INTEGRATED RESOURCE PLAN

UPDATE

2018

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energy
Department:
Energy
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ALBERTINA SISULU Centenary 2018

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2030 NDP

BACKGROUND – WHAT IS AN IRP?

An integrated resource plan (IRP), is an electricity generation plan for meeting forecasted annual peak and energy demand, plus some established reserve margin, through a combination of supply-side and demand-side resources over a specified future period.

Objectives of the IRP is to provide electricity generation plan that aims to:

- ensure security of supply
- minimise cost of supply
- minimise water usage
- reduce emissions

BACKGROUND

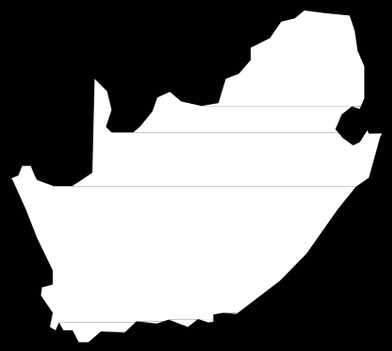
- The Integrated Resource Plan (IRP) 2010-30 was promulgated in March 2011;
- Like with all other long term plans, the IRP 2010-30 was based on some assumptions about the future;
- The plan was finalised following public consultations and a number of policy decisions were included in that plan;
- In line with S34 of the Electricity Act, Minister of Energy use the promulgated IRP to issue Determinations for new capacity; The IRP is not a procurement plan; and
- Assumptions made in the IRP 2010-30 have since changed and therefore necessitated an update.

IRP Update Process Stages

The IRP Update process consisted of four stages:

- The development of input assumptions,
- The development of a credible base-case (starting point) and scenario analysis,
- The production of a balanced plan,
- The production of policy adjusted plan.

Input Assumptions were subjected to a public consultation process between December 2016 and March 2017:



9 Public Workshops in 9 Provinces

Total number of presentations from the public: 63

Total number of people who attended: 640

Written submissions received: 190

Inputs from Consultation on Assumptions

Process Issues

The timing of the start of the consultation process

Frequency of revision of IRP

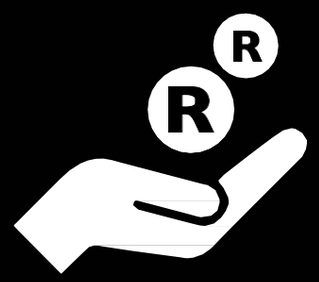
The link between the IRP and IEP

Demand Forecast

Demand Forecast is outdated and that it does not take into account current GDP projections

Inputs from Consultation on Assumptions

Technology Costs



The costs used for RE

The publication of the Ingerop report used to derive nuclear costs

Exchange Rate

The use of R11.55/$ vs R16/$ during consultations

Inputs from Consultation on Assumptions

Demand side

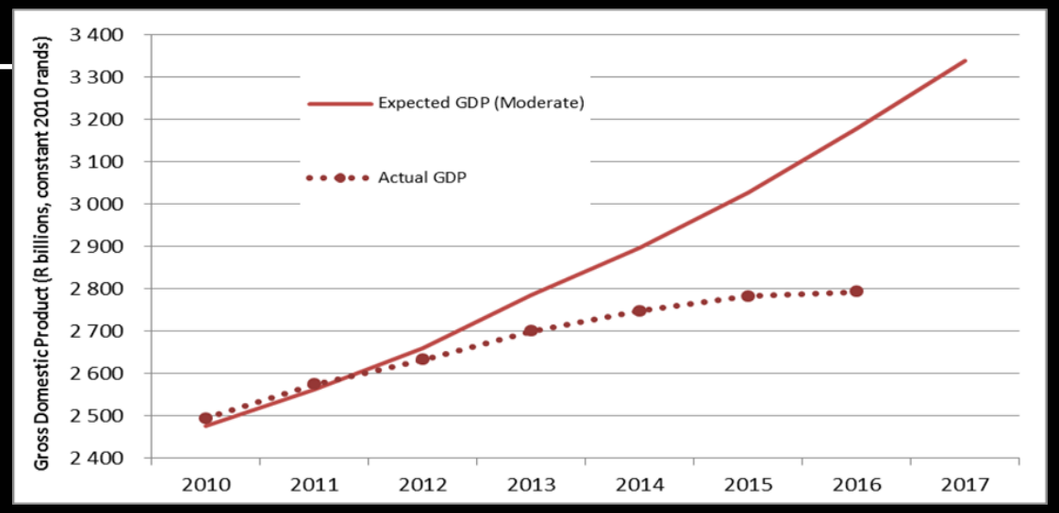
Need to account for energy efficiency, embedded generation and fuel switching

