South Africa’s IRP and Eskom restructuring
RMB’s SA Investment Forum

London, 6 March 2019
Dr Tobias Bischof-Niemz

Summary
• More than 10 years of energy planning background, work experience in the US, Europe and South Africa
• Author of the book “South Africa’s Energy Transition – a roadmap to a decarbonised, low-cost and job-rich future”, endorsed by the former South African Minister of Finance and by the former German Minister of Energy (link)
• Member of the inaugural South African Ministerial Advisory Council on Energy (MACE)

Professional Background
• 2017 – today: Head of Strategy at ENERTRAG, CEO ENERTRAG South Africa, leading market entry into new geographies; commercialising new business models in hydrogen, e-mobility, microgrids

• 2014 – 2017: Head of Energy Department at the South African Council for Scientific and Industrial Research, established & led the national integrated energy research centre with today 90 staff members

• 2012 – 2014: Chief Engineer at Eskom, developed South Africa’s energy master plan (IRP)

• 2007 – 2012: Senior Consultant at The Boston Consulting Group, Berlin and Frankfurt, developed strategies for European utilities and equipment manufacturers related to the energy transition

Education
• Master of Public Administration (MPA) on energy and renewables policies from Columbia University, New York
• Mechanical Engineering at Technical University of Darmstadt and UC Berkeley, Dr.-Ing. and Dipl.-Ing. degrees
What we want you to take away from the book

A power-system in South Africa that is based on renewables is

• Cheaper than all alternatives
• Cleaner than all alternatives
• Creates more jobs and localisation potential

It helps re-industrialising the country on the back of a low-cost, low-carbon electricity platform

Authors: Tobias Bischof-Niemz and Terence Creamer

Visit the book’s website at
http://saenergytransition.net
>150 GW of new solar PV and wind added to the grid in 2018 globally

Global annual new capacity in GW/a

- **Solar PV**
- **Wind**

Subsidies

Cost competitive

- Total South African power system (approx. 45 GW)
Agenda

Electricity planning in South Africa: the IRP

Current supply shortage and Eskom financials

Eskom restructuring
Energy Planning in South Africa:
Last promulgated IRP is IRP 2010, update currently ongoing (IRP 2018)

Integrated Resource Plan (IRP): long-term capacity expansion plan for the South African power system

Applies least-cost planning principles to meet expected future demand reliably, taking into account all existing & future supply resources and their cost structure, while adhering to certain boundary conditions

The South African Department of Energy (DoE) is mandated to develop the IRP and update it periodically

The latest promulgated IRP is the one developed in 2010 and promulgated in early 2011 (“IRP 2010”)
South Africa has scheduled to decommission 28 GW of coal by 2040

Operational coal-fired capacity in GW

Scheduled decommissioning until...

- 2030: -13 GW
- 2040: -28 GW
- 2050: -35 GW

Sources: Eskom, IRP
Electricity in TWh/a

- 241 in 2016
- 265 in 2020
- 321 in 2030
- 362 in 2040
- 397 in 2050

Sources: DoE, IRP 2018

An Integrated Resources Plan model fills the supply gap in the least-cost manner, subject to any constraints imposed (e.g. level of security of supply, CO2 emissions).

Existing and committed power generators in South Africa (2016)
Of all available technologies for bulk electricity generation, solar PV and wind are now the cheapest new-build options in South Africa, by far.

