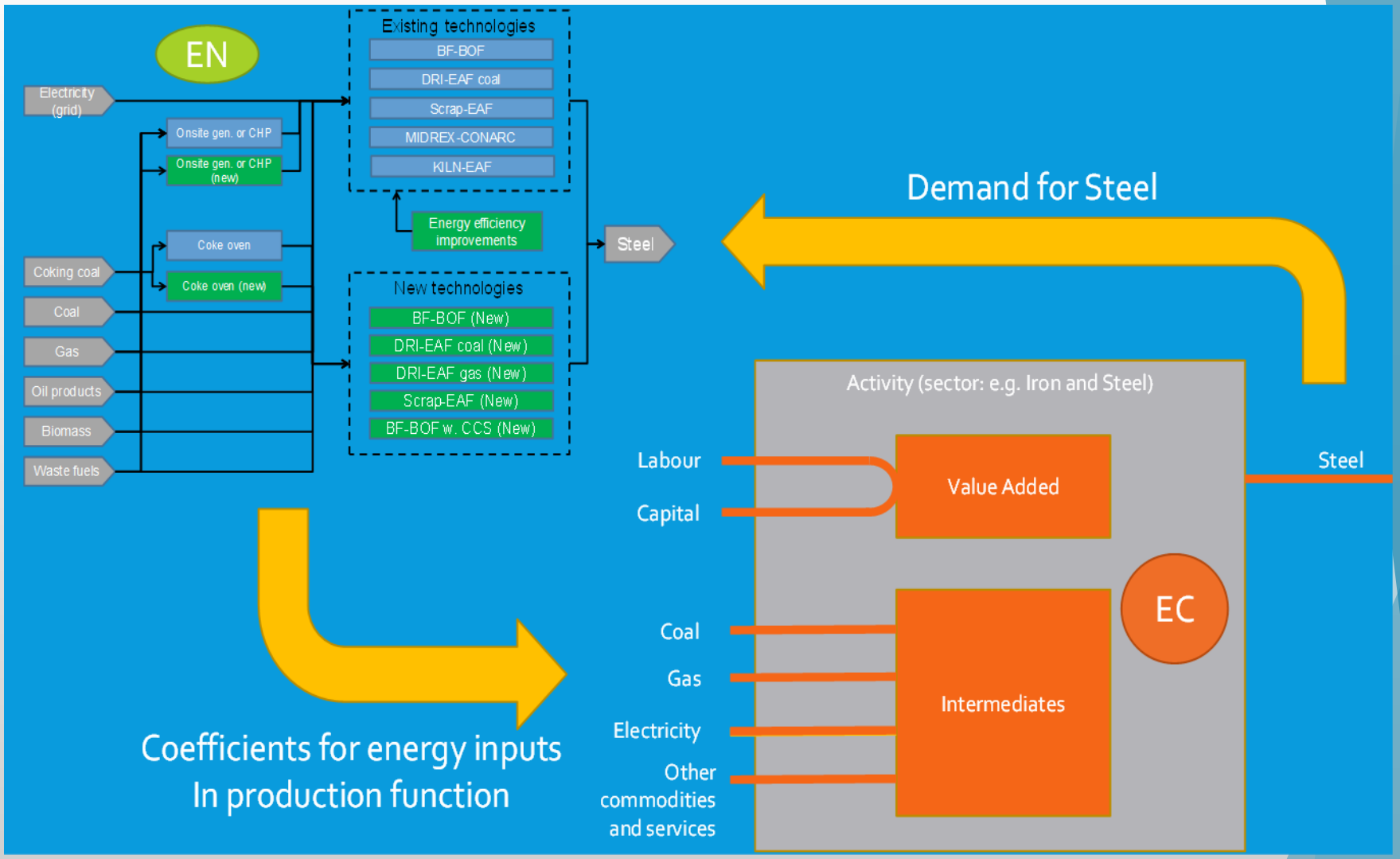
Introduction

- Declines in renewable energy costs has enabled the potential **low cost power supply and decarbonisation in the power sector**
- However **concerns remain on how to significantly increase the share of renewables in power generation** – technical (e.g. systems integration) but also developmental (i.e. impacts on economic development and employment)
- Objective of the research presented here is to **assess the impact of including renewable technologies in the power sector** → by comparing the least cost optimal inclusion of renewables in the power system versus keeping them out through maximum annual capacity additions
- **Hard linked energy-economic model (SATIMGE)** initially developed in collaboration with a number of institutions including UNU-WIDER and the National Treasury; and further developed with IFPRI under the SA-TIED project and other collaborators such as SANEDI