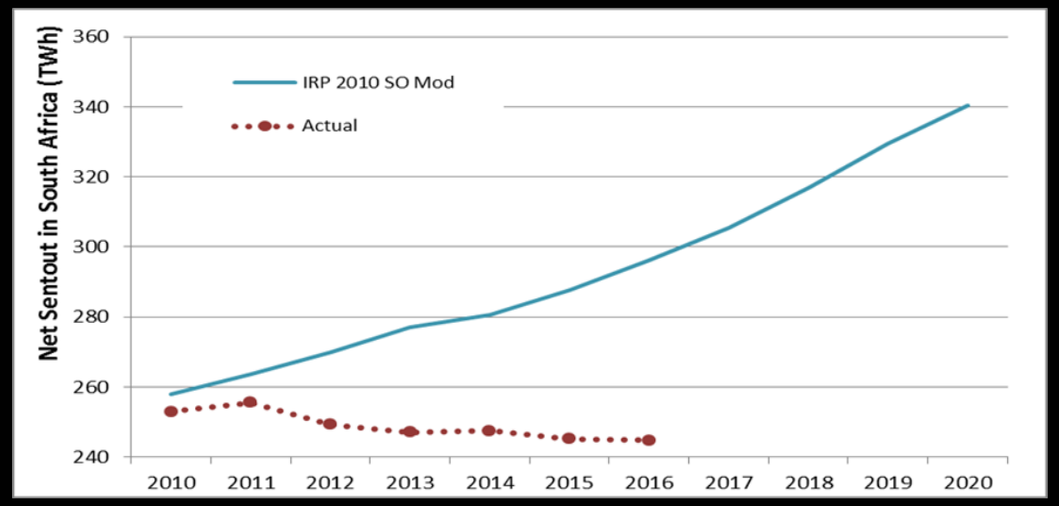
RE Constraints on preliminary base case

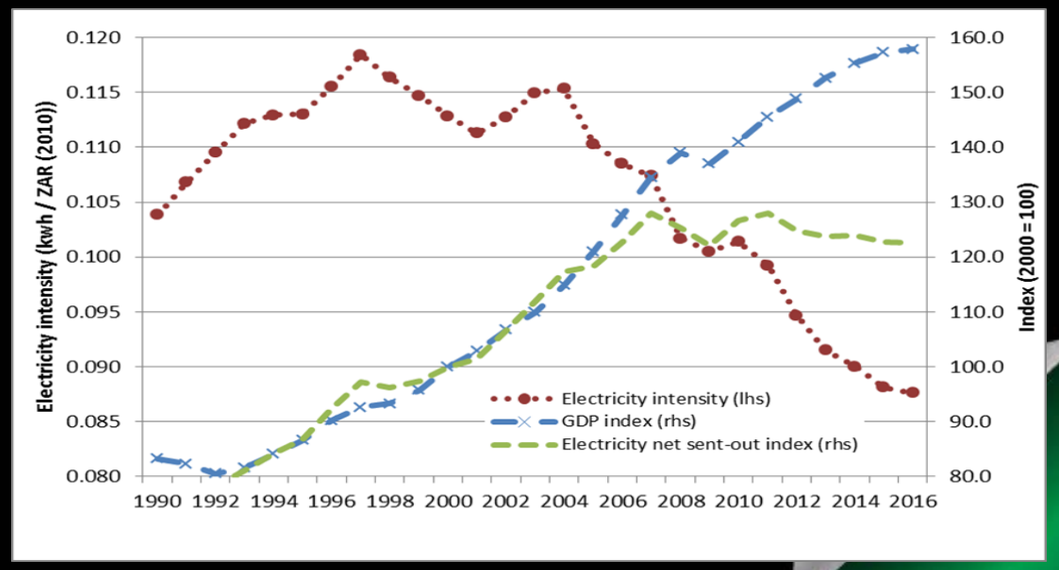
The IRP2010 imposed 1000MW and 1600MW annual build limits on Photovoltaic (PV) and Wind Power respectively

Key Assumptions

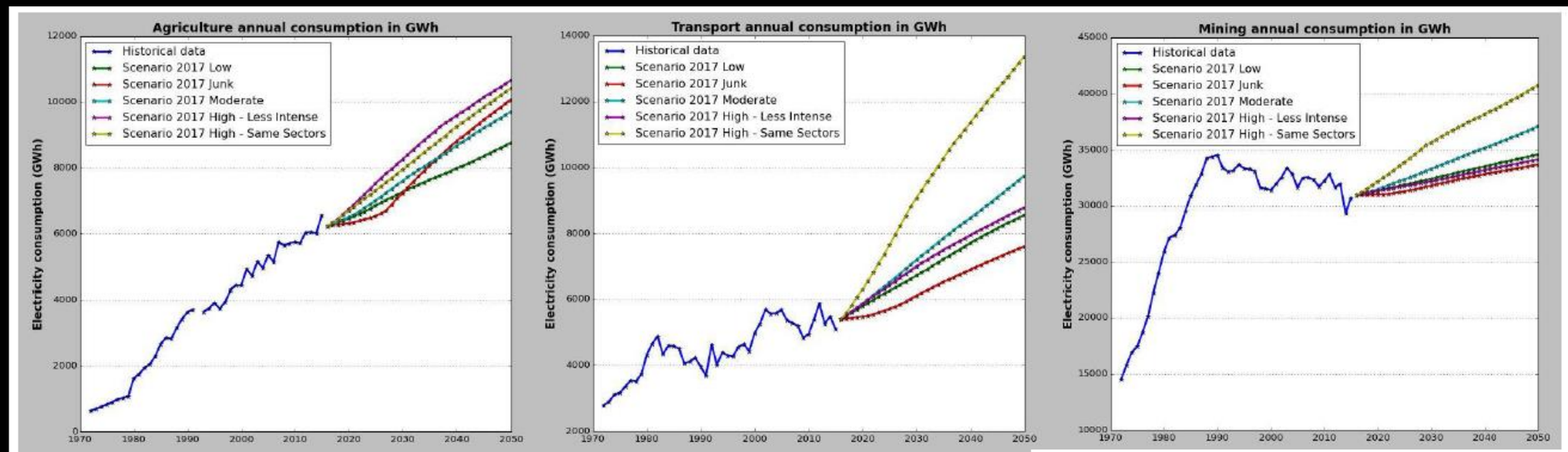
- Electricity demand outlook as forecasted in the IRP 2010-30 has not been realized;
  - Electricity pricing and commodity price issues impacting energy intensive users;
  - Improved energy efficiency, partly as a mitigation for the electricity price increases;
  - Growing number of generation for use (example: rooftop Photo-voltaic (PV) installations); and
  - Fuel switching from electricity to LPG for cooking and space heating.
- Additional Capacity brought online
  - 18000MW commitments already made (Eskom & REIPPP).
- Lower than anticipated Existing Eskom Plant Performance;
- Constrained Transmission Network Capacity; and
- Changes in technology and fuel costs.

