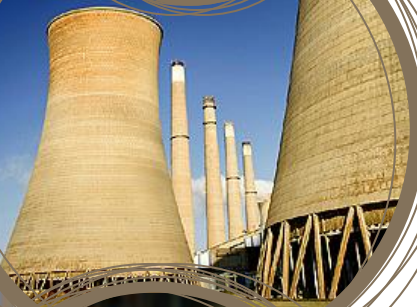


Current State & Future Opportunities for Power Sector Planning in South Africa

Kubeshnie Bhugwandin
Planning for 21st Century Power Systems
21 April 2016
Eskom Academy of Learning



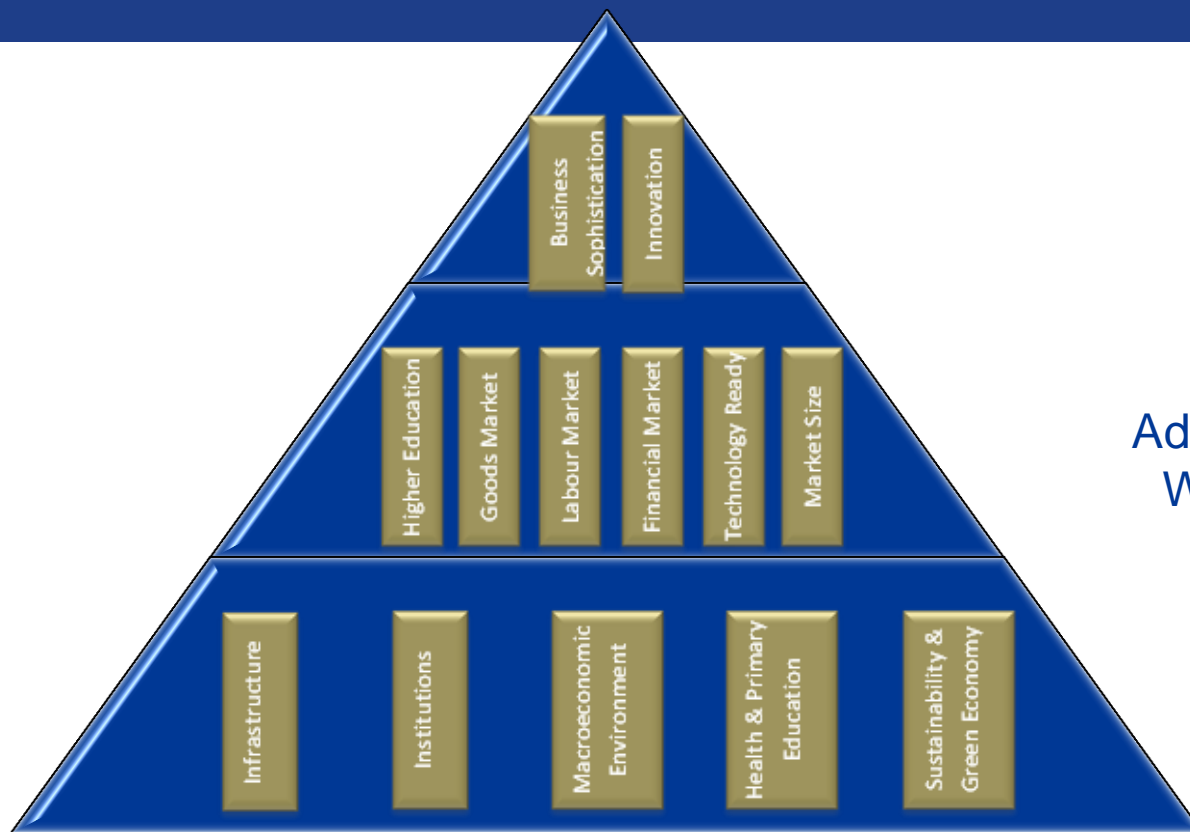
- National Development Plan
- IRP – role of the State Utility
- Regional Opportunity
- Coal Industry Challenges
- Water limitations – planning consideration for IEP and IRP
- Flexibility of coal fleets – implication for planning
- Decommissioning of coal fleets – opportunity for cleaner technology investments
- Revenue Decline – implications for forecasting demand
- Top 10 technology disruptors

- The objective of the National Development Plan (NDP) is to:

Eradicate Poverty through Job Creation by 2030

- To achieve the objective requires a **growth of 5.4%** in the economy
- Thus any hurdle to the growth must be removed
- Key hurdles to economic growth is the limitations in infrastructure:-
 - **Energy**
 - Transport
 - Communication

Energy is a fundamental Pillar for Global Competitiveness



Adapted from
WEF 2014

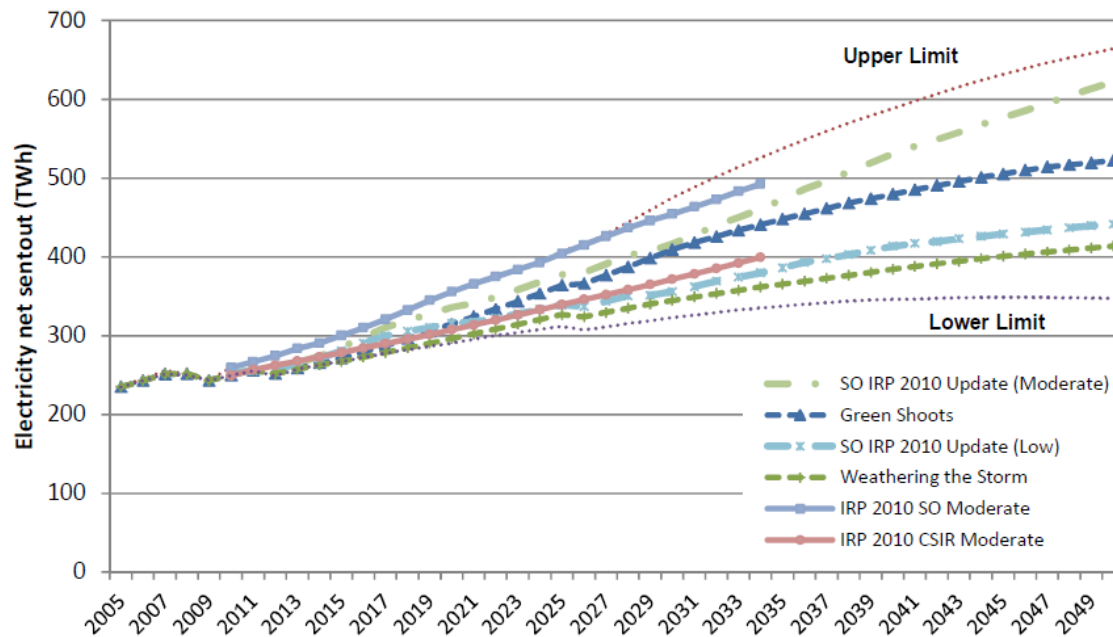
- Foundation to unleash economic capacity
- Infrastructure, Primary Health and Education is the bottleneck
- Fundamentally the Foundation layer challenges needs to be resolved, thereafter maintained and Grown
- Case in Point: Innovation without Higher Education and Technology Readiness