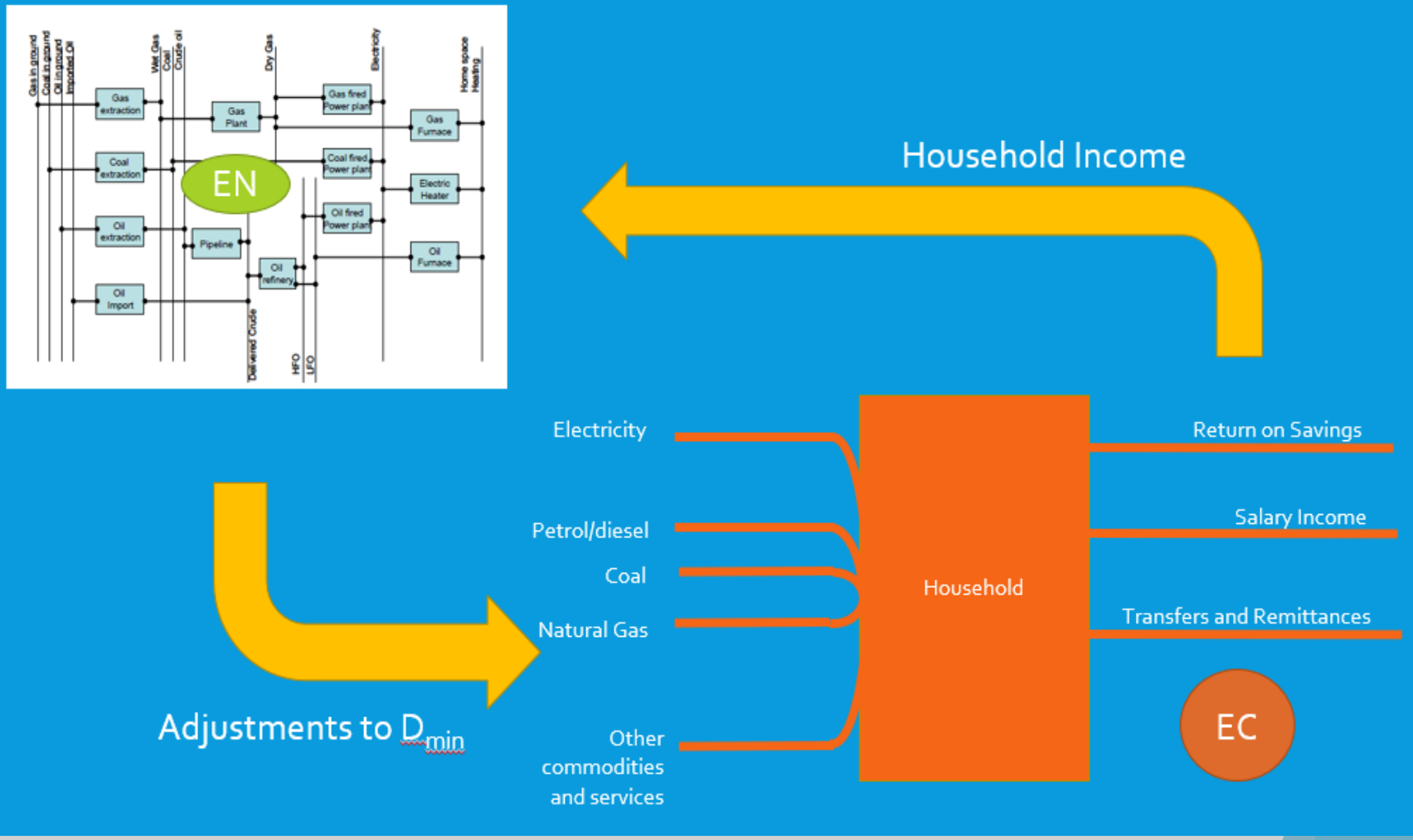
Linked energy-economic model - SATIMGE



Linked model: production of steel



Linked model: demand

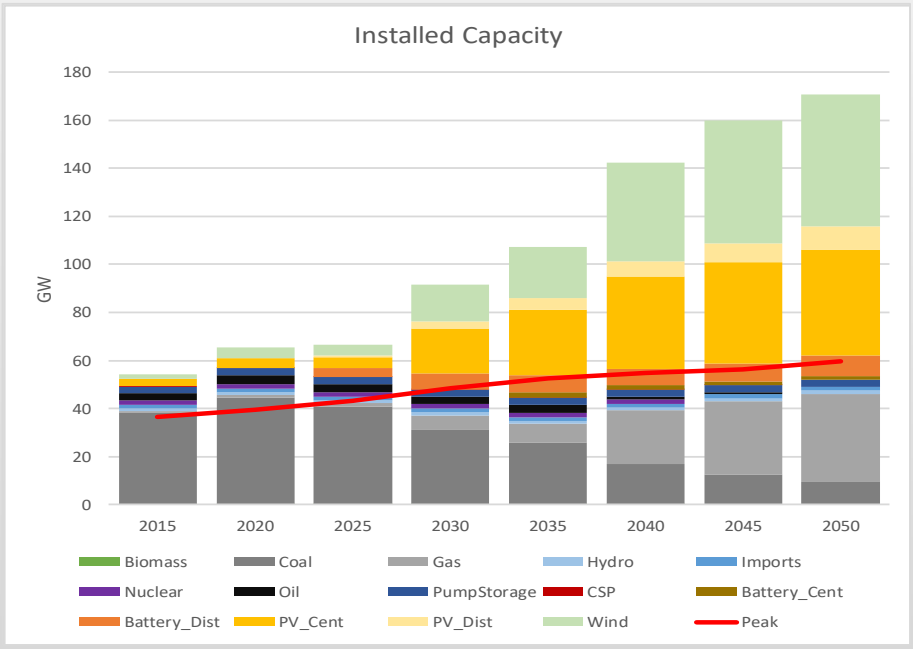


Scenarios and assumptions

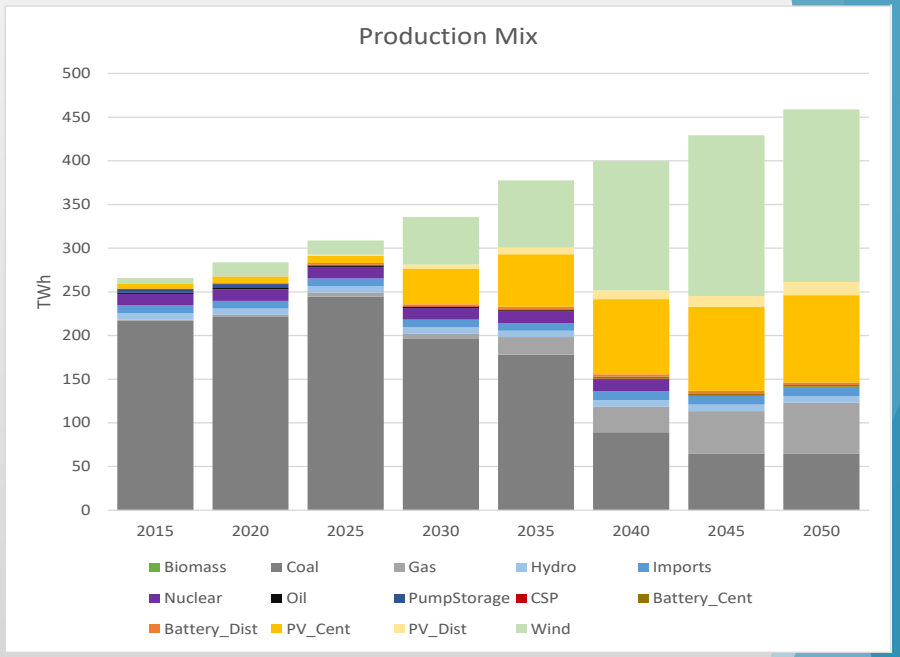
- 2 scenarios using least cost optimisation, including and excluding an energy emissions constraint
  - **CONALLRE**: least cost optimisation energy mix for meeting demand **with constraints on renewable capacity additions** (currently the case in national planning). Solar PV and wind additions are capped at 1GW and 1.8GW per annum; 15% restriction on the share of peak demand met by distributed renewable energy.
  - **UCONRE**: same as CONALLRE but **no constraints on solar PV and wind additions.**
- Key assumptions (http://sa-tied.wider.unu.edu/)
  - Conservative wind and solar PV costs (Ireland and Burton, 2018)
  - Upward sloping labour supply curves for all skill levels