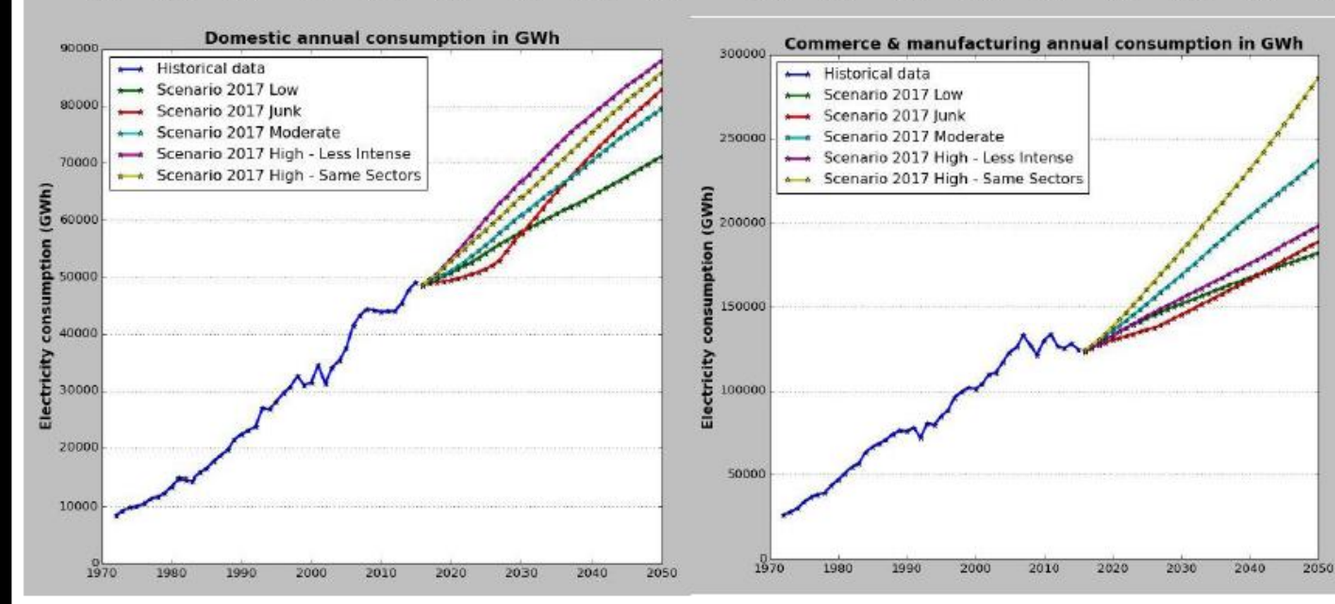


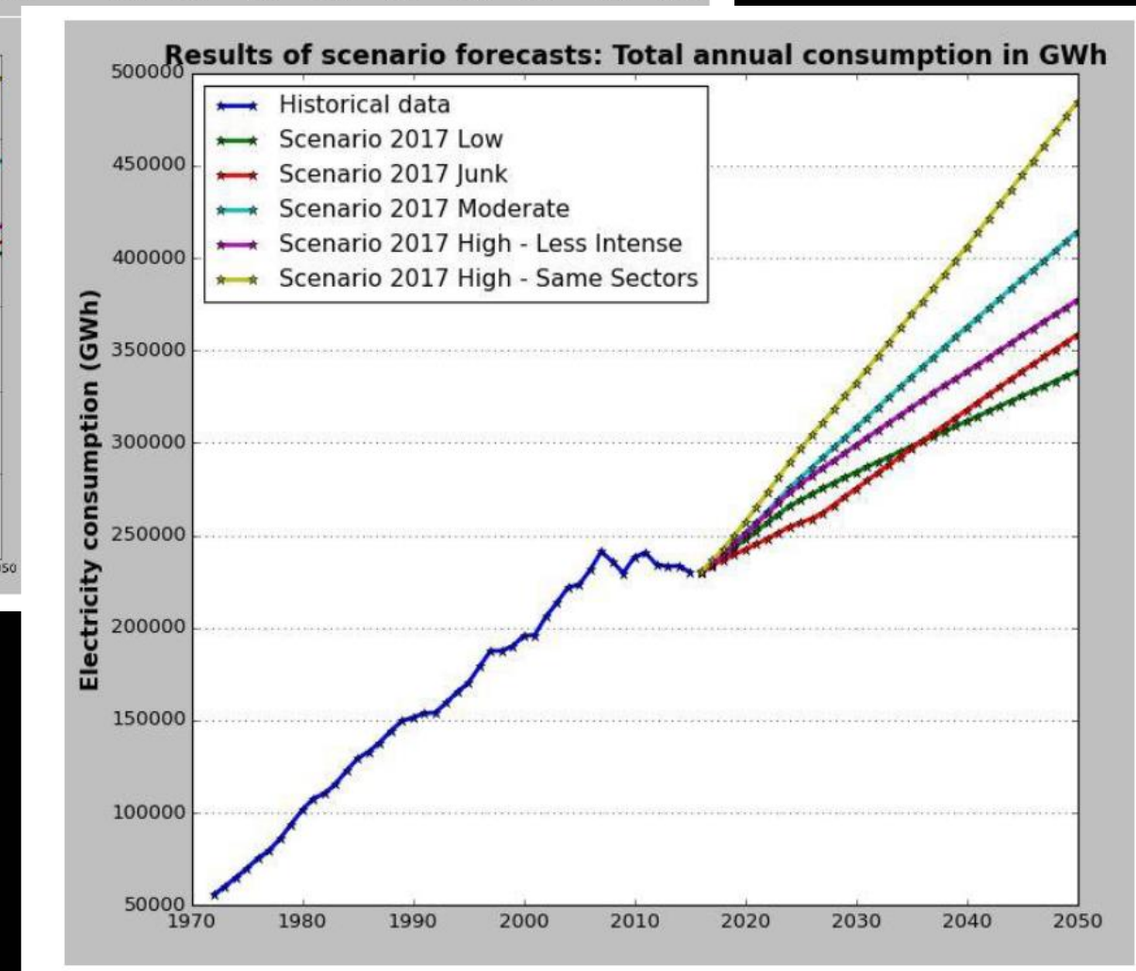




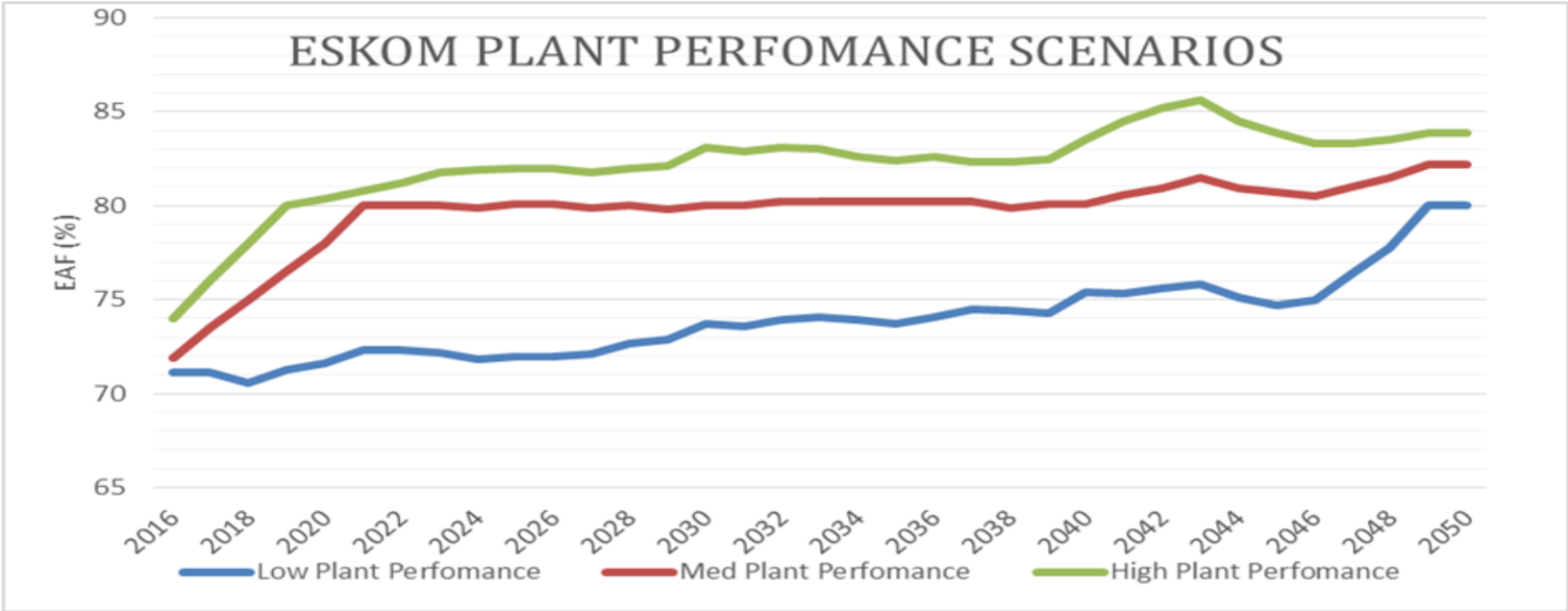
Key Assumptions – Demand Forecast

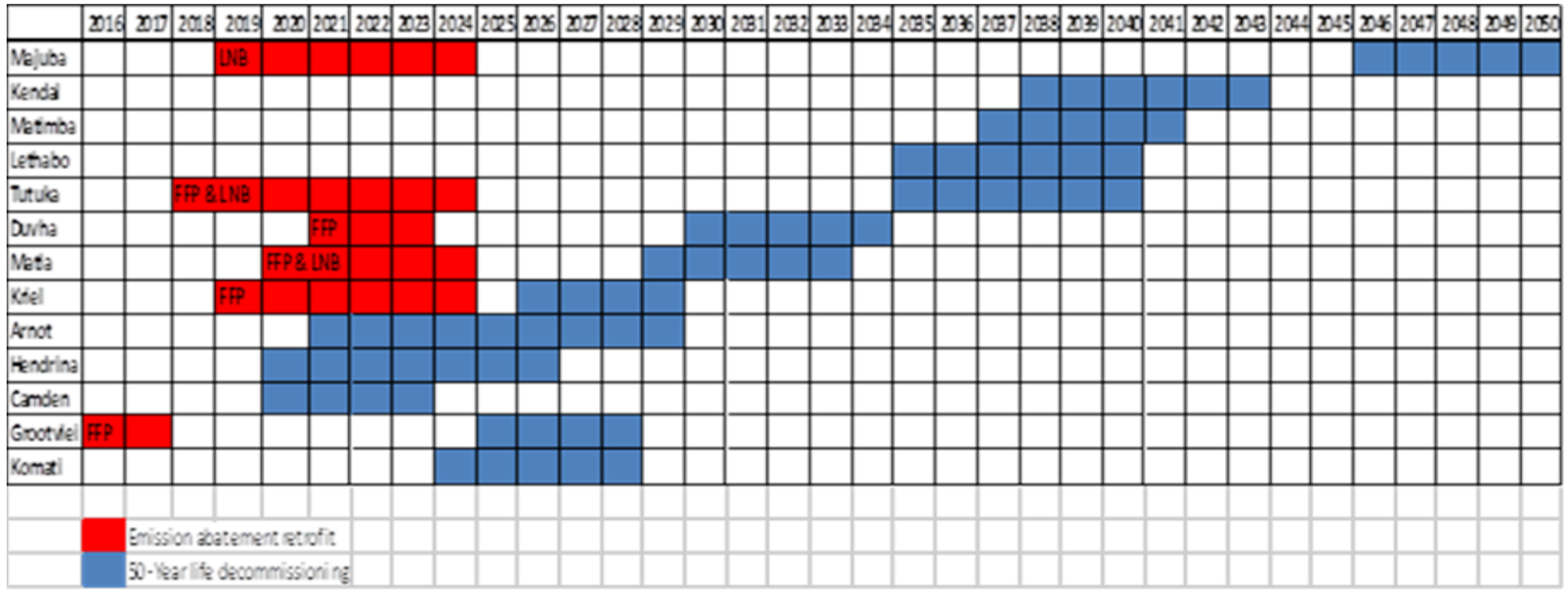




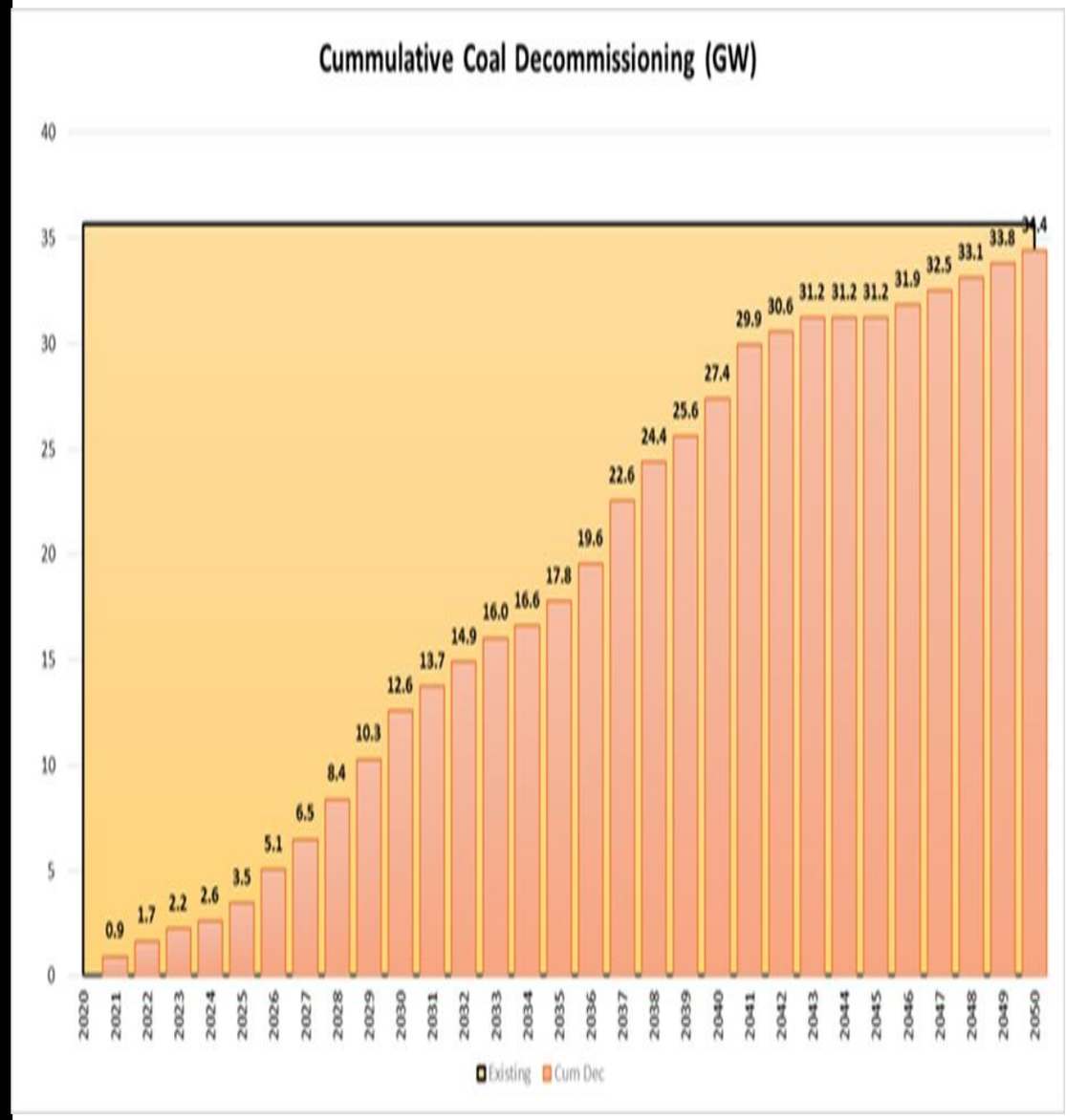


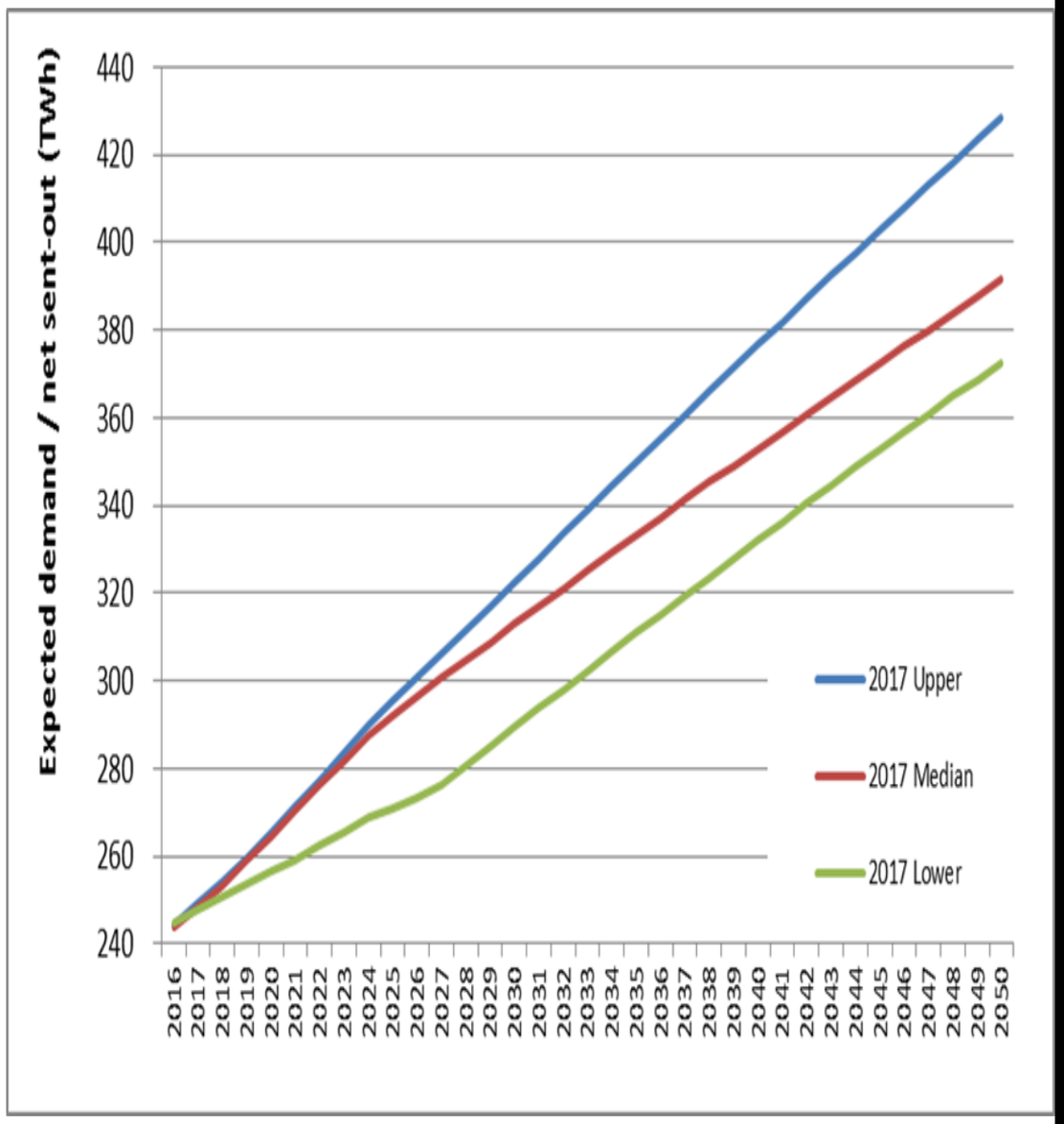
Key Assumptions - EAF & Decommissioning





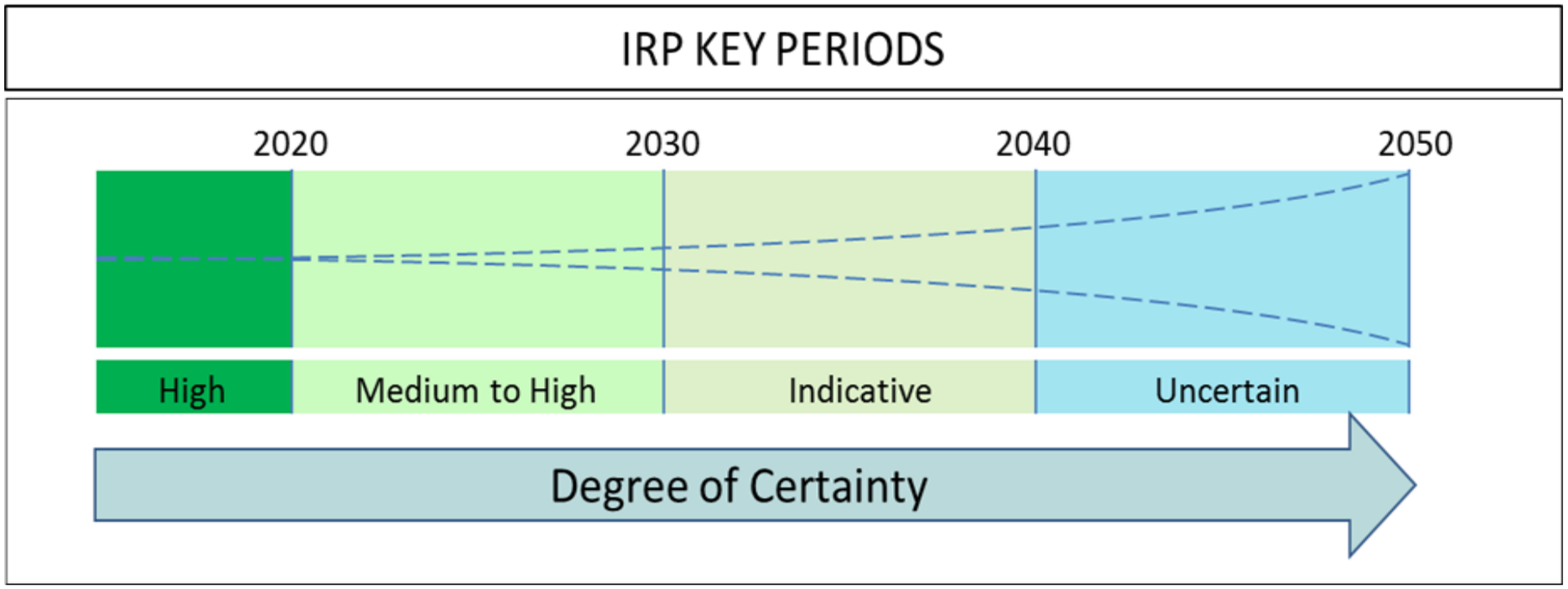
Drivers of New Additional Capacity