The NDP provides a Plan for the Energy Sector

<ul style="list-style-type: none"> • National coal policy and investment strategy • Freight rail infrastructure • Exploration of coal seam and shale gas reserves • Commission Eskom's Medupi coal power station and Ingula • Independent System and Market Operator • Resolving maintenance and refurbishment • National electrification plan. • Nuclear energy • Address GHG emissions 	<ul style="list-style-type: none"> • Coal rail capacity • The Kusile coal-fired power station • 7 000 MW of renewable energy • Liquefied natural gas infrastructure • Pro-poor electricity tariffs • Access to grid electricity. • A decision to invest in a new refinery 	<ul style="list-style-type: none"> • 20 000 MW of renewable energy • Rail and port capacity. • Older coal-fired power stations will be decommissioned • R&D and technology-transfer • Coalbed seam and shale gas reserves • Lower carbon and energy intensity. • Access to grid electricity. • Hybrid and electric vehicles
2015	2020	2030

Source: National Development Plan 2030

Stifling the Energy Demand constrains Economic Growth

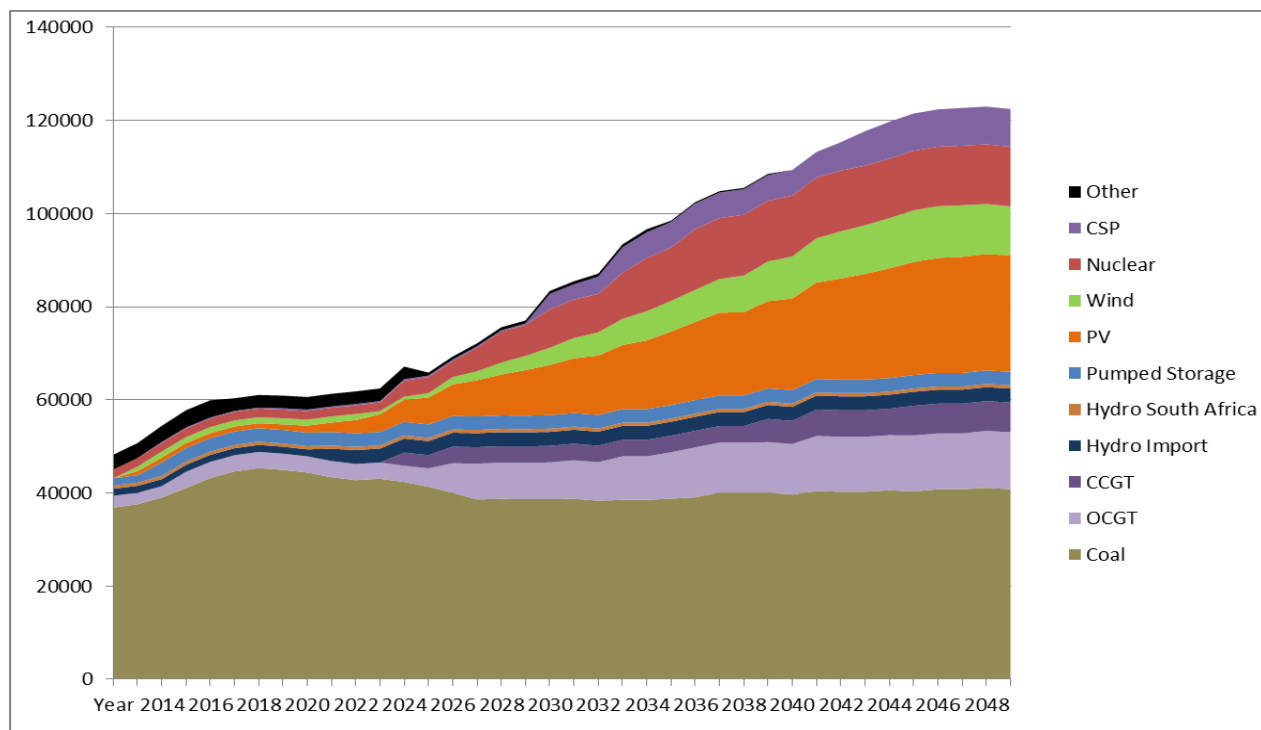


Source: IRP
2010

- The CSIR “Green Shoots” depict the energy demand forecast for 5,4% Economic Growth
- An additional 40GW by 2030
- Coal Generation is stagnant

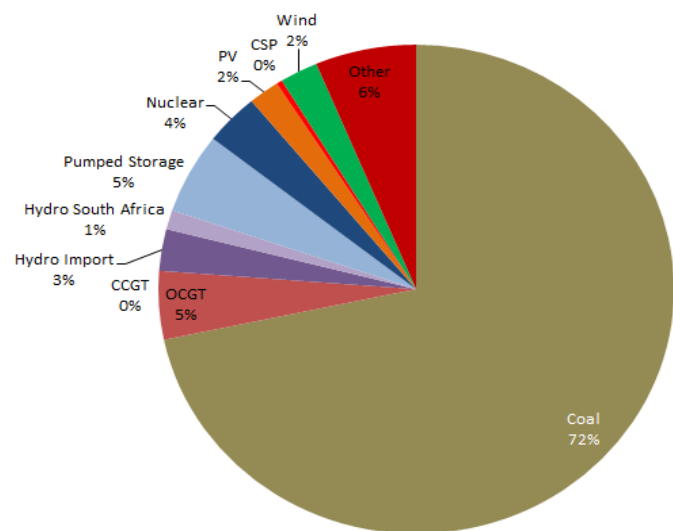
The Changing Energy Mix is driving Market Changes