When not constrained, renewable energy is primary producer of electricity

Constrained energy emissions case



Total power sector capacity

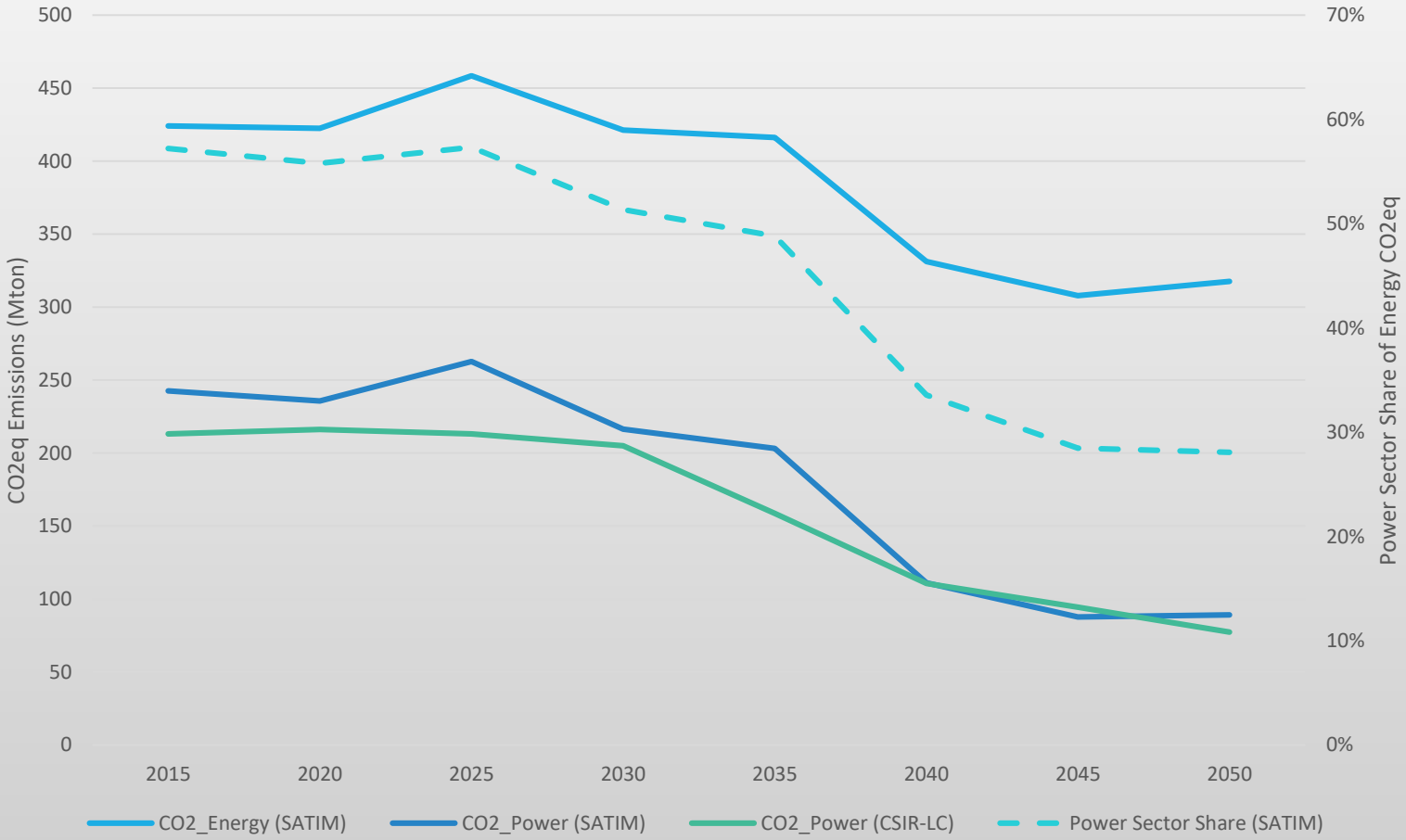


Total power generation by technology

- Imported gas provides system flexibility → more recent research highlights the potential for batteries

