

Energy planning in the context of South Africa's NDC

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Background for study

An assessment of the IRP on technical, and policy grounds using the SATIM model, and an exploration of climate change mitigation efforts

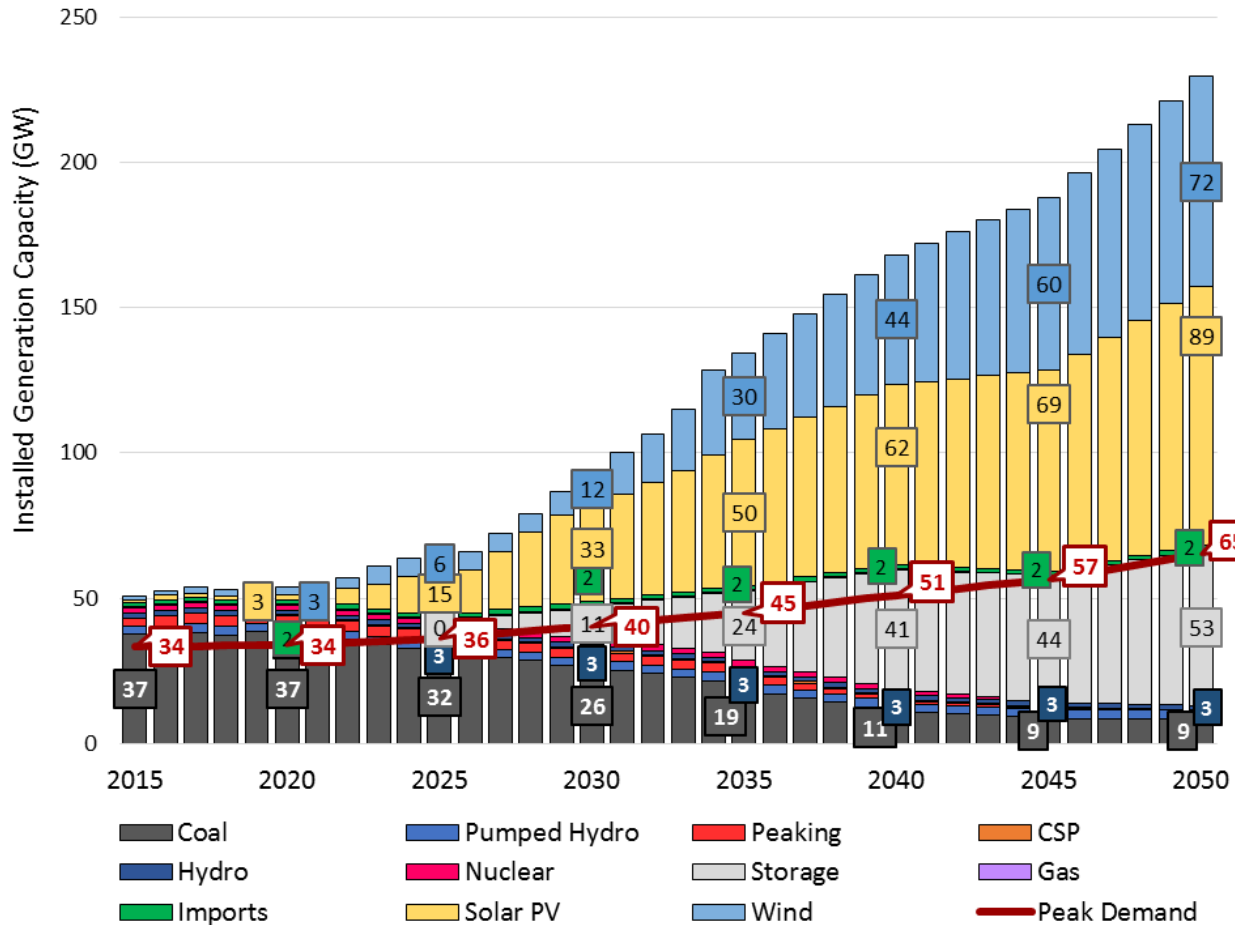
- ▶ IRP methodology concerns:
 - ▶ Electricity only
 - ▶ Adequate/accurate costing of new options
 - ▶ Minimum Emissions Standards (MES) not included
 - ▶ Assumptions on new build rates
- ▶ IRP scenarios incompatible with current NDC, let alone expected updated NDC
 - ▶ Includes new coal fired power stations

Our work...