- IPP's are being contracted for Wind, Solar, Nuclear, Gas and Coal
- State Utility Generation Mix seems fixed in the short to medium term
- State Utility will be labelled a “Dirty Utility” – limiting access to finance
- Industry is forcing a Business Model Change for a State Utility

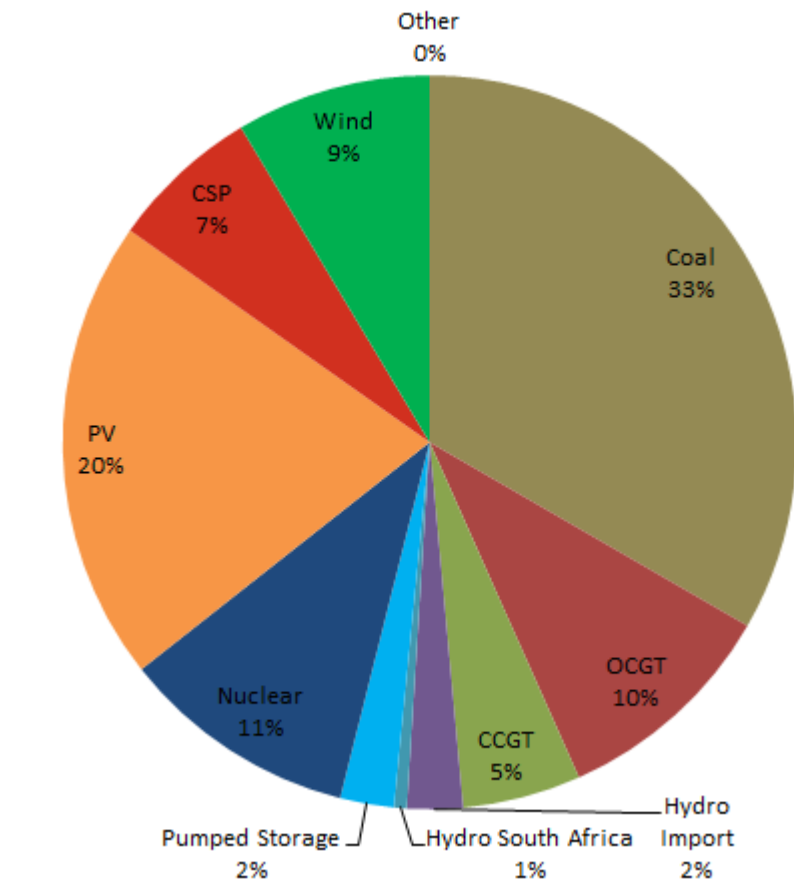


adapted from
the IRP 2010

National Energy Mix is Changing ...Role of the State Utility?



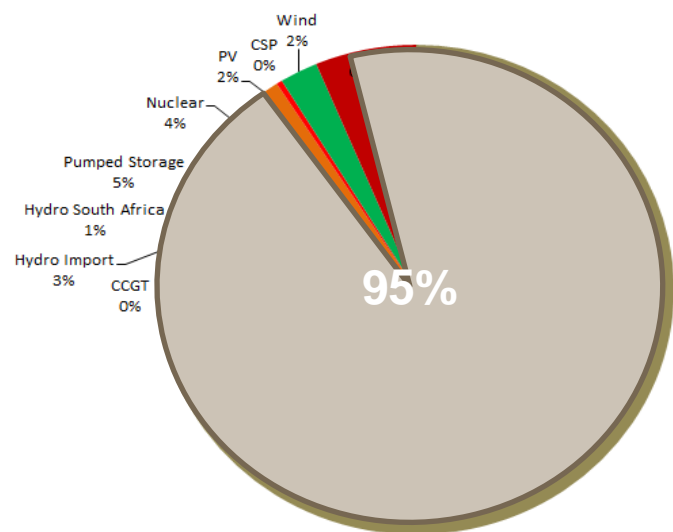
Today (2015)



Future (2050)

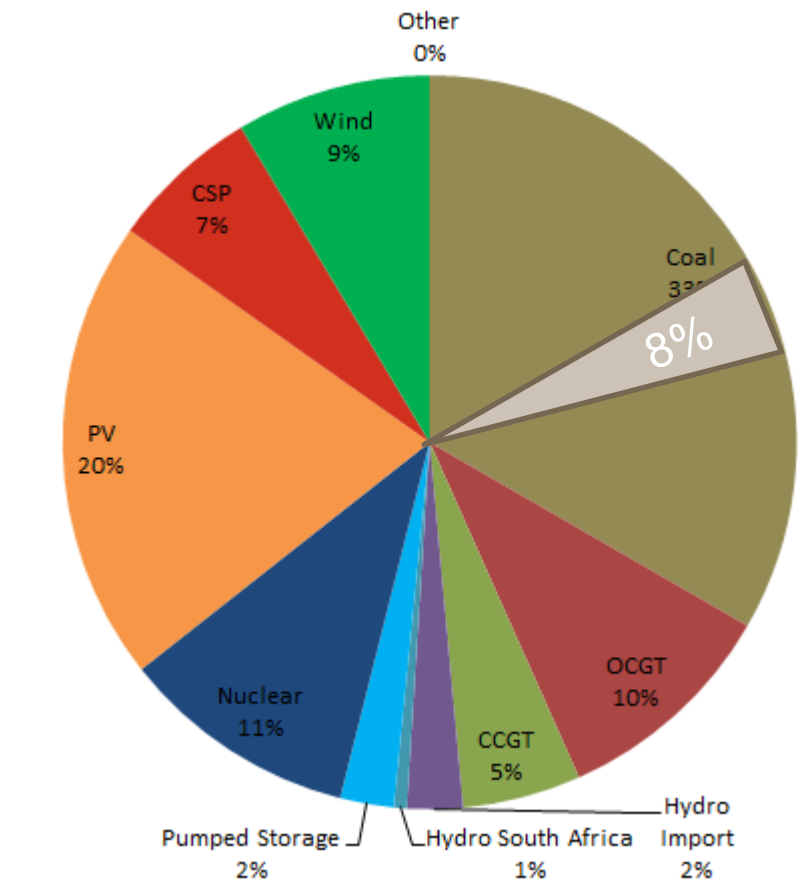
Based on draft IRP 2013

National Energy Mix is Changing ... Role of the State Utility?