Renewables allow for significant decarbonisation in the power sector

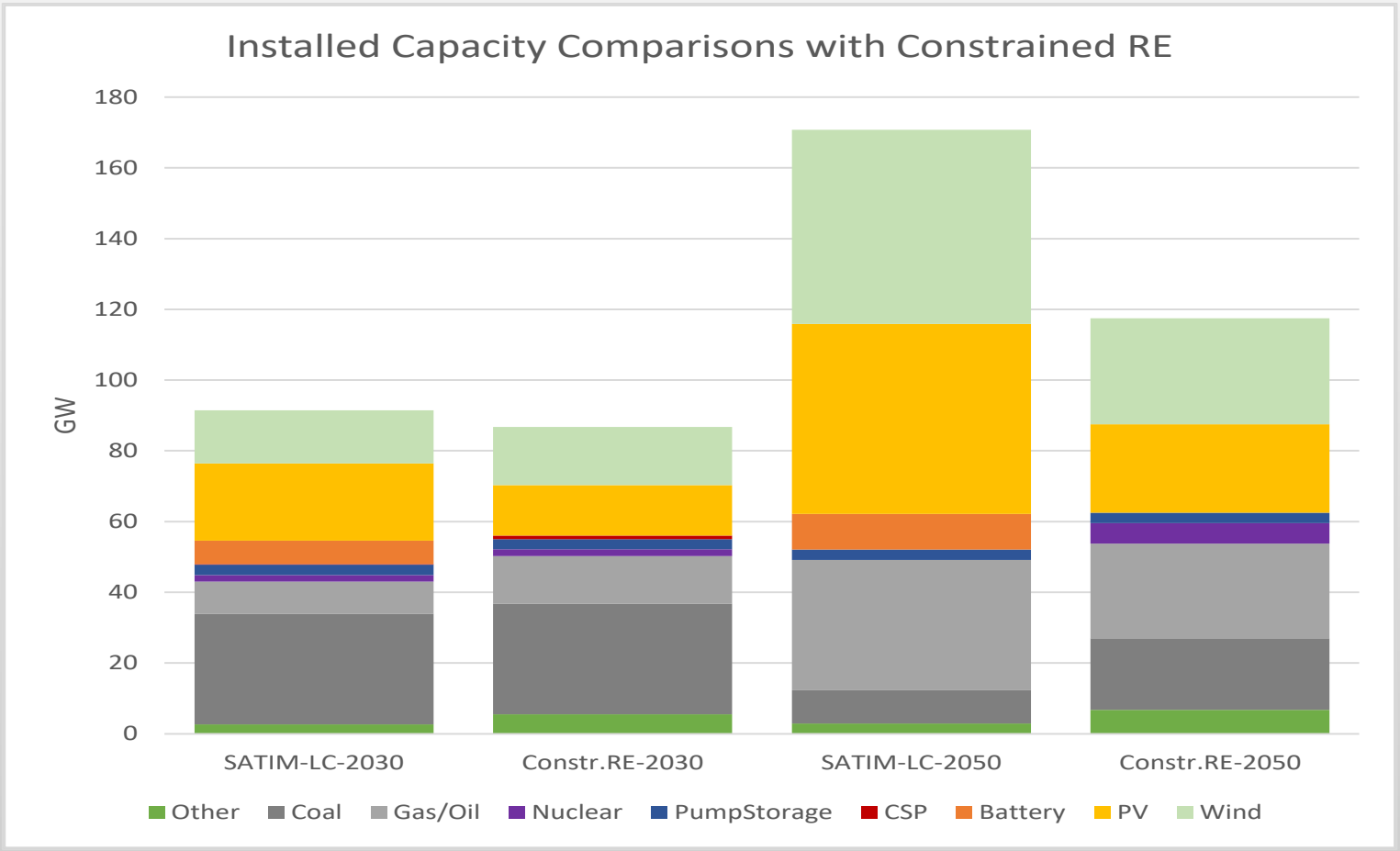
Constrained energy emissions case



Energy and power sector emissions

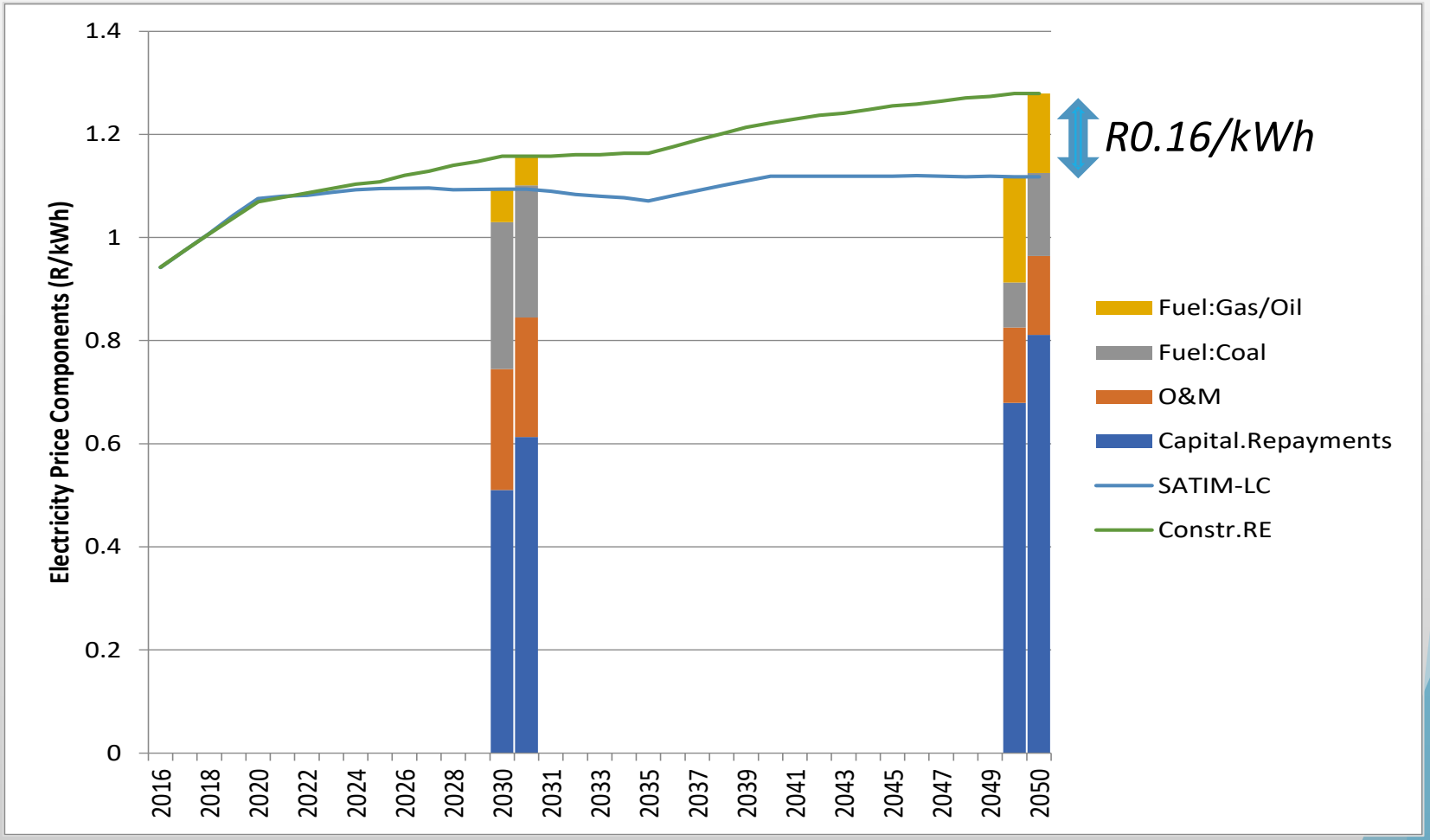
Keeping renewables out results in the use of more expensive technologies