- ▶ Use full sector energy-economy model (SATIMGE)
 - ▶ With updated costs
 - ▶ Legal MES plant requirements
 - ▶ Revised RE build rates
- ▶ Reference scenario to gauge IRP results in context new build options,
- ▶ To explore new climate change mitigation ambition and their economic impacts

Results: reference scenario

Power Sector Total Installed Generation Capacity (2015 - 2050)



Important bits:

- Decommission one whole plant (Majuba) due to MES feasibility, coal costs
- Storage is now important in

2030:

45GW wind + solar ~42% electricity produced

2050:

161GW wind +solar ~ 90% electricity produced

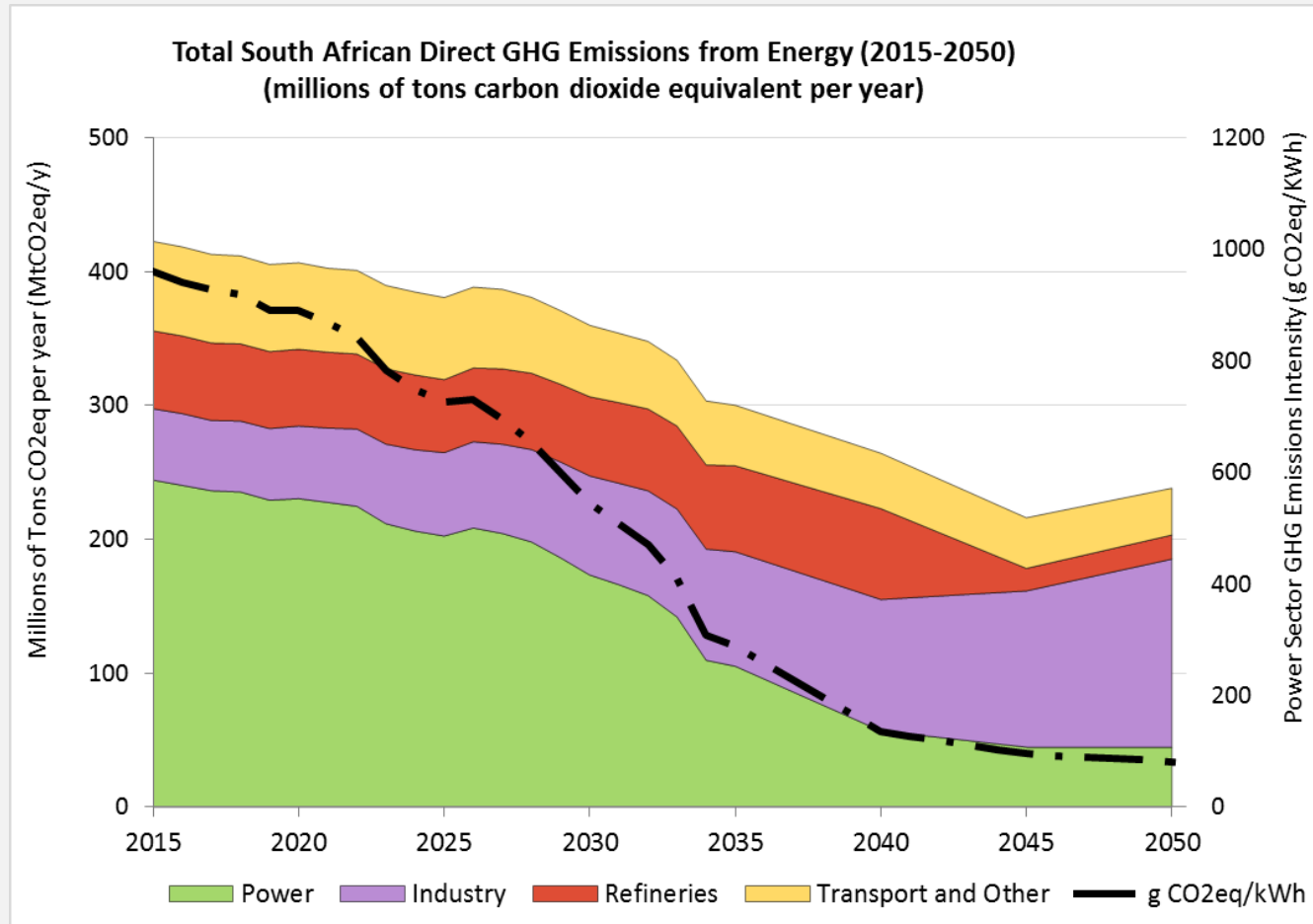
Draft IRP 2018 plan

	Coal	Nuclear	Hydro	Storage (Pumped Storage)	PV	Wind	CSP	Gas / Diesel	Other (CoGen, Biomass, Landfill)	Embedded Generation
