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Faculty of Economic and Management Sciences

Fakulteit Ekonomiese en Bestuurswetenskappe
Lefapha la Disaense tša Ekonomi le Taolo

An Economy-Wide Evaluation of New Power Generation in South Africa: The Case of Kusile and Medupi

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Outline

- Introduction
- Simulation Design Basics
- Policy Simulation: The Exogenous Shock
- Macroeconomic Results
- Industry Results
- Conclusions

Introduction

- In 2005, Eskom and the Department of Energy launched the New Build Programme (now absorbed into the Integrated Resource Plan) which includes the commissioning of two new modern coal-fired power stations, Kusile and Medupi, with a generation capacity of around 4800MW each
- Kusile and Medupi were scheduled to come online over a six-year period (2014-2019)
- The aim of this paper is to **evaluate the economy-wide impact that the additional power generation coming from Kusile and Medupi will have across a broad range of macroeconomic and industry variables**
- We use UPGEM, a dynamic CGE model of South Africa

Simulation Design: Basics

- In order to isolate and measure the economy-wide impact of any policy shock we run two separate simulations
- 1) **Business-As-Usual (BAU) baseline forecast of the economy in the absence of the exogenous shock**
 - 2) **Policy simulation which includes the exogenous shock**
- Results are reported as percentage deviations over time between the BAU and the policy simulation run

Business-As-Usual Baseline Forecast

**Includes
Kusile and
Medupi**

- Picture of the future evolution of the economy up to 2030
- It includes all the main macroeconomic variables for which reliable forecast exists (i.e. GDP, population growth)
- ***Includes*** the expected growth in the country's electricity generation capacity up to 2030, as per IRP (2013)
- Provides a baseline against which to measure a counterfactual scenario