Constrained energy emissions case



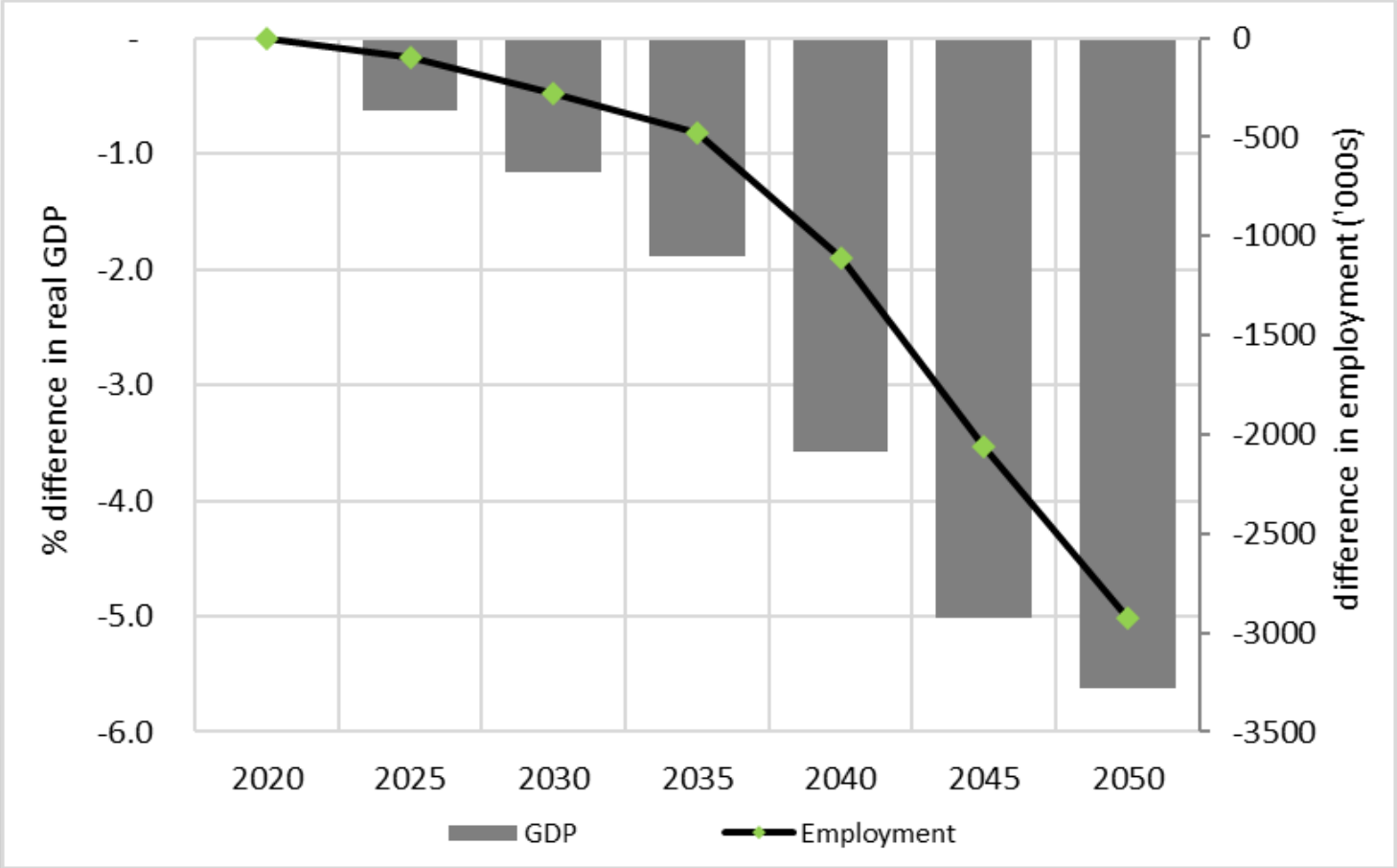
Requiring more investment and a higher electricity price

Constrained energy emissions case



Leading to lower GDP and employment…

Constrained energy emissions case



… Across almost all sectors

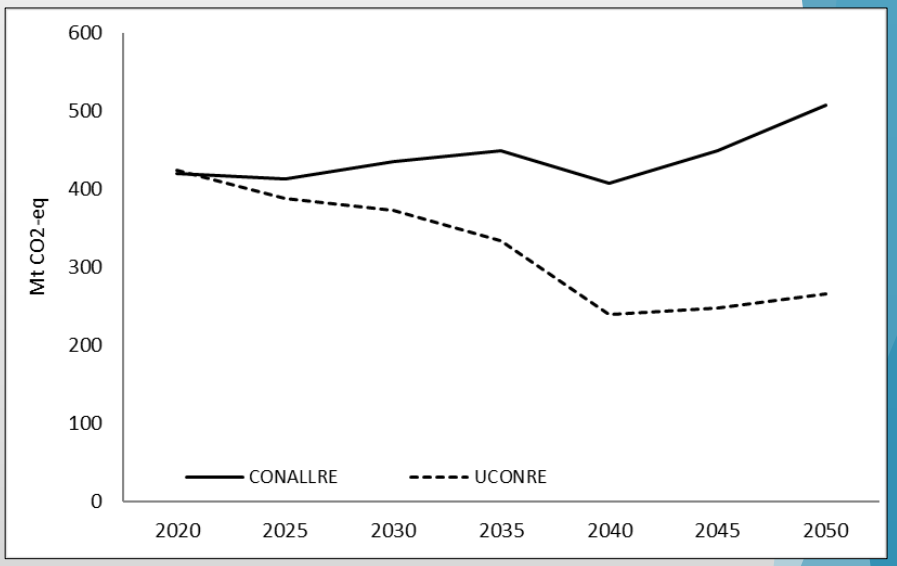
Constrained energy emissions case

	Percent difference in GVA level by	
	2030	2050
GDP	-1.2	-5.6
Agricuture	-1.0	-4.5
Mining	-0.1	-7.0
Coal	2.9	4.1
Manufacturing	-0.9	-5.9
Food and beverages	-0.7	-3.6
Texties & clothing	-1.0	-4.9
Wood & paper	-0.8	-4.1
Non-metallic minerals	-1.1	-5.2
Chemicals	-1.5	-13.7
Petroleum	-0.1	0.1
Metal products	-1.3	-8.1
Machinery	-0.7	-2.7
Vehicles	-0.8	-3.9
Other manufacturing	-0.5	-2.4
Other industry	-4.4	-8.1
Electricity, gas & water	-8.1	-11.0
Services	-1.0	-5.3
Trade	-0.9	-5.7
Transport &communication	-0.8	-4.6
Financial & business	-1.1	-5.2
Government	-1.1	-5.7
Other	-1.1	-5.3

Capping renewables leads to lower GDP in long-term under no emissions constraint with higher emissions

Unconstrained energy emissions case

	Percent difference in GVA level by	
	2030	2050
GDP	0.2	-2.2
Agricuture	0.0	-3.2
Mining	0.7	0.3
Coal	8.1	38.1
Manufacturing	0.1	-1.9
Food and beverages	0.5	-1.9
Texties & clothing	0.0	2.4
Wood & paper	0.3	-2.0
Non-metallic minerals	0.1	-1.2
Chemicals	0.3	-1.2
Petroleum	-0.2	0.0
Metal products	-1.1	-4.4
Machinery	0.2	-1.8
Vehicles	0.0	-2.3
Other manufacturing	0.4	-0.7
Other industry	-0.3	-3.4
Electricity, gas & water	-0.7	-5.0
Services	0.2	-2.4
Trade	0.1	-2.3
Transport &communication	0.4	-1.9
Financial & business	0.2	-2.7
Government	0.2	-2.3
Other	0.1	-2.5



Key messages

- Long-term mutual goals of economic development and decarbonisation are no longer mutually exclusive.
- In the case of South Africa, the least cost energy technology mix includes a significant share of renewable energy, specifically solar PV and wind.
- Constraining the use of renewables in power generation limit the benefits to economic growth and employment...
- … and the ability to decarbonise and reach our Nationally Determined Contributions.
- Reducing emissions in line with the NDC and constraining the inclusion of renewables, increases the burden on other sectors and raises the cost of decarbonising the economy.