2018	39 126	1 860	2 196	2 912	1 474	1 980	300	3 830	499	Unknown
2019	2 155					244	300			200
2020	1 433				114	300				200
2021	1 433				300	818				200
2022	711				400					200
2023	500									200
2024	500									200
2025					670	200				200
2026					1 000	1 500		2 250		200
2027					1 000	1 600		1 200		200
2028					1 000	1 600		1 800		200
2029					1 000	1 600		2 850		200
2030			2 500		1 000	1 600				200
TOTAL INSTALLED	33 847	1 860	4 696	2 912	7 958	11 442	600	11 930	499	2600
Installed Capacity Mix (%)	44.6	2.5	6.2	3.8	10.5	15.1	0.9	15.7	0.7	

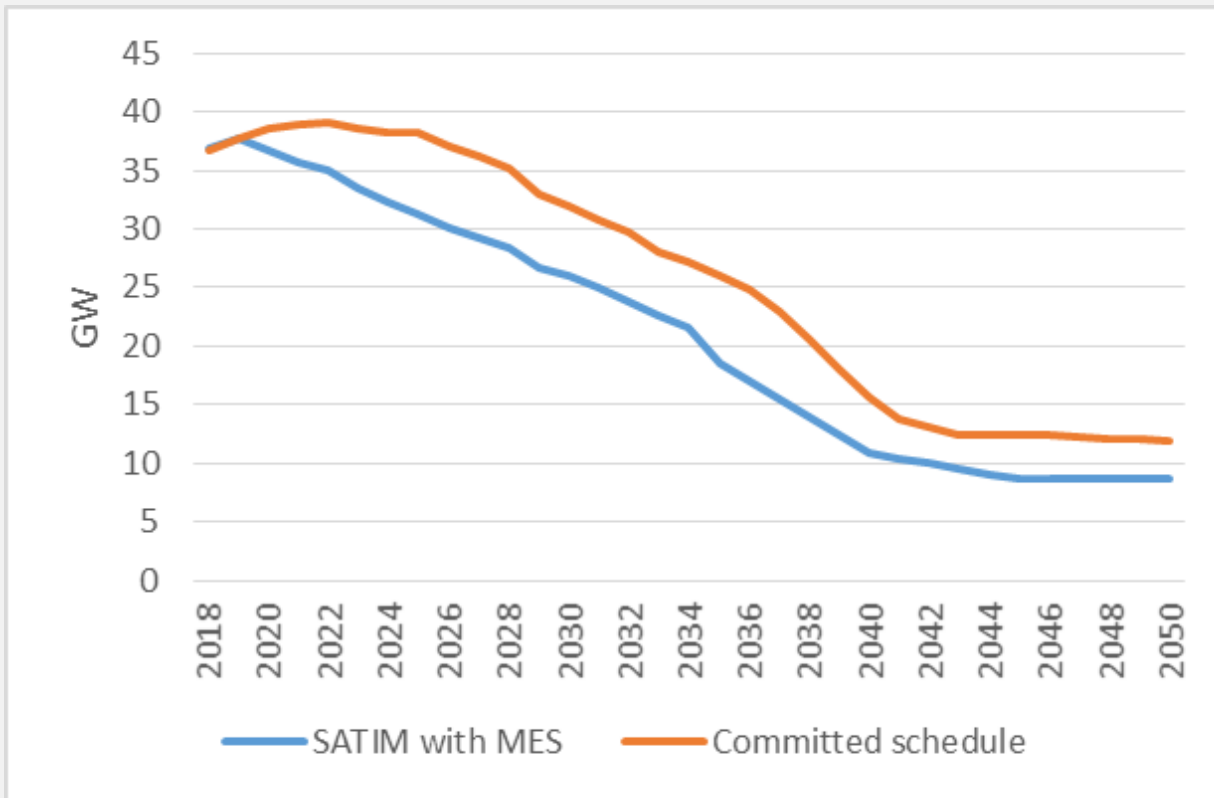
Installed Capacity
 Committed / Already Contracted Capacity
 New Additional Capacity (IRP Update)
 Embedded Generation Capacity (Generation for own use allocation)