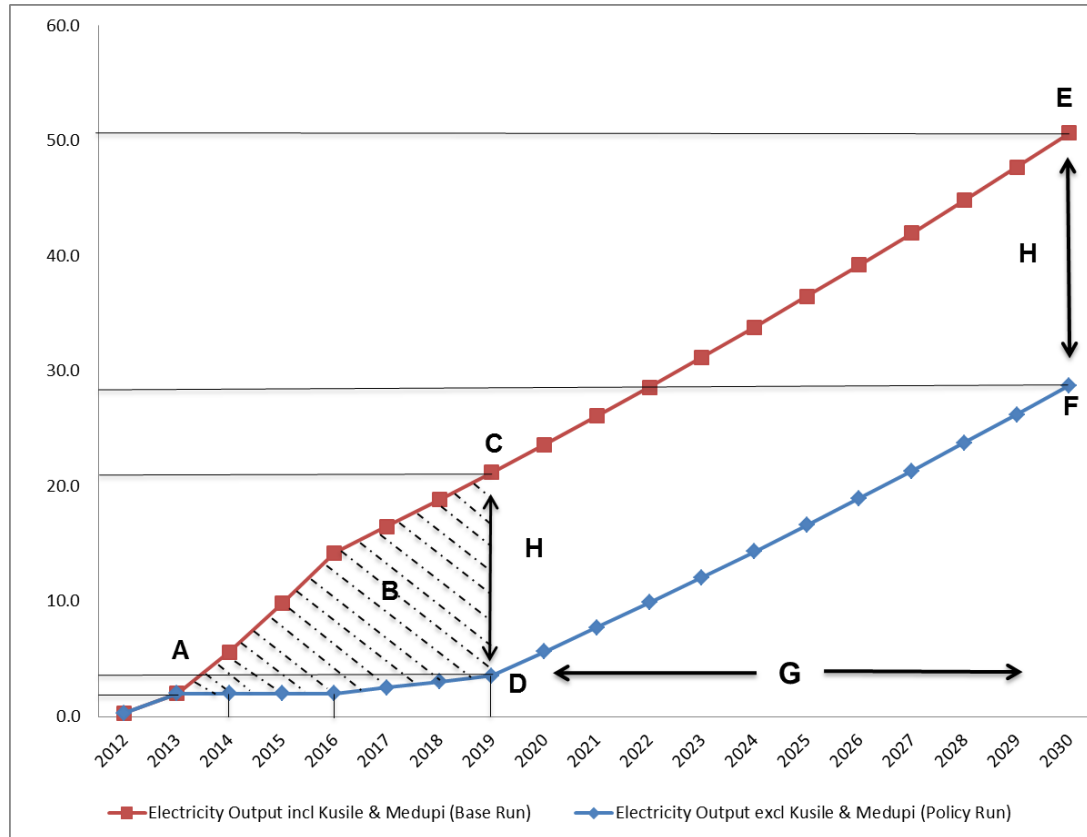
**Excludes
Kusile and
Medupi**

Policy Simulation Design

- We run a counterfactual policy simulation in which the additional 9600MW that is scheduled to come online between 2014 and 2019 is **eliminated**
- Electricity supply growth is set to zero per cent in 2014, 2015 and 2016. This simulates the elimination of the new generating capacity expected from Kusile and Medupi over this period
- From 2017 other sources of electricity generation, besides Kusile and Medupi, are expected to come online. For the years 2017, 2018 and 2019 electricity supply growth is set to 0.5 per cent
- From 2020 onward, no additional shocks are applied to the economy in the policy run

Policy Simulation: The Exogenous Shock

Electricity Output Deviation in Policy versus Base: Cumulative Percentage Changes



Policy Simulation Results: Macroeconomic

Selected Macro Results (Cumulative Percentage Difference Relative to Baseline)

Macro Variables	2014	2015	2016	2017	2018	2019	2020	2030
Real GDP	-0,44	-0,90	-1,61	-2,37	-2,70	-3,15	-3,11	-1,00
Households	-0,98	-1,48	-2,26	-2,89	-2,55	-2,76	-2,10	-0,57
Investment	-2,77	-5,26	-7,85	-9,94	-9,58	-9,49	-7,02	1,22
Government	-0,98	-1,48	-2,26	-2,89	-2,55	-2,76	-2,10	-0,57
Exports	1,30	1,65	1,87	1,56	0,12	-0,74	-2,35	-1,49
Imports	-1,69	-2,68	-3,82	-4,61	-3,98	-3,91	-2,53	0,46
Capital	-0,01	-0,20	-0,56	-1,12	-1,84	-2,48	-3,07	-2,16
Labour	-0,81	-1,42	-2,25	-2,98	-2,90	-3,10	-2,51	0,49
Real Wage	-0,41	-1,12	-2,24	-3,73	-5,18	-6,73	-7,97	-11,84
Real Devaluation	1,68	1,76	2,01	1,78	0,23	-0,16	-1,56	0,06
Terms of Trade	-0,45	-0,60	-0,70	-0,63	-0,15	0,15	0,73	0,47
Export Price Index	-0,45	-0,60	-0,70	-0,63	-0,15	0,15	0,73	0,46
Consumer Price Index	-0,94	-0,80	-0,68	-0,23	0,96	1,45	2,47	1,76

Source: UPGEM (GEMPACK) and Author's Own Calculations

Policy Simulation Results: Industry

Industry Output Results (Cumulative Percentage Difference Relative to Baseline)