Thank you!

We are open for collaboration and contributions for future work…

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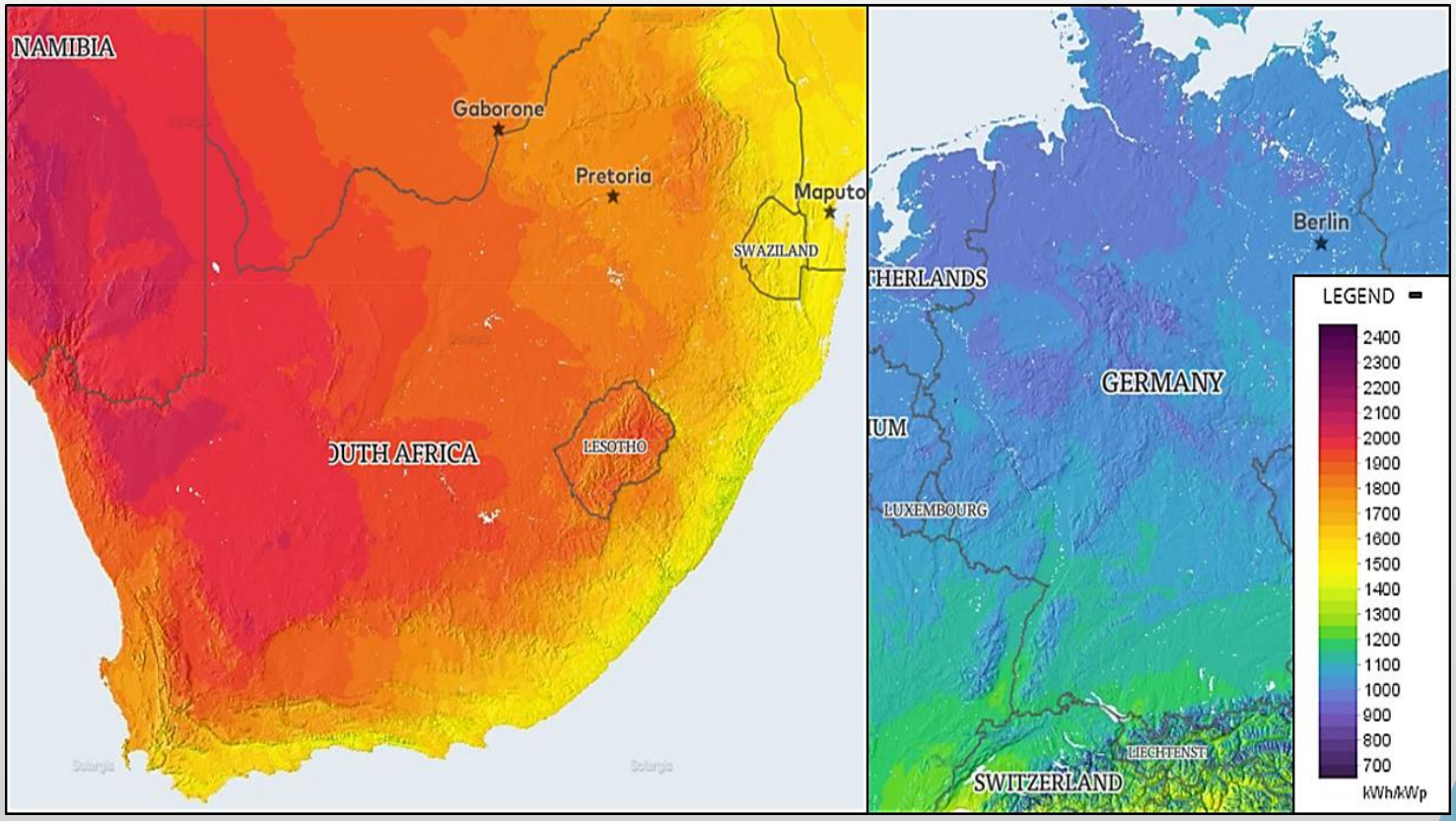
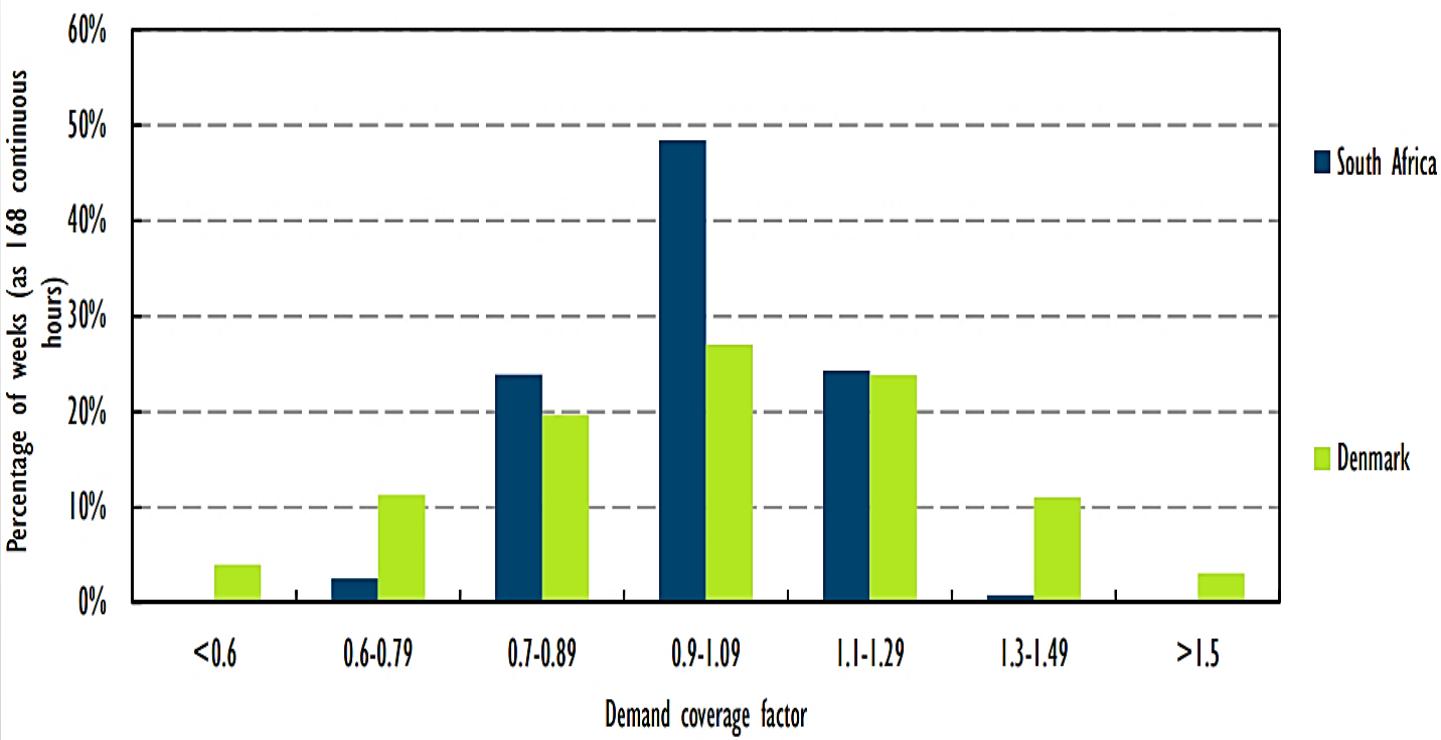
Renewable resources in South Africa relative to Germany