Unit cost in $ct/kWh and cost structure:
- Solar PV: 4.4
- Wind: 4.4
- Coal: 7.4
- Nuclear: 7.8
- CCGT (Gas): 8.2

Actual tariffs (auctions in 2015):
- Solar PV: 4.4
- Wind: 4.4
- Coal: 7.4
- Nuclear: 7.8
- CCGT (Gas): 8.2

IRP planning assumptions:
- Investment
- Fixed O&M
- Fuel (and variable O&M)

Assumed utilization (capacity factor):
- Solar PV: 23%
- Wind: 40%
- Coal: 82%
- Nuclear: 90%
- CCGT (Gas): 50%

Notes: Exchange rate of 14 USD/ZAR assumed. Sources: DoE’s IRP2018, REIPPPP auction results.
IRP 2018, scenario “IRP1”
Least Cost expansion path: 67% renewables energy share by 2050

Draft IRP 2018 (scenario: IRP1)
ENERGY

Total electricity produced in TWh/a

<table>
<thead>
<tr>
<th>Year</th>
<th>2016</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>TWh</td>
<td>240</td>
<td>255</td>
<td>318</td>
<td>358</td>
<td>397</td>
</tr>
</tbody>
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As per South Africa’s Draft IRP 2018

Draft IRP 2018 (scenario: IRP1)
CAPACITY

Total installed capacity in GW

1) No new nuclear
2) No new coal

<table>
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<tr>
<th>Year</th>
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<tr>
<td>GW</td>
<td>48</td>
<td>61</td>
<td>78</td>
<td>121</td>
<td>148</td>
</tr>
</tbody>
</table>

Sources: DoE, IRP 2018

Renewables = 67% Wind/PV = 59% … of primary electricity
What can give comfort to the Department of Energy regarding its results: Several studies independently come to the same conclusion.

**Common thread: No new coal, no new nuclear**
In the longer term: Three key disruptions have not been considered yet

**Electric Vehicles uptake**
- Small effect on overall electricity demand (1 million Evs → 3 TWh/a)
- But potentially huge effect on demand-side flexibility (smart charging), which makes integration of variable renewables easier and cheaper

**Stationary batteries cost reductions**
- A measure for smoothing intra-day fluctuations on demand and supply side
- Complements the deployment of pumped hydro (weekly storage) and gas-fired power (weekly / monthly storage)
- Costs today: 350 €/kWh, in future: 150 €/kWh
- Costs assumed: around 600-700 €/kWh, no reduction

**Flexibility on the demand side**
- Lots of flexibility option on the demand side available
- Flexible demand helps to absorb variability from solar PV/wind and makes integration easier & cheaper
- Low-hanging fruit: electric warm water provision

All of this considered does not change the fundamental direction, but increases 2050 RE share considerably to 85%
Taking all this into account: Probable “Least Cost”: same direction as IRP2018, higher RE share

CSIR Least Cost 2017
ENERGY

Total electricity produced in TWh/a

Renewables = 85%
Wind/PV = 82%
... of primary electricity (388 TWh in 2050)

CSIR Least Cost 2017
CAPACITY

Total installed capacity in GW

1) No new nuclear
2) No new coal

Sources: CSIR
Agenda

Electricity planning in South Africa: the IRP

Current supply shortage and Eskom financials

Eskom restructuring
South Africa has recently experienced so-called “load shedding”, the controlled rolling curtailment of customer load. This is due to an imbalance in supply and demand; the availability of the Eskom fleet declined, while the demand stagnated. Had the implementation of the renewables procurement programme not been halted for three years, the recent load shedding would have largely been avoided.

Load shedding curtails customer load of roughly 20 GWh per day (Stage 2 load shedding: 2000 MW, for 10 hours).

Solar PV and wind projects of Bid Windows 4 and 4 Expedited will produce 25 GWh per day on average.
Options to address Current supply shortage

**Short-term: Open up the market for embedded generators**
- Any new power generator in South Africa above 1 MW currently requires a generation license from the regulator
- More than 2,000 MW of new generation capacity is waiting for approval by the regulator
- These embedded generators (mostly solar PV for commercial and industrial applications) can be brought online very quickly

**Medium-term: Enable municipalities to buy electricity directly from IPPs**
- Municipalities are currently not allowed to enter long-term power purchase agreements with IPPs
- If municipalities could procure their own supply sources, it would unlock additional capacity

**Medium-term: Finalise IRP and procure new capacity through auctions**
- The IRP is the capacity-expansion plan for the South African power system
- The last IRP was developed in 2010 and promulgated in early 2011
- New generators were last procured in late 2014, almost 4.5 years ago
- It is essential to publish the new IRP, update it frequently (once a year) and consistently procure the new capacities in competitive auctions for energy and capacity
Current Eskom financial crisis

One could always give Eskom a large tariff increase (say 20%), and the immediate liquidity problem is solved.