Table 7: Proposed Updated Plan for the Period Ending 2030

Results: reference scenario emissions

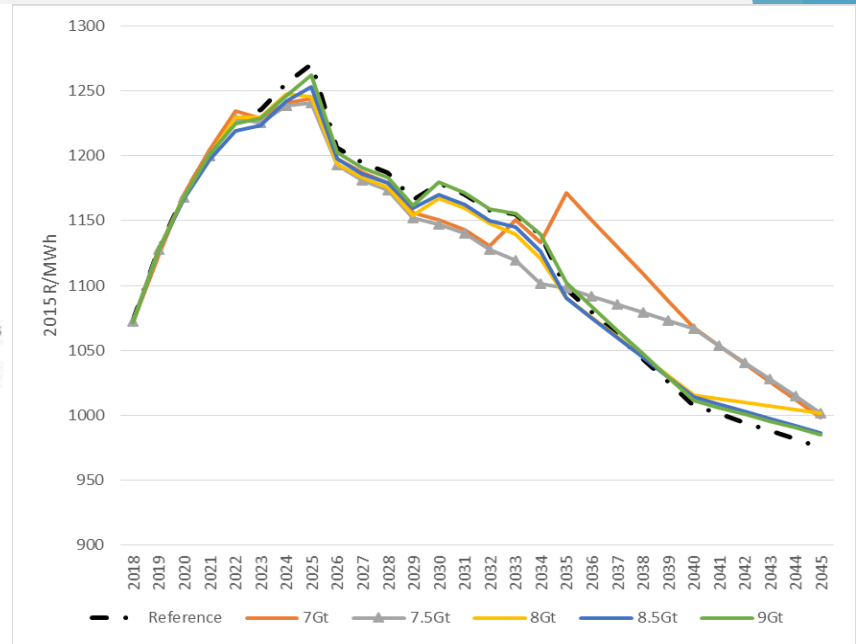
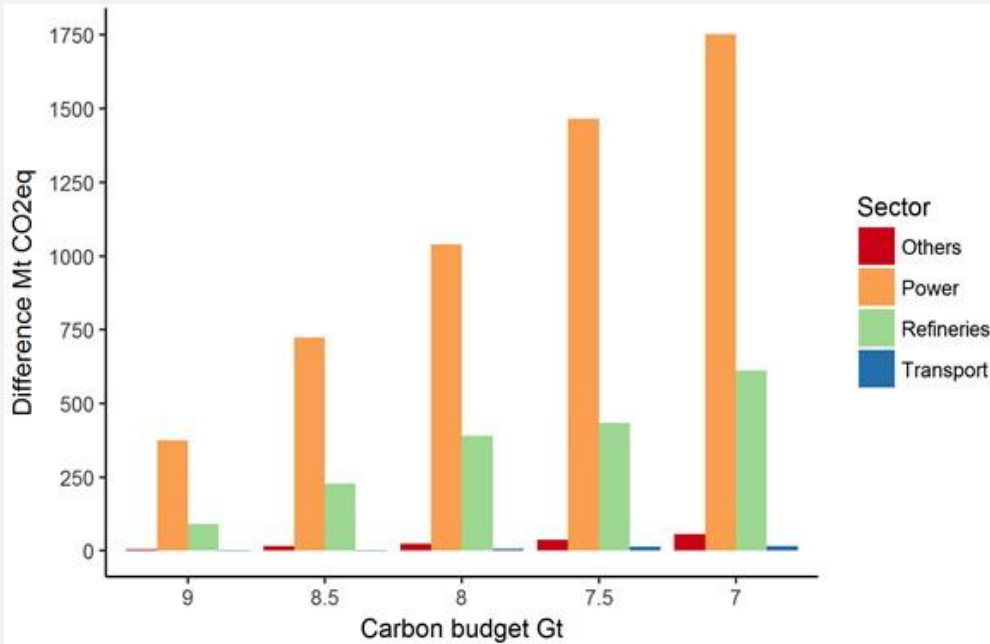