Comparison of the long-term solar PV production potential from a typical solar PV project in South Africa (left) compared to the same project in Germany (right). Source: SolarGIS, World Bank. Global Solar Atlas: An innovation of the world bank group. Energy Management and Assistance Program, SolarGIS. 2017.

Demand coverage factors for South Africa and Denmark



Demand coverage factors for South Africa and Denmark: wind and solar. Source: IEA. Next Generation Wind and Solar Power: From cost to value. Paris: International Energy Agency. 2016.

Renewable energy cost assumptions

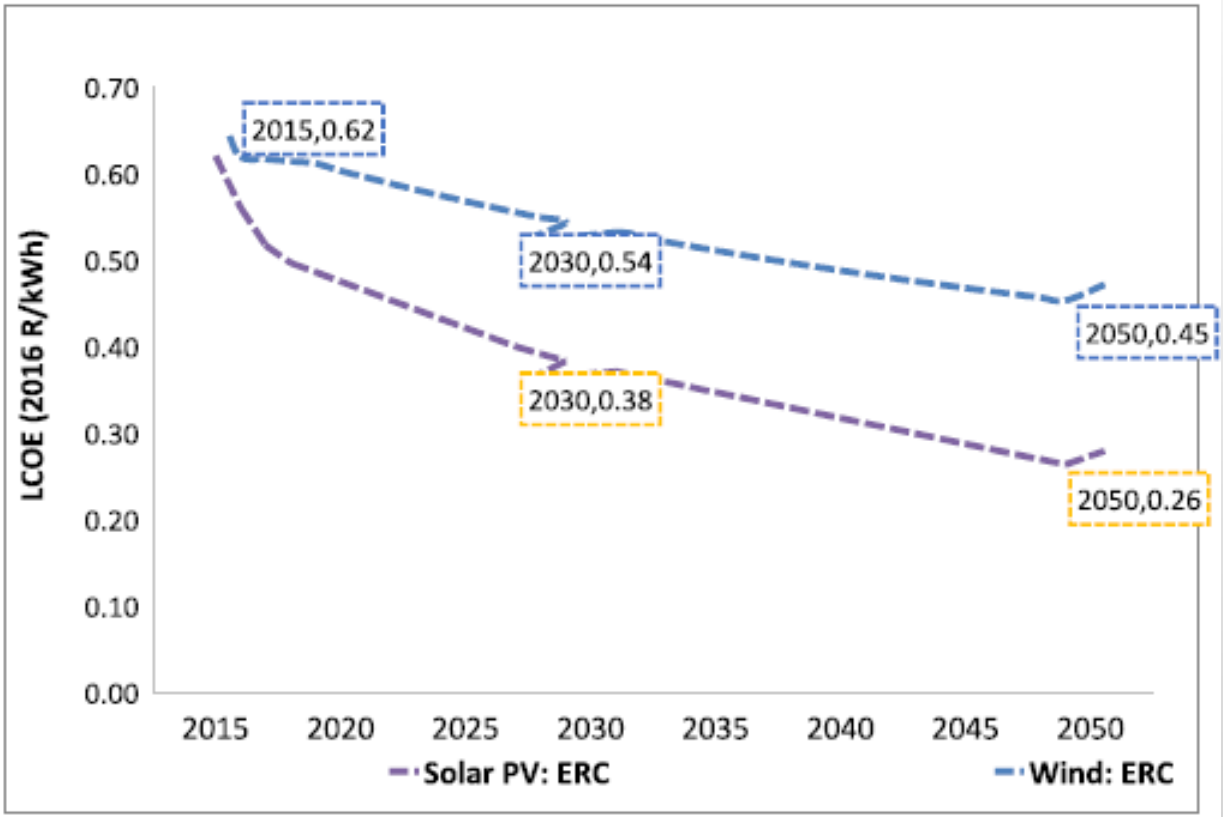
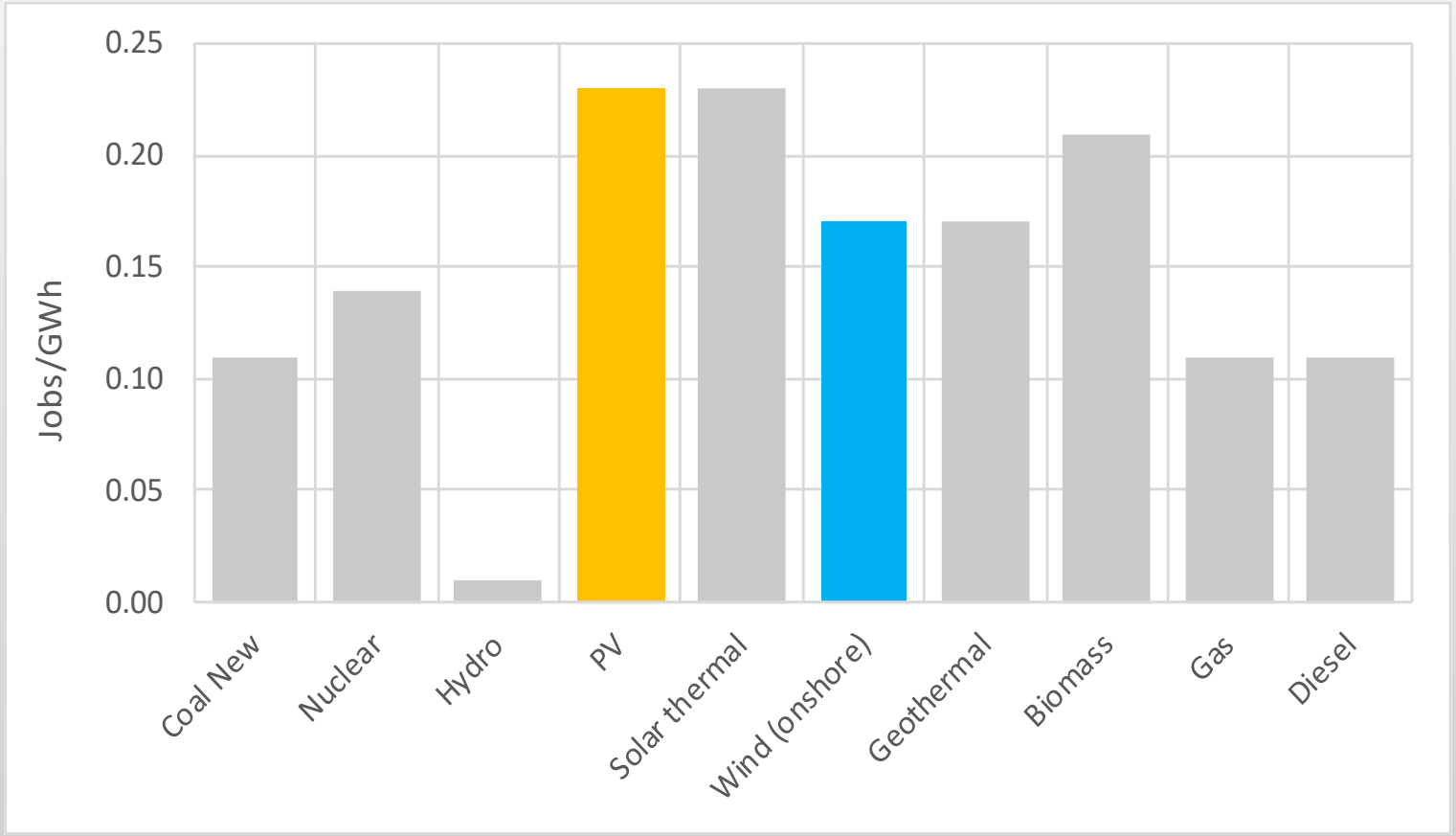