- The demand forecast has been revised downward by 143TWh compared to that shared during consultations on assumptions.
- Demand forecast is 33% less than IRP2010-30

Update Results Analysis Periods



Cases / Scenarios Studied

Scenarios Tested and Reported on:

- Growth scenarios (High, Medium, Low)
- Gas Scenarios
- Renewables Scenario
- Emission reduction scenarios

Key assumptions and considerations

- The demand forecast for various growth trajectories;
- The maintenance and the relaxation of the renewable energy annual build rate as assumed in the IRP 2010. The plan assumed 1000MW for PV and 1600MW for Wind per annum;
- The GHG reductions constrain using the Peak Plateau Decline (PPD) mitigation strategy except for one scenario which tested the Carbon Budget mitigation strategy;
- The performance of the Eskom fleet as per the Eskom performance undertakings;
- Decommissioning dates of existing generation plants;
- The cost associated with the dedicated Transmission infrastructure costs for that energy and capacity mix; and
- Committed planned generation plants such as Medupi, Kusile and IPPs up to Bid Window 4.

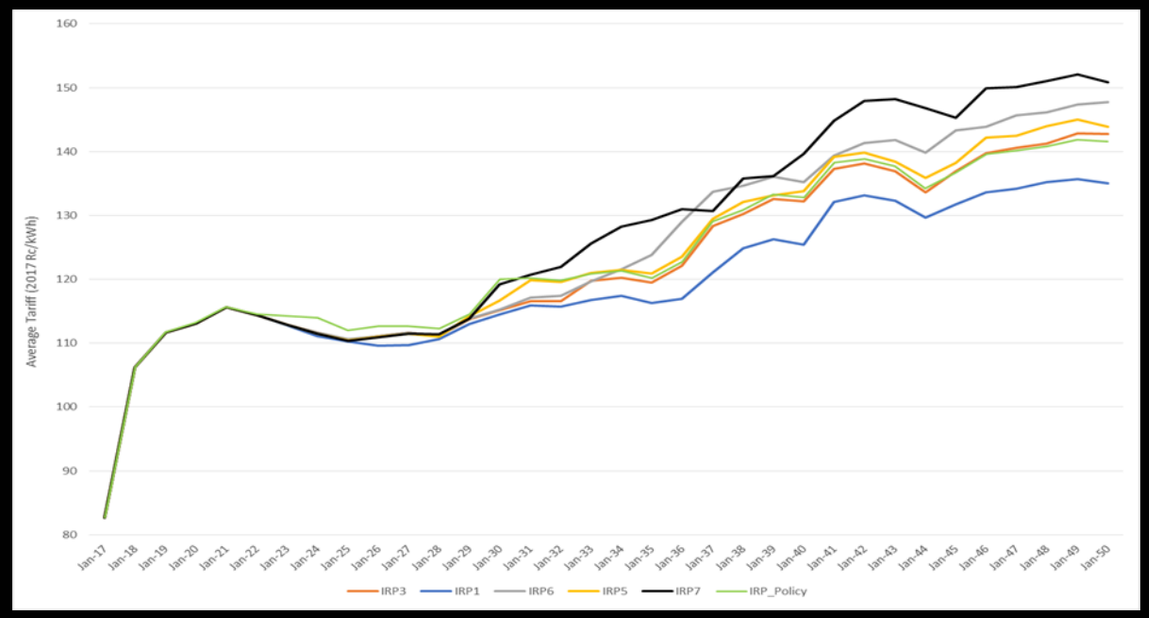
Summary Additional Installed Capacity pre 2030