Results: MES compliance

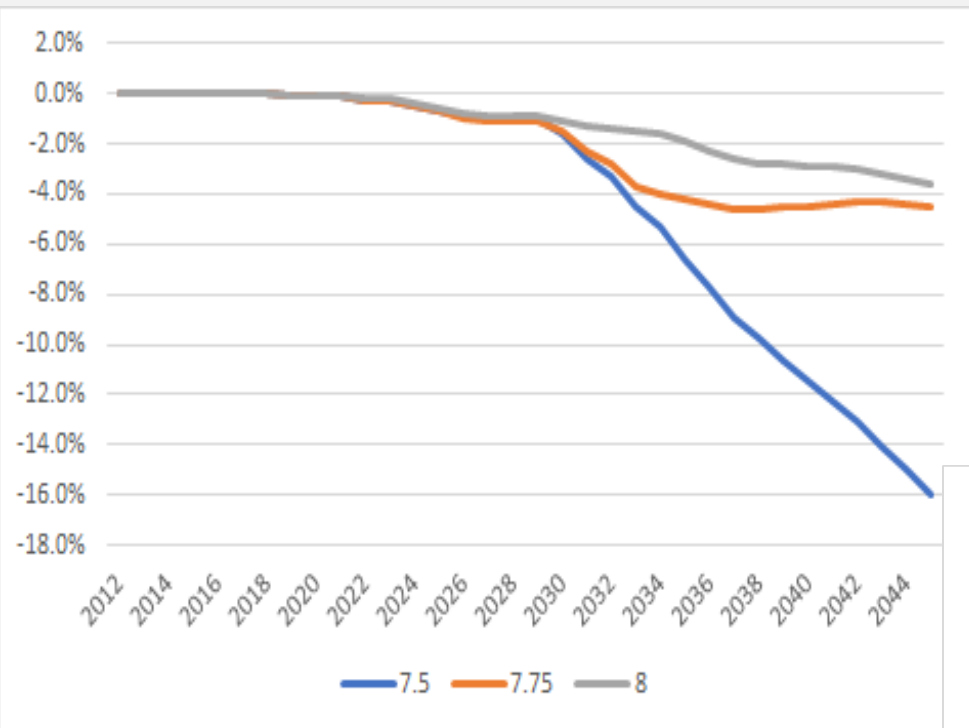


Station	no. units refurbished
Duvha	6
Kendal	6
Lethabo	6
Matimba	6
Majuba	0
Matla	5
Tutuka	2

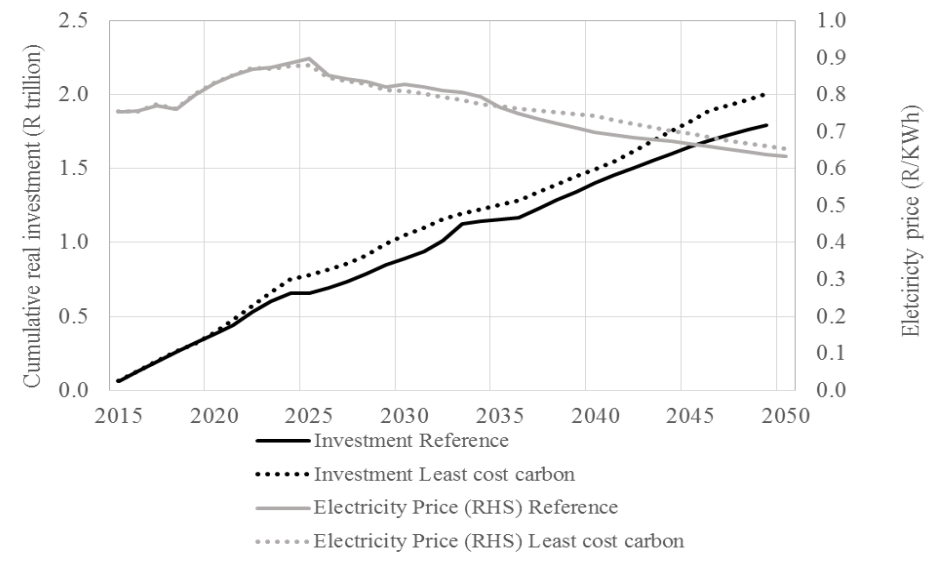
Methodology for estimating more ambitious NDC: carbon budgets