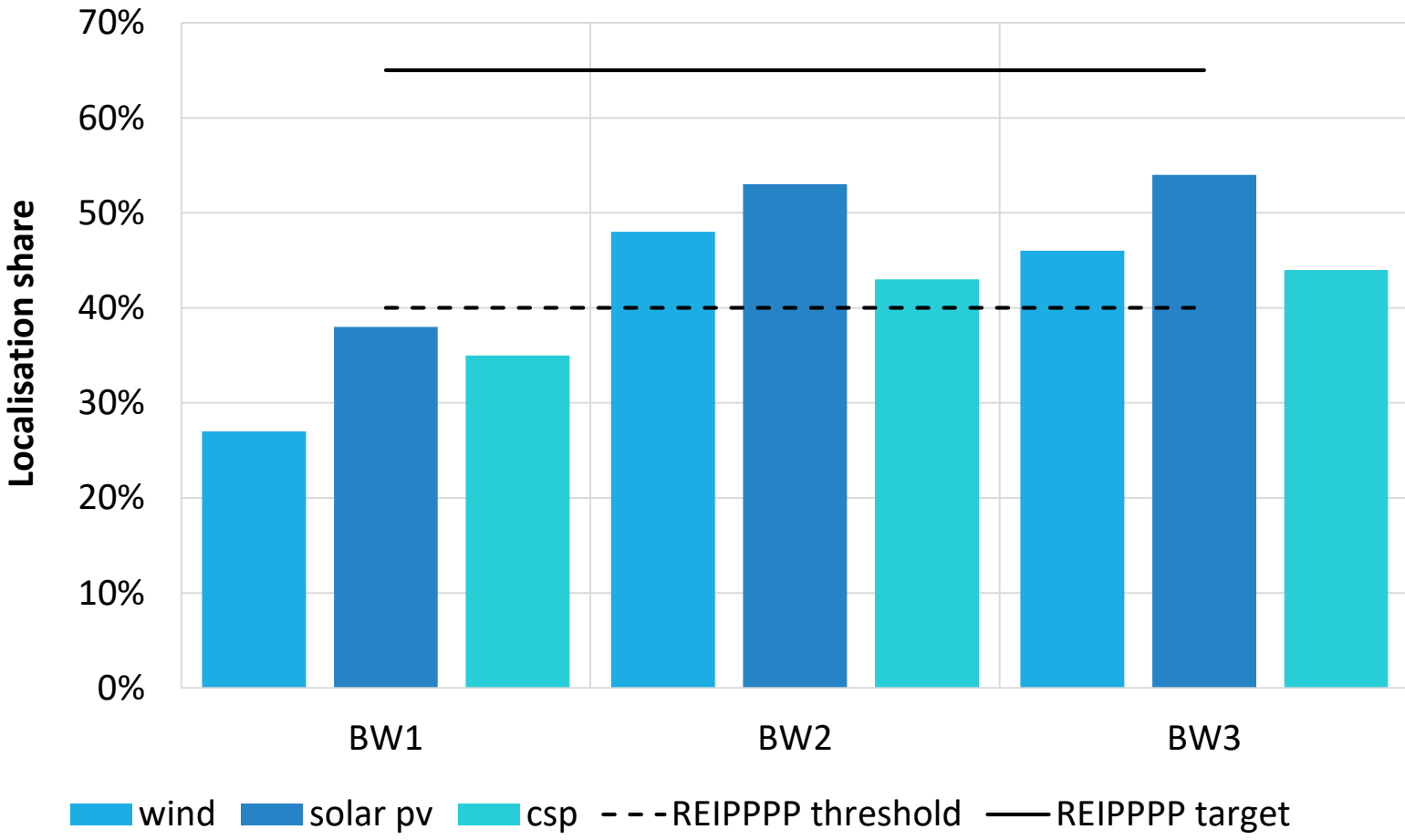
Figure 3: Solar PV and wind cost and learning assumptions 2015-2050 (April 2016 Rand)

Source: Ireland and Burton, 2018.

Jobs/GWh


Jobs/GWh
0.25
0.20
0.15
0.10
0.05
0.00
Coal New
Nuclear
Hydro
PV
Solar thermal
Wind (onshore)
Geothermal
Biomass
Gas
Diesel

Localisation



A localization rate of 54%, 44% and 47% is included for solar PV, solar CSP and wind respectively. These are based on the outcomes from bid window 3.