40GW

Today (2015)



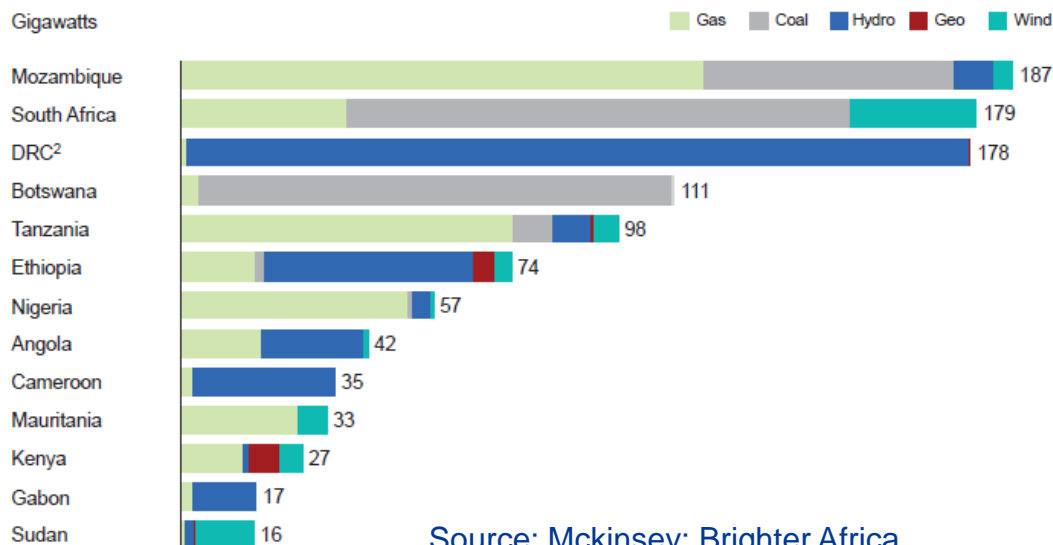
120GW

Future (2050)

Based on IRP 2010

Unlocking Regional Capacity for Import makes Transmission Strategic

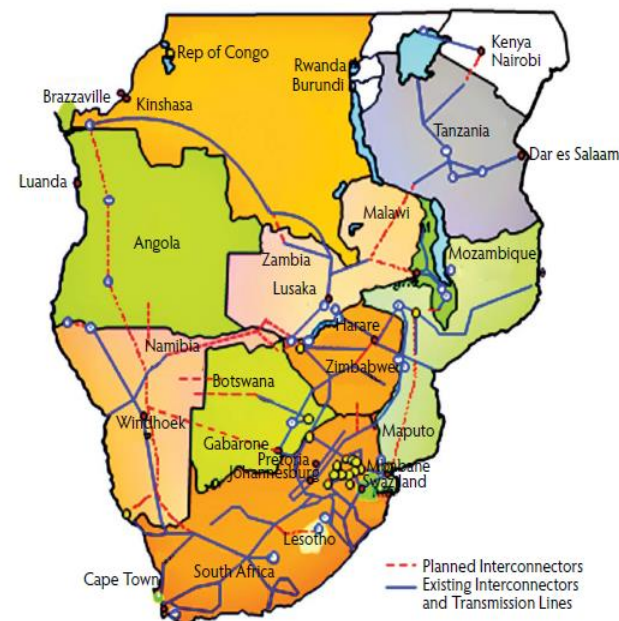
Power-generation potential for select sub-Saharan African countries by technology¹



Source: McKinsey: Brighter Africa

¹ Potential from domestic resources only; gas includes all conventional proven/speculative reserves, and hydro includes all technically exploitable potential.
² Democratic Republic of the Congo.

Source: Geothermal: International Market Overview Report, Geothermal Energy Association, May 2012, geo-energy.org; International Energy Statistics, US Energy Information Administration, 2013, eia.gov; National-Scale Wind Resource Assessment for Power Generation, National Renewable Energy Laboratory, June 2013, nrel.gov; Rystad Energy database, rystadenergy.com; World Energy Resources: 2013 Survey, World Energy Council, October 2013, worldenergy.org



SADC Master Plan

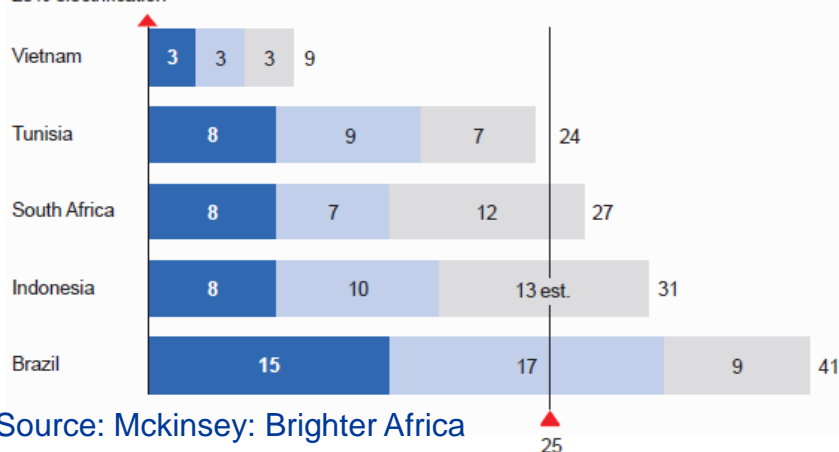
- There are significant Sources of Energy (Green) in the region
- The country with the resources do not require the Capacity; other countries in the region have Capacity Constraints
- Weak Transmission Infrastructure inhibit use of the region's abundant resources
- Pricing and infrastructure hurdles such as grid connections, manufacturing, and quality testing impede development of the region's renewable energy potential