Least Cost Electricity Plan

Year	PV	Wind	Gas (CCGT/CC-GE/OCGT)	Landfill Gas
2020				
2021				
2022				
2023				
2024				
2025			2380	
2026			750	250
2027	2290		1480	
2028	1640	2500	2200	
2029	2180	2800	2200	
2030	1710	3700	1930	
TOTAL	**7820**	**9000**	**10940**	**250**

Plan With Renewal Energy Annual Limits

Year	PV	Wind	Gas (CCGT/CC-GE/OCGT)	Landfill Gas
2020				
2021				
2022				
2023				
2024	1000			
2025	1000	1600		
2026	1000	1600	2380	
2027	1000	1600	1650	
2028	1000	1600	1950	
2029	1000	1600	3000	250
2030	1000	1600	1800	
TOTAL	**7000**	**9600**	**10780**	**250**



Least Cost in the IRP refers to the cost associated with the cheapest combination of generation technologies to meet the projected electricity energy demand for the period under study. This is therefore not a user tariff but an estimated unit cost (kWh) of electricity at generation level taking into account capital and operating costs. Where available externality costs have also been accounted for.

Conclusions from Study Results

- The review of the IRP therefore imply that the pace and scale of new capacity developments needed up to year 2030 must be curtailed compared to that in the IRP 2010-30 projections.
- Ministerial Determinations for capacity beyond bid window 4 (27 projects) issued under the IRP 2010–30 must be reviewed and revised in line with the projected system requirements.
- Without a policy intervention, all technologies included in IRP 2010–30 where prices have not come down like in the case of PV and Wind are not deployed by the model as the "Least Cost" option only contain PV, Wind and Gas.
- The significant change in energy mix post 2030 indicates the sensitivity of the results observed to the assumptions made. A slight change to the assumptions can therefore change the path chosen. In-depth analysis of the assumptions and the economic implications of the electricity infrastructure development path chosen post 2030 will contribute to the mitigation of this risk.
- Recommendation to confirm the plan for the period ending 2030 and detailed studies must be undertaken to better inform the energy mix plan post 2030.

Recommended Studies - Post 2030

- The following studies (**work**) are recommended to inform the post 2030 electricity mix at next IRP Update iteration.
  - Detailed analysis of gas supply options (international and local) to better understand the technical and financial risks and required mitigations for a renewable energy and gas dominated electricity generation mix post 2030.
  - Detailed analysis of the appropriate level of penetration of renewable energy in the South African national grid to better understand the technical risks and mitigations required to ensure security of supply is maintained during the transition to low carbon future.
  - Detailed analysis of other clean energy supply options (Coal, Hydro, Nuclear and others) including their associated costs and economic benefits.
  - Detailed socio-economic impact analysis of the decommissioning of old coal fired power plants that would have reached their end of life.
- Any other study as recommended by stakeholders.

Policy Adjustment Period pre-2030

- *Adopt a plan with annual build limits for period up to 2030. This provides for smooth roll out of renewable energy which will help sustain industry.*
- *Make provision for 1000MW in 2023/24 of Coal to Power based on two already procured projects. Jobs created from the projects will go a long way in minimising the impact of job losses due to decommissioning of Eskom coal power plants.*
- *Make provision for 2500MW in 2030 of Hydro Power to facilitate the RSA-DRC treaty on Inga Hydro Power project.*
- *Adopt a position that all new technologies identified and endorsed for localisation will be enabled through determinations utilising existing allocations.*
- *Adopt a position that makes annual allocations of 200MW for generation for own use between 1MW to 10MW starting year 2018. This allocations will not initially be discounted off the plan but will be discounted during the issuing of determinations taking into account generation for own use filed with NERSA.*

Least Cost Plan

Year	PV	Wind	Gas (CCGT/CC-GE/OCGT)	Landfill Gas
2020				
2021				
2022				
2023				
2024				
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Plan With Renewal Energy Annual Limits

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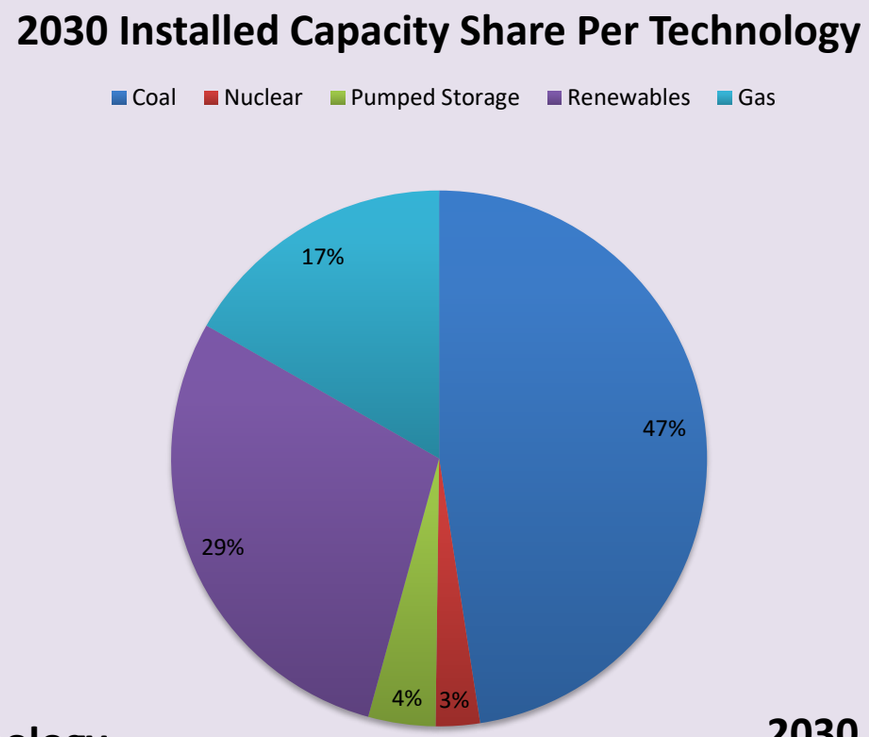
2024	1000			
2025	1000	1600		
2026	1000	1600	2380	
2027	1000	1600	1650	
2028	1000	1600	1950	
2029	1000	1600	3000	250
2030	1000	1600	1800	
TOTAL	**7000**	**9600**	**10780**	**250**