... and the impact on economy

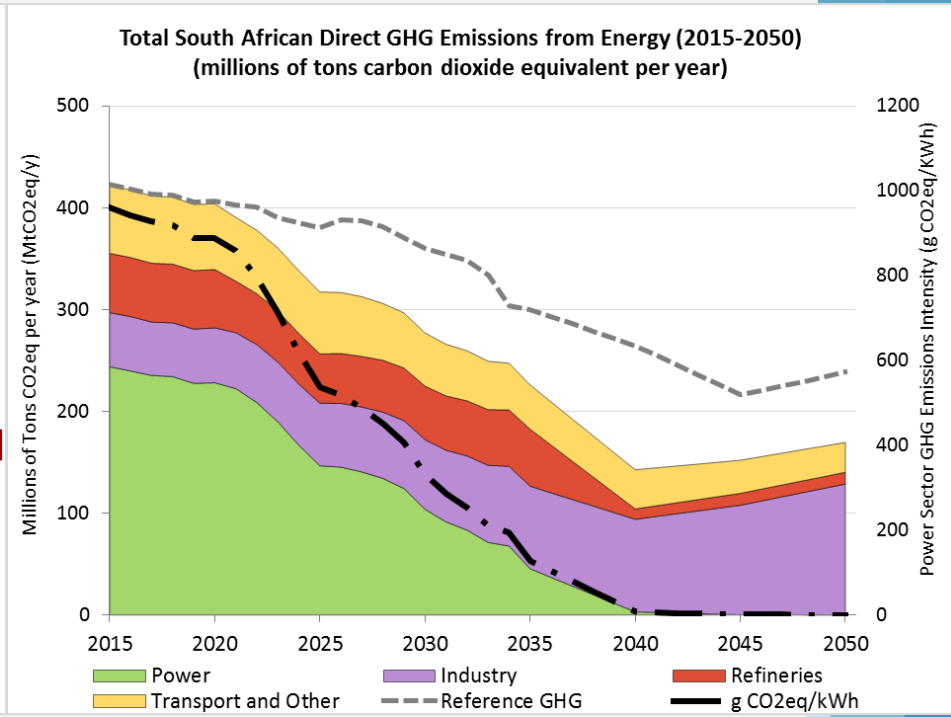
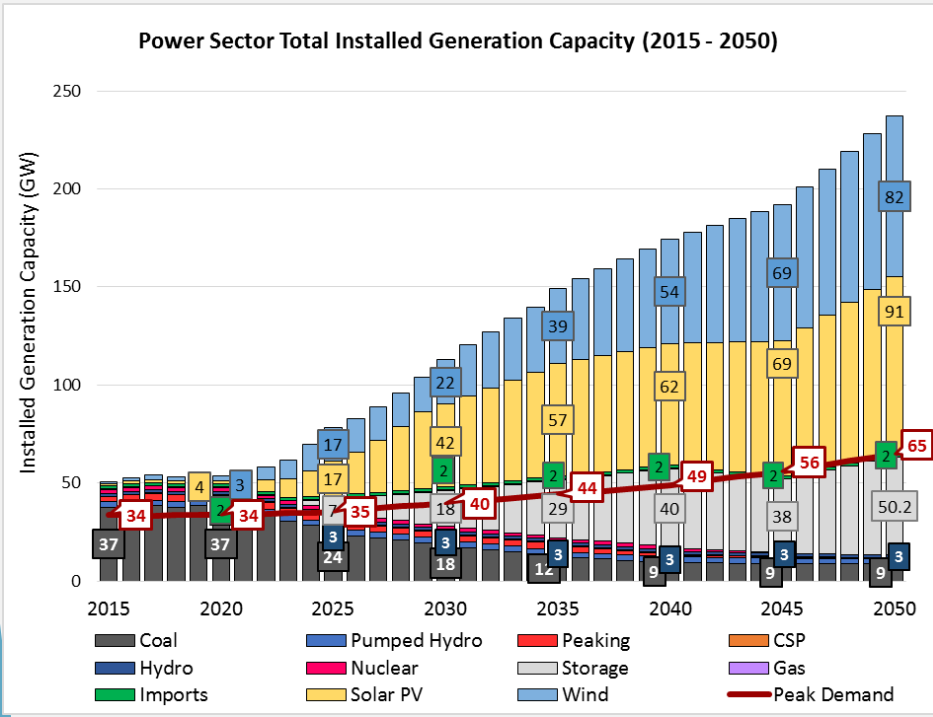


GDP relative to unconstrained



Arrive at 7.75Gt carbon budget (a new NDC)

Results: New NDC...



2030: 64GW wind + solar
 2050: 173GW wind + solar ~98%

Some economic impacts from increased CC ambition

- ▶ Some decline: non-metallic minerals, metal products and motor vehicles sub-sectors.
- ▶ The differences in employment are the largest in the services sector, which is the largest employer in the country. 1.32 million jobs lower in the carbon constrained scenario.
- ▶ The next largest differences are in the manufacturing and other industry sectors which employ 237 000 and 165 000 fewer workers than in the reference scenario.