Electrification in the Region is a big opportunity

Electrification growth timeline, number of years

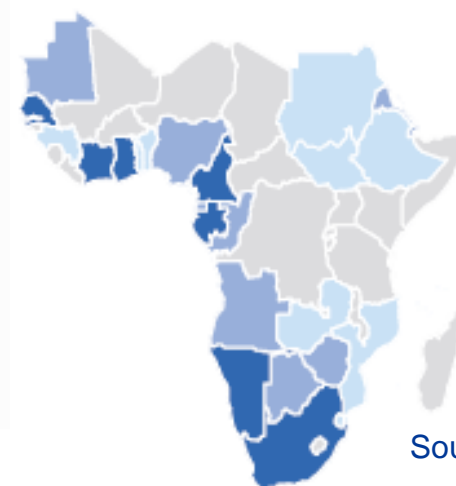
■ Years to move from 20 to 40% ■ Years to move from 40 to 60% ■ Years to move from 60 to 80%

Starting point, 20% electrification



■ <20% connected ■ 20–34% connected
■ 35–49% connected ■ >50% connected

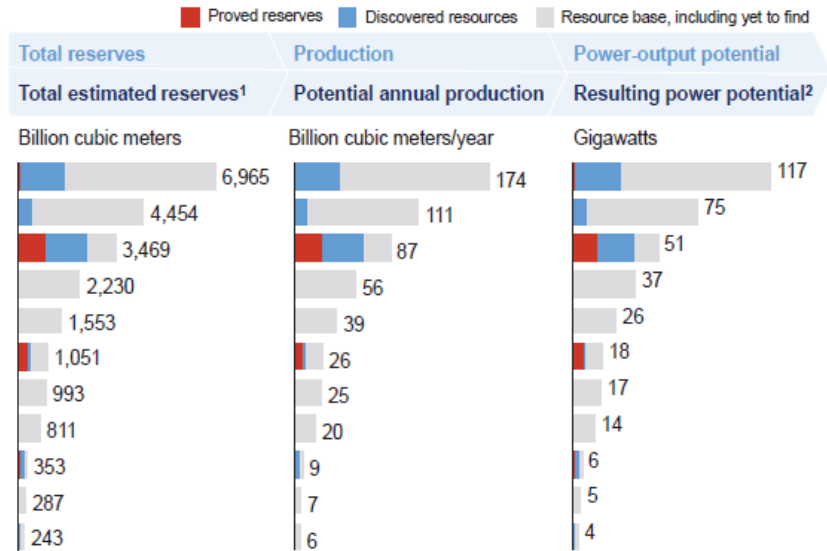
Sub-Saharan Africa electrification rates⁵



Source: Mckinsey:
Brighter Africa

- Only 5% of rural areas in the region have any access to electricity;
- SADC falls behind other Regional Economic Communities in Africa regarding access to electricity.
- SADC situation is dismal and biased by South Africa's electrification stats
- Eskom/ South African Utility has core competencies in electrification and can easily expand business beyond South Africa

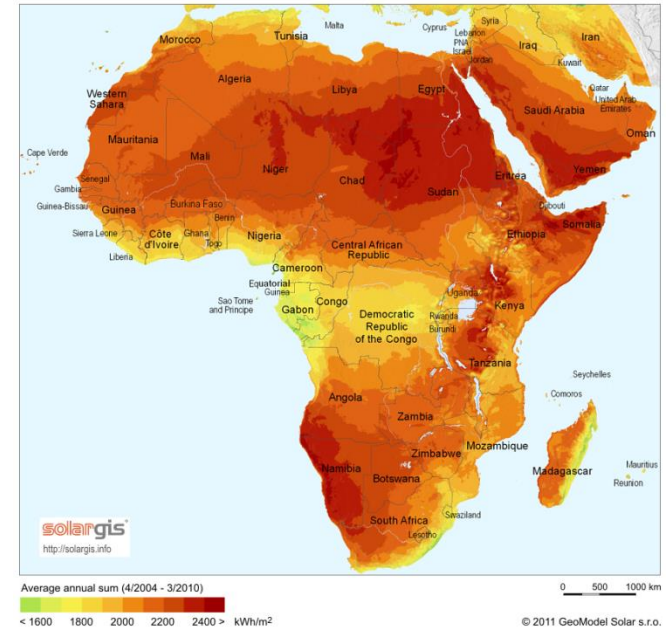
Generation in the Region is another big opportunity



Source: McKinsey: Brighter Africa

Global horizontal irradiation

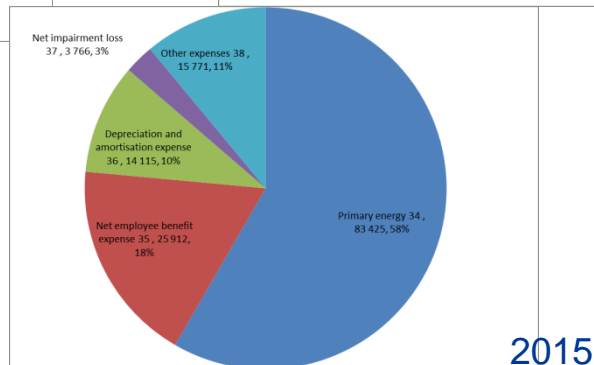
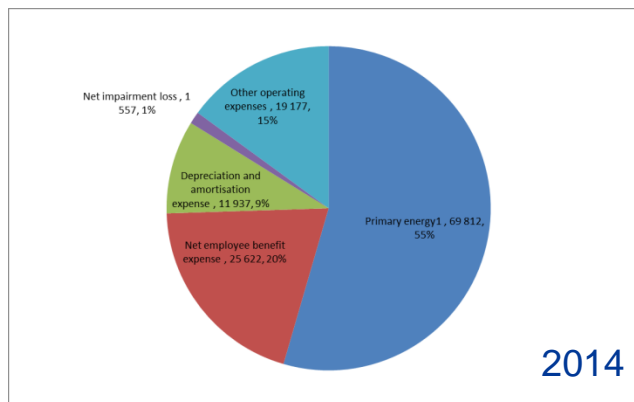
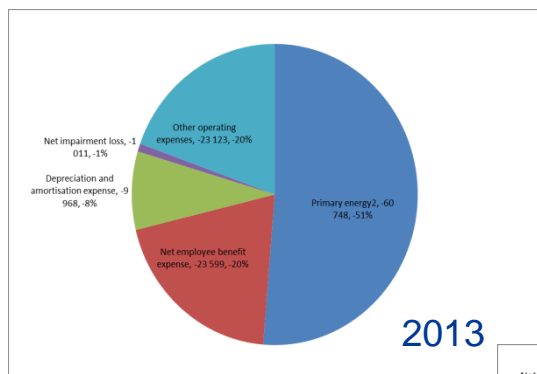
Africa and Middle East