Industry	2014	2015	2016	2017	2018	2019	2020	2030
Agriculture	-0,06	-0,12	-0,29	-0,54	-0,76	-1,01	-1,13	0,18
Coal Lignite	0,02	0,05	-0,05	-0,27	-0,64	-1,15	-1,65	-1,98
Mining of Metal Ores	0,10	0,19	0,14	-0,05	-0,42	-0,91	-1,38	-0,87
Other Mining	0,12	0,22	0,18	-0,03	-0,44	-0,99	-1,55	-1,53
Food	-0,25	-0,46	-0,85	-1,30	-1,44	-1,71	-1,65	0,25
Beverages, Tobacco	-0,06	0,01	0,02	0,02	0,04	-0,06	-0,10	1,41
Textiles, Footwear	-0,35	-0,90	-1,82	-2,87	-3,25	-3,74	-3,62	-0,93
Petroleum, Chemicals	-0,17	-0,87	-2,11	-3,73	-4,98	-6,14	-6,83	-5,00
Iron & Steel	-0,16	-1,73	-3,88	-6,38	-8,13	-9,36	-9,78	-5,14
Other Metal Equipment	0,20	-0,30	-1,12	-2,25	-3,41	-4,31	-4,93	-1,10
Electrical Machinery	-0,91	-2,18	-3,62	-4,99	-5,53	-5,89	-5,30	0,70
Transport Equipment	-0,07	-0,41	-0,93	-1,55	-2,05	-2,40	-2,47	1,69
Other Manufacturing	0,00	-0,26	-0,72	-1,36	-2,00	-2,54	-2,88	0,16
Electricity	-2,91	-6,20	-9,37	-11,99	-13,29	-14,56	-14,56	-14,56
Water	-0,13	-0,34	-0,67	-1,10	-1,43	-1,74	-1,88	-0,38
Construction	-2,45	-4,85	-7,34	-9,43	-9,33	-9,33	-7,20	0,85
Trade	-0,26	-0,75	-1,57	-2,54	-3,21	-3,88	-4,09	-1,09
Hotel & Restaurants	0,20	0,42	0,54	0,53	0,26	-0,18	-0,72	-1,11
Transport Services	0,05	0,10	0,01	-0,19	-0,53	-0,98	-1,41	-0,50
Post & Communication Services	-0,02	-0,04	-0,18	-0,42	-0,72	-1,10	-1,40	0,21
Business	-0,21	-0,47	-0,91	-1,40	-1,71	-2,04	-2,09	0,38
General Government	-0,95	-1,44	-2,21	-2,82	-2,47	-2,65	-1,98	-0,29
Education	-0,39	-0,75	-1,29	-1,84	-1,93	-2,15	-1,91	0,52
Health & Social Services	-0,32	-0,63	-1,09	-1,57	-1,69	-1,90	-1,74	0,53
Other Services	-0,16	-0,28	-0,47	-0,67	-0,73	-0,85	-0,80	1,09

Source: UPGEM (GEMPACK) and Author's Own Calculations



Conclusion

- Economic growth will be severely harmed in the medium term without the additional electricity generation capacity scheduled to be brought online through Kusile and Medupi.
- The problem of excess demand relative to tight supply in the electricity market will be greatly relieved once the additional capacity from Kusile and Medupi is installed
- Our simulation results clearly show the need for both stations' additional capacity in order to facilitate economic growth, prevent widespread blackouts and reduce upward pressure on electricity prices

Thank you

Suggestions, questions and comments are welcome

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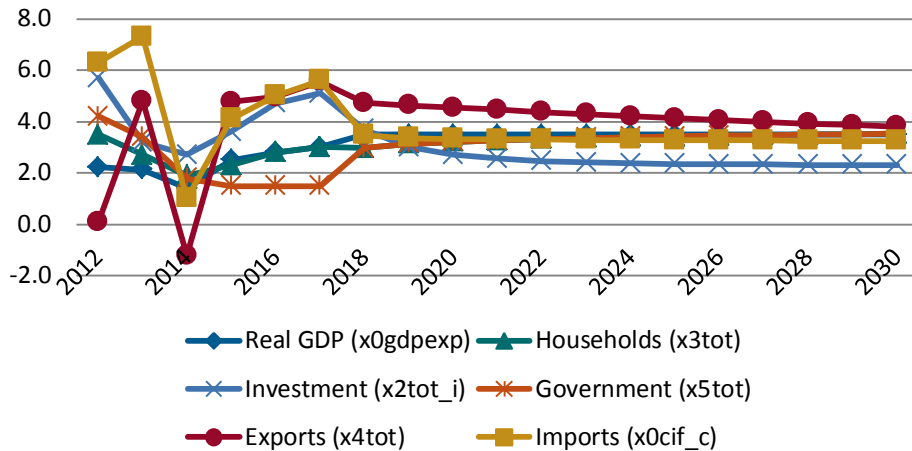
Conclusion

Our results clearly show the additional generation capacity scheduled to come from these new power plants will improve the economy's ability to grow and attract investment, alternatively stated, the delays in constructing Kusile and Medupi are costing the economy as we speak