Conclusions

- ▶ Increased ambition for mitigation means decarbonised electricity by 2040.
- ▶ Least cost reference is almost consistent with lower PPD (but insufficient for Paris Agreement)
- ▶ Storage will be a game changer
 - ▶ Need flexible generation and storage to compliment cheap RE
- ▶ MES compliance will accelerate coal phase out
- ▶ Cost to economy to be ambitious on CC about ~4% in 2050

Thank you

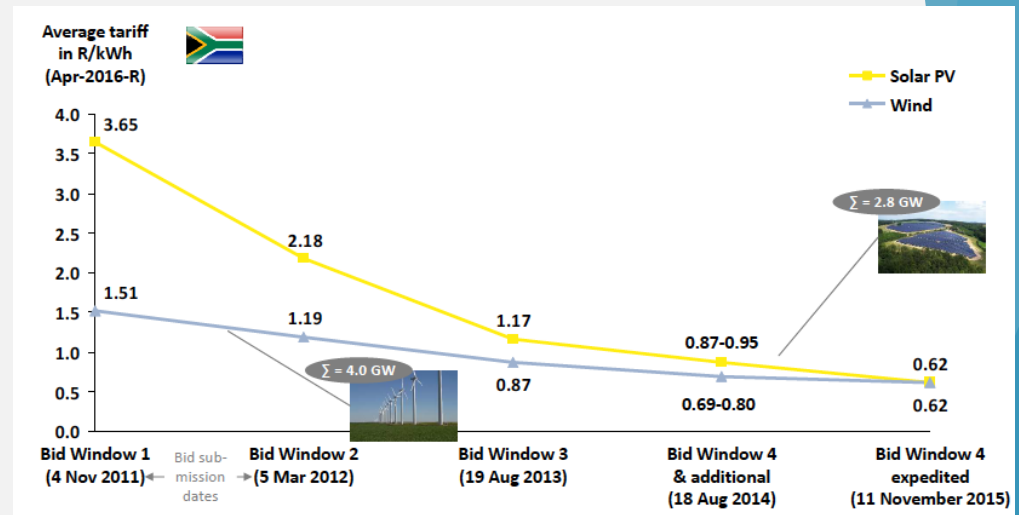
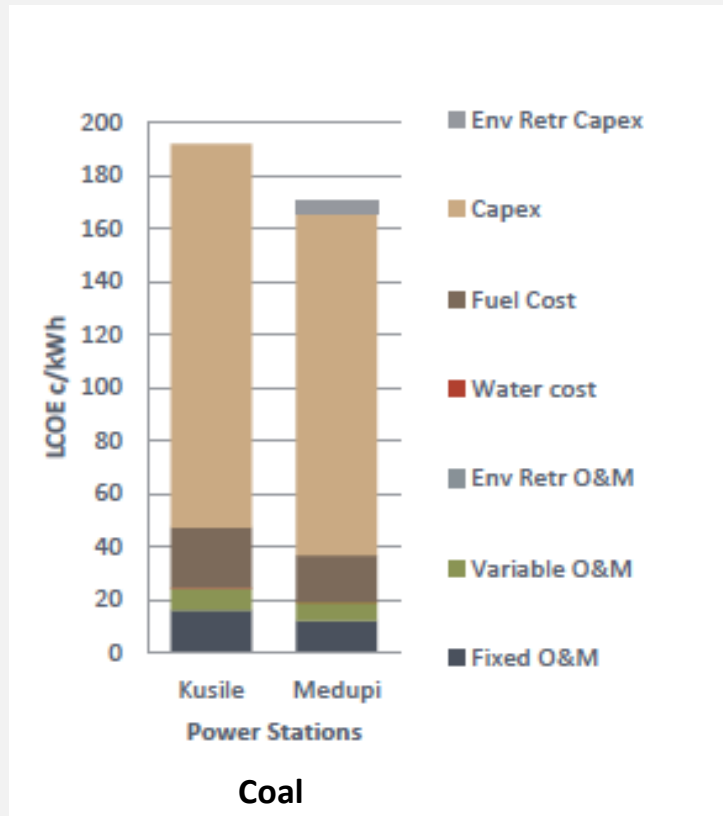
Reference scenario – additional inputs (over IRP)

- ▶ Coal specific costs to individual stations
- ▶ Minimum Emissions Standards requirement for coal plants (adds cost, affects availability) before 2025
- ▶ RE build limits
- ▶ Included battery technology option for storage