Source: geosun.co.za

- Solar potential in the region is 11 Terawatts (McKinsey)
- There is significant untapped gas potential in the region
- The core competencies to operate a gas plant is similar to a coal fired plant

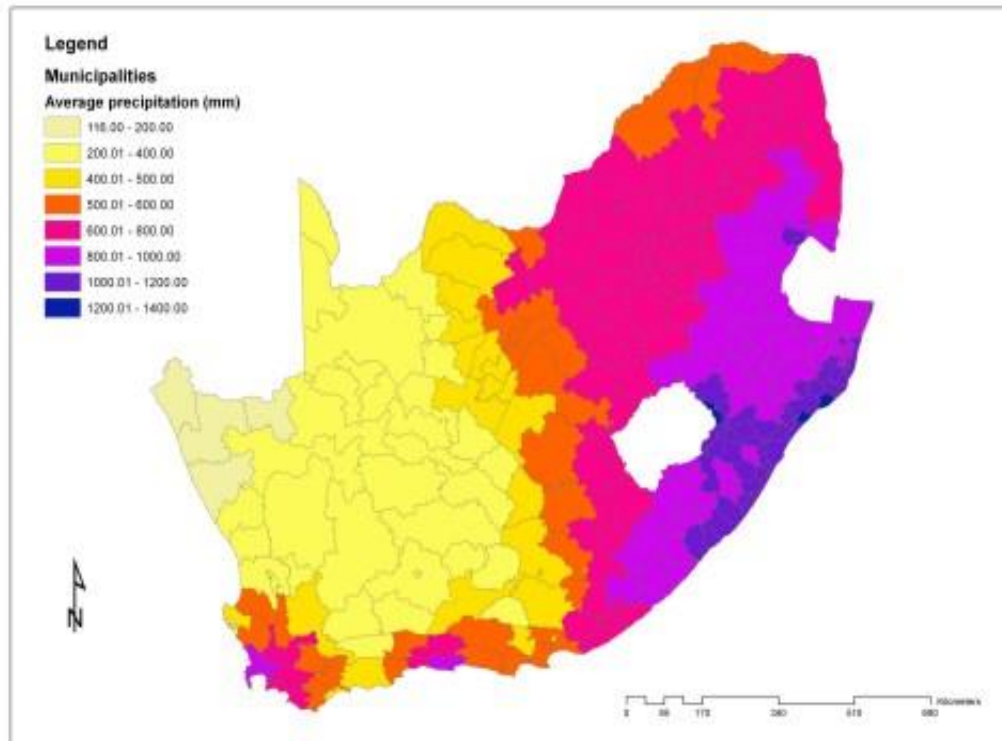
Primary Energy Costs are over 50% and increasing fast



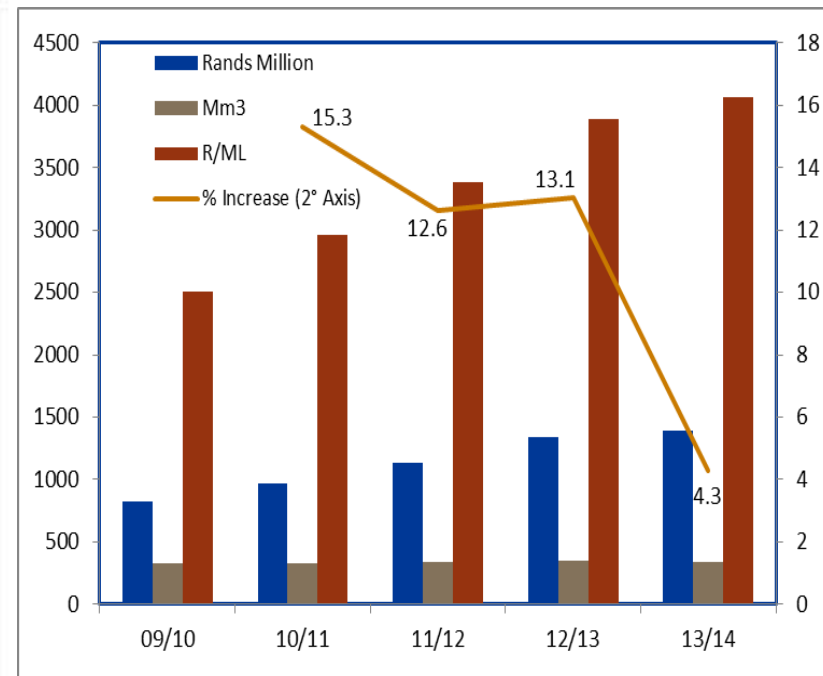
Source: Eskom Annual Report

- Coal costs increasing in SA whilst decreasing globally
- The Global coal industry is undergoing structural changes
- No new investment in coal mines – increase in industrial action and unemployment in S.A
- Risk to security of supply at power stations – more consumers go off grid, planning implications