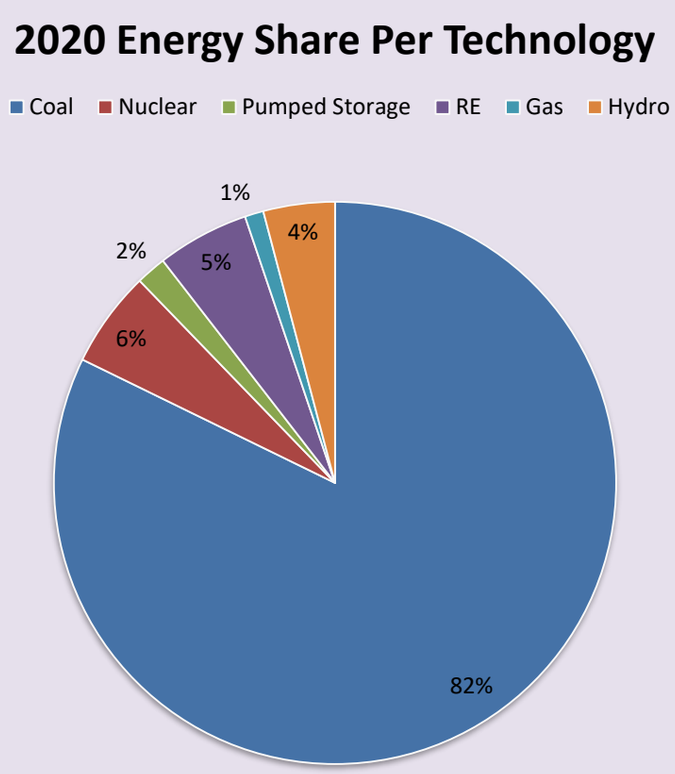
Summary Policy Adjusted Plan pre-2030 Installed Capacity (MW)

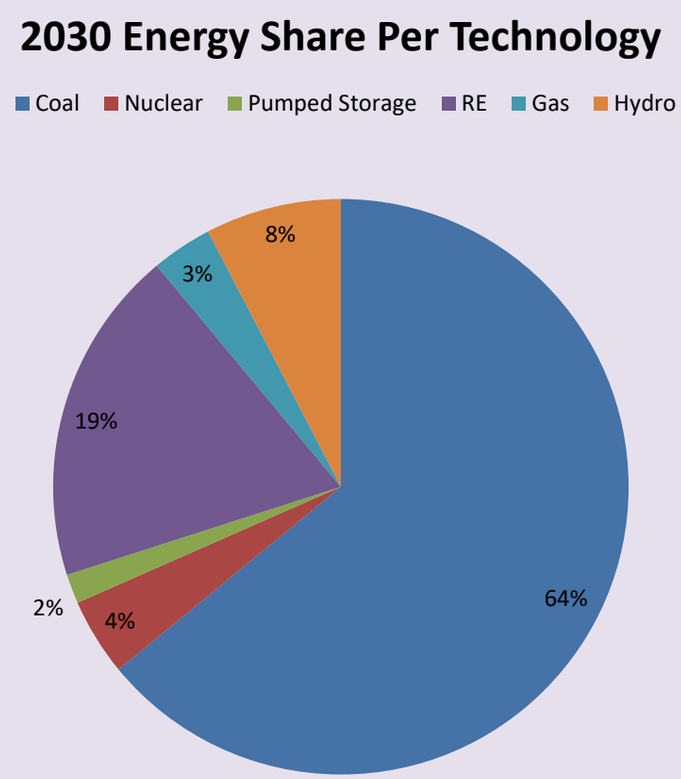
	Coal	Nuclear	Hydro	Storage (Pumped Storage)	PV	Wind	CSP	Gas / Diesel	Other (CoGen, Biomass, Landfill)	Embedded Generation
2018	39 126	1 860	2 196	2 912	1 474	1 980	300	3 830	499	Unknown
2019	2 155					244	300			200
2020	1 433				114	300				200
2021	1 433				300	818				200
2022	711				400					200
2023	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)

Summary Policy Adjusted Plan pre-2030 Capacity (MW) vs Energy (MWh)







Additional Info – Modelling team Experience

- Over 20 years experience as a team
- Combined 60 years energy sector, energy planning, power system operations and analysis experience
- Professions ranges from:
  - Engineering (Registered Professional Engineers)
  - Mathematical scientists
  - Scientists
  - Economists

Additional Info – Plexos Tool

- Australian developed production and capacity expansion simulation tool
- Been used by the modelling team since 2009 (Also used by System Operator for Plant Scheduling)
- Plexos is used extensively globally
  - USA
  - Europe
  - South America
  - Asia
- Users locally
  - Eskom
  - CSIR
  - NERSA
- Study Input Independently verified by
  - CSIR
  - NREL
  - Energy Exemplar (Developers of Plexos)

Additional Info – Treatment of Capital Costs

- Starting point is Overnight cost
  - Future valued (FV) to account for phasing of expenditure based on the lead time of the technology
  - FV overnight costs converted into annual premiums (annuities) which takes into account the different economic life of the technology as by equation:

$$Annuity \quad = FV \text{ x } 1000 \text{ x } Max\ Capacity$$
$$\text{x} \left(\left(\frac{1}{1 + Discount\ \text{Rate}} \right) \right) \text{x} \frac{Discount\ \text{Rate}}{\left(1 - \left[\left(\frac{1}{1 + Discount\ \text{Rate}} \right) \right]^{Economic\ Life} \right)}$$

- The mathematical formulation of the objective function takes perpetuity (years after the end of the study period repeated up to infinity) into account in order to ensure that the end of the study horison is not seen as the end of time