RE build rate (per year) used

Technology	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Wind	1.36	2.04	2.73	3.41	4.09	4.77	5.45	6.13	6.81	7.49	8.17
Solar PV	1.40	2.00	2.59	3.18	3.77	4.36	4.95	5.54	6.13	6.72	7.31

Electricity supply options in South Africa



Latest IRP build plan

Build plan from the current IRP 2018 draft (feb 2019)

	Coal	Nuclear	Hydro	Storage	PV	Wind	CSP	Gas/ Diesel	Dist. Gen
2019	2155					244	300		
2020	1433				114	300			
2021	1433				300	818			
2022	711			513	1400	1600			
2023	750				1000	1600			500
2024		1860				1600		1000	500
2025					1000	1600			500
2026						1600			500
2027	750					1600		2000	500
2028					1000	1600			500
2029				1575	1000	1600			500
2030			2500		1000	1600			500

Table 5: Emerging IRP 2018

Electricity projections are important

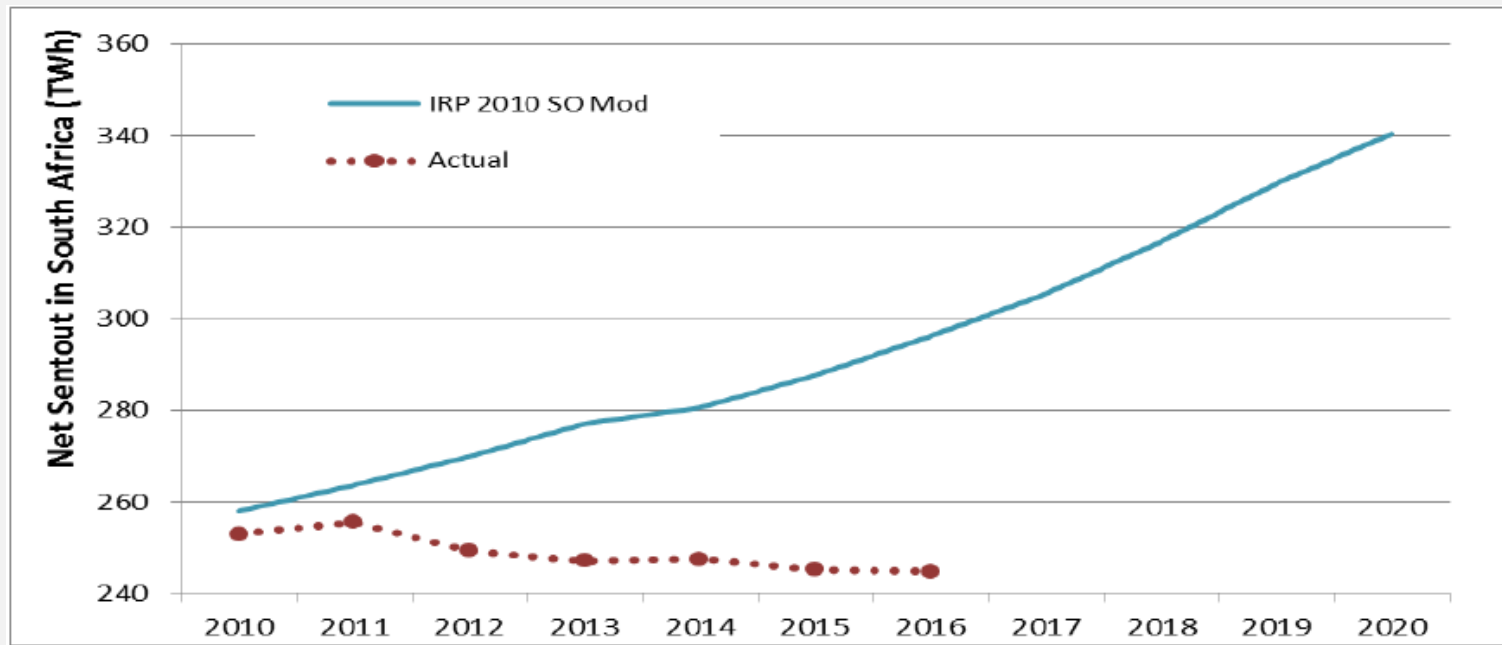


Figure 3: Expected Electricity Sent-out from IRP 2010–2030 vs Actual (Sources: Statistics SA & Promulgated IRP 2010–2030)