Water is scarce and the situation becomes dire in the future



Source: Department of Water Affairs



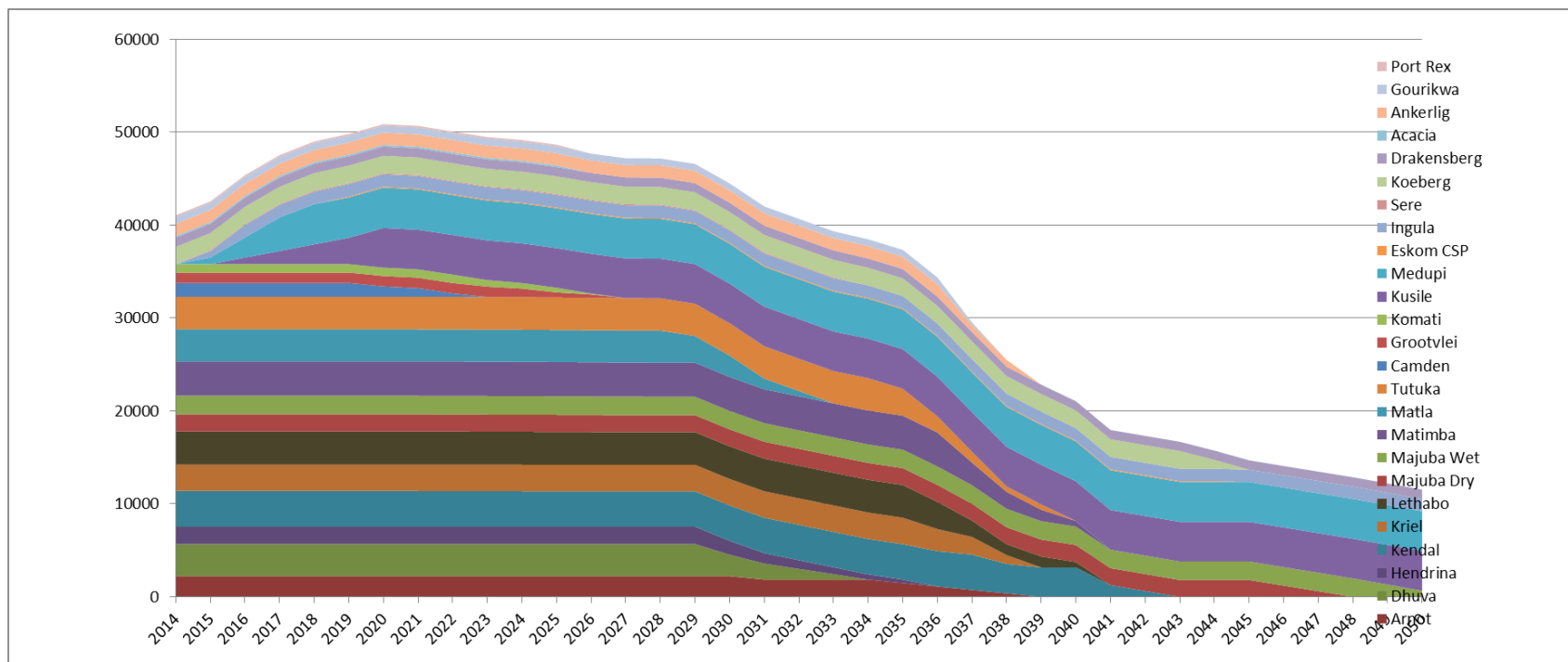
Source: Eskom Annual Report

- South Africa is a water scarce country and forecasts indicate a “Water Cliff”
- Water prices have been increasing whilst water usage has decreased
- Additional water requirements will become increasingly difficult

- Stricter legislation on emissions and impending carbon tax in South Africa. Country needs to develop clean coal technologies and move towards cleaner technology investments
- Country needs to move towards waterless technologies
- Requires South African solutions similar to dry cooling

- Global trend is coal fleets are becoming more flexible. Ramping up and down in minutes.
- Coal fleet will be expected to endure:
 - load following to balance grid
 - reduce load
 - cycle off line completely when power production from more cost effective and environmentally friendly power generation is available
- Output of coal fleet expected to change in the next 5-8 years due to stricter air quality legislation, fluctuating coal prices and integration of renewable energy projects onto the grid.