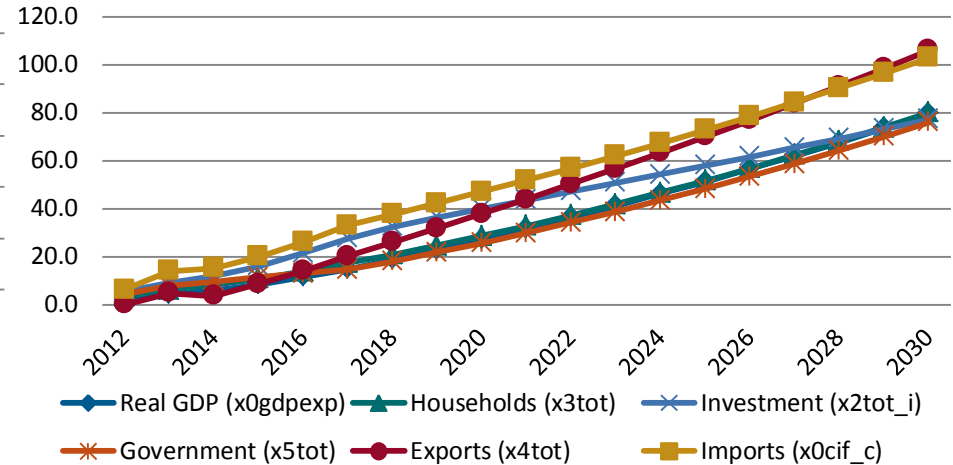
Business-As-Usual Baseline Forecast (Continued)

- Real GDP is expected to grow by 79.7 per cent from 2012 to 2030, representing an average growth of 3.1 per cent over the 19-year period

Base Run: Year-on-Year Percentage Changes in GDP Expenditure Components



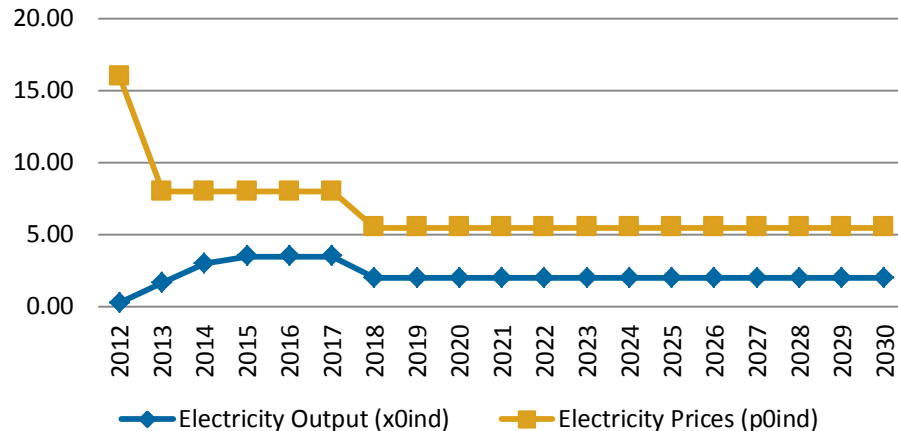
Base Run: Cumulative Percentage Changes in GDP Expenditure Components



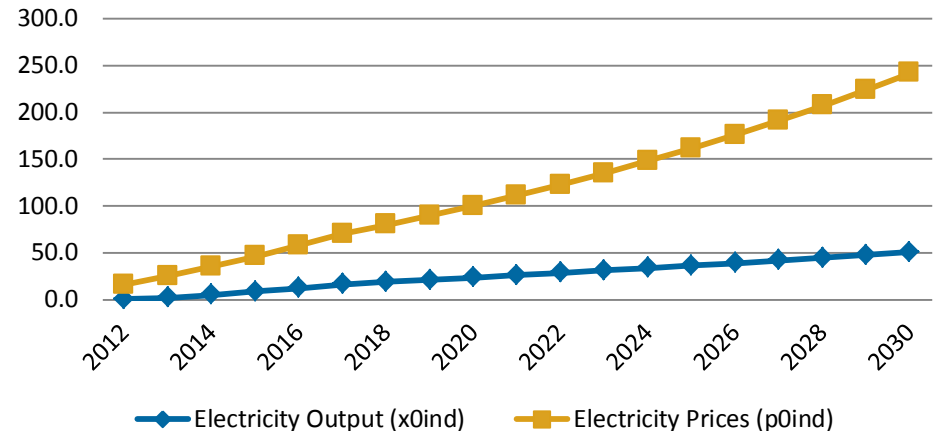
Business-As-Usual Baseline Forecast (Continued)

- Nominal electricity prices are expected to grow by 241.9 per cent and electricity generation capacity is expected to grow by 50.7 per cent over the 19-year forecast period