Decommissioning of Generation Plant is a complex matter

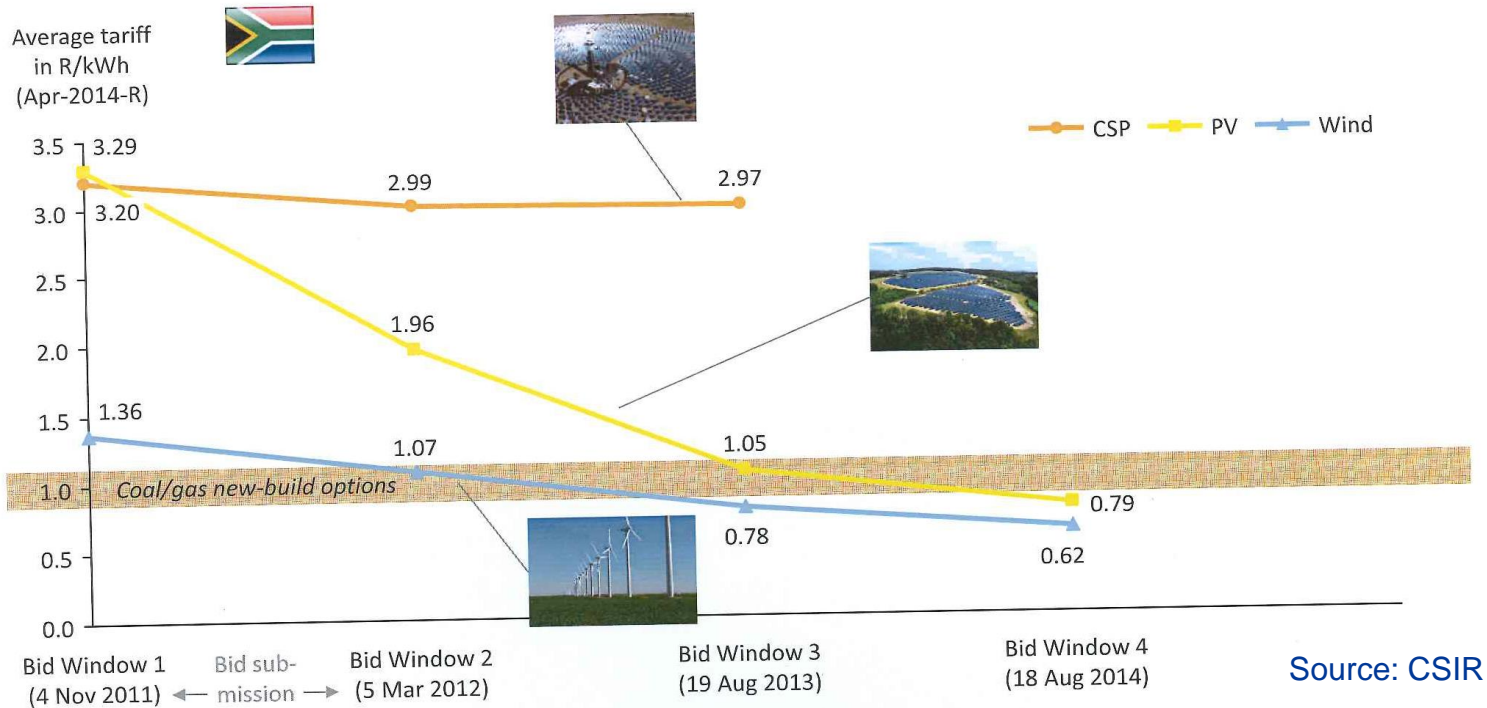


• According to ISEP decommissioning of Eskom plants:

Source: Eskom ISEP

- 2020 – Camden
- 2023 – Grootvlei
- 2024 – Komati

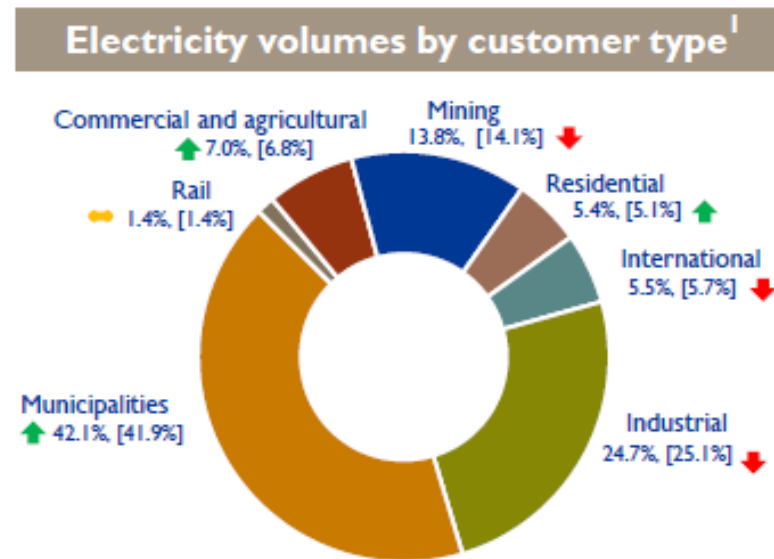
Renewables is a growth business



- The REIPPP bids are becoming highly competitive
- Prices have reduced towards lower end of the IRP costs
- Can be incorporated into the IRP for more accurate projections

Revenue Problem

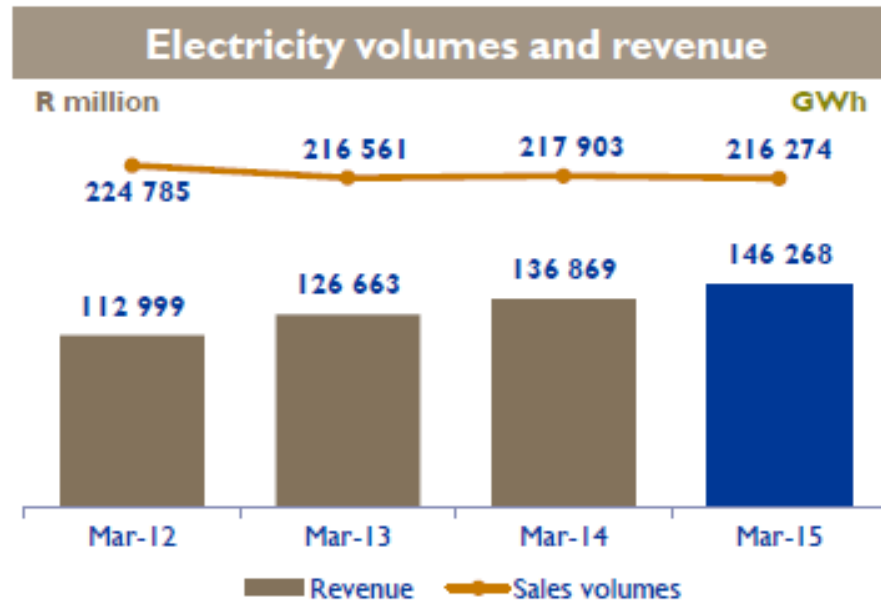




Source: Eskom Annual
Report – March 2014

- Energy sales (TWh) has been on a reducing trend
- A concern is that the largest revenue sector (Municipalities and Industry) is declining

- Hypothesis that the revenue decline is due to a number of factors:
 - Substitute products (e.g. Gas)
 - Energy Efficiency
 - Non-technical Losses
 - PV
- Price signal is interpreted by the customer as find alternatives
- TOU is a catalyst to substitute products
- Roof top PV is key disruptor because there is no barriers to entry



- Prices are increasing.
- Consumers are going off grid which has planning implications
- The demand for grid is reducing and projections are changing

1. Storage
2. Clean Coal Technologies
3. Residential Off Grid (PV)
4. Energy Efficiency and Demand Side Management
5. Big Data, Modelling & Analytics
6. Smart Grids
7. Internet of Things
8. Advanced Materials
9. Solar Augmentation
10. Electric Vehicles

Thank You

Kubeshnie Bhugwandin (Pr. Sci. Nat)
BSc (UKZN), BSc Hons (UKZN), MSc (Witwatersrand)
Technology Strategy Manager –
Renewables, Clean Coal & Fuel Resources,
Applied Chemistry & Microbiology, Plant Material & Integrity
Tel +27 11 629 5112
Cell +27 721410308
E-mail Kubeshnie.Bhugwandin@eskom.co.za