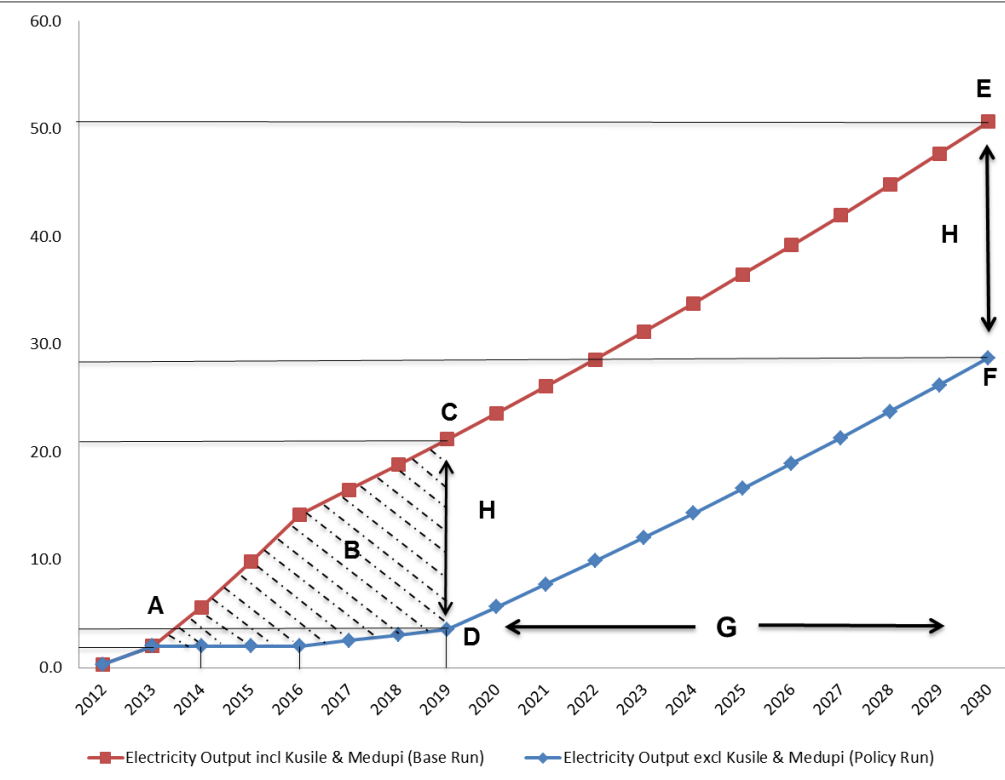
Base Run: Year-on-Year Percentage Changes in Electricity Output and Prices



Base Run: Cumulative Percentage Changes in Electricity Output and Prices



Policy Simulation Results: The Exogenous Shock



*** Electricity capacity in 2011 = 44000MW

A: Electricity output grows at the same rate in both the baseline and the policy simulations up to 2013

B: The shaded area represents the 'absence of Kusile and Medupi' for the period 2014-2019 where the policy shock was imposed

Electricity output growth is limited to 0.0% per annum for the years 2014, 2015 and 2016

Electricity output growth is limited to 0.5% per annum for the years 2017, 2018 and 2019

(Electricity output growth beyond 2020, grows at 2% per annum, same as the baseline)

C: Electricity output growth in the baseline was forecasted to be 21.1% in 2019, which represents total electricity capacity of 53297MW

D: Electricity output growth in the policy simulation is forecasted to be 3.5% in 2019 which represents total electricity capacity of 45533MW

E: Electricity output growth in the baseline was forecasted to be 50.61% in 2030, which represents total electricity capacity of 66268MW

F: Electricity output growth in the policy simulation is forecasted to be 28.7% in 2030, which represents total electricity capacity of 56615MW

G: Electricity output from 2020 and beyond grows at 2.0% per annum in both the baseline and the policy simulation

H: The cumulative percentage difference in electricity output between the baseline and the policy simulation is 14.5% calculated for 2030 as

$$\frac{[(\text{difference})/(\text{base}) * 100]}{100} = \frac{[(44000 * 1.2867 - 44000 * 1.5061) / (44000 * 1.5061) * 100]}{100} = \frac{[(56615 - 66268) / (66268) * 100]}{100} = \frac{[-9654] / (66268) * 100}{100} = 14.5\%$$

Policy Simulation Results: Industry

Figure 12: Selected Industry Output Results (Percentage Difference Relative to Baseline)