Adverse effects on customer demand can be addressed via appropriate tariff structures.

That, macroeconomically, would be more efficient than government bailouts, because a bailout is effectively shifting costs from the electricity system to the tax system and hence is a subsidy, which leads to inefficient capital allocation in the long run.

However, the underlying problem would not be addressed: Eskom has prudently and efficiently incurred cost and it has non-prudently and non-efficiently incurred cost, and it is almost impossible for the regulator to differentiate between them.

Furthermore, how to deal with the non-efficiently incurred sunk cost at Medupi and Kusile?

The electricity sector can only be moved into one that only incurs prudently and efficiently its cost by restructuring the system into smaller pieces, with clear individual accountabilities and roles.
Agenda

Electricity planning in South Africa: the IRP

Current supply shortage and Eskom financials

Eskom restructuring
## Today, Eskom is a fully vertically integrated electric utility

### Eskom Holdings SOC Ltd

<table>
<thead>
<tr>
<th><strong>Generation (Gx)</strong></th>
<th><strong>System Operation</strong></th>
<th><strong>Transmission (Tx)</strong></th>
<th><strong>Distribution (Dx)</strong></th>
<th><strong>Customer Service</strong></th>
</tr>
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</table>
| • 40 GW coal-fired power stations  
• 1.8 GW nuclear  
• Others  
• Responsible for efficient operations of the fleet of Eskom power generators | • National Control Centre in Germiston  
• Day-to-day dispatch of power generators  
• Ultimate responsibility for stable operation of the entire power system  
• Organisationally this function resides within Eskom Transmission | • >30 000 km of high-voltage lines  
• Long-distance transmission of electricity  
• Responsible for building, operating and maintaining the transmission-grid infrastructure  
• Includes the Single-Buyer Office (i.e. “market operator”) | • 350 tkm low- to medium voltage lines  
• Regional distribution and reticulation of electricity to end-customers  
• Responsible for building, operating and maintaining the distribution- and reticulation-grid infrastructure | • 6 million direct Eskom end-customers  
• Retail supply in Eskom’s own distribution areas  
• Wholesale supply to municipalities (i.e. electricity distributors)  
• Direct supply to large industries |

### Non-Eskom today

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<th><strong>Generation</strong></th>
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| • Some Independent Power Producers  
• Some self-generation industrial power plants | • Generally, large municipalities are responsible within their jurisdiction | • Generally, municipalities are responsible within their jurisdiction |
### Decision made: Separate Eskom into three!

#### Proposal: How to assign Eskom’s functions into the three separate companies

<table>
<thead>
<tr>
<th>Eskom Generation</th>
<th>Eskom TSO</th>
<th>Eskom Distribution and Sales</th>
<th>Non-Eskom today</th>
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Decision made: Separate Eskom into three! Proposal: How to assign Eskom’s functions into the three separate companies
### Today: South African electricity system fully regulated with only accounting unbundling

Overview of the regulatory framework for the South African electricity market, status 2019

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<th>Parameter</th>
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<th>Comments</th>
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<tr>
<td>Grid access</td>
<td>Not regulated or single-buyer model</td>
<td>• Only way to connect to the grid: Eskom or munic’s grid; NERSA consent required if non-self-consum.</td>
</tr>
<tr>
<td>Grid tariff</td>
<td>None</td>
<td>• Part of the grid costs charged as connection and use of system charges, but not fully cost reflective</td>
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<tr>
<td>TSO unbundling</td>
<td>None</td>
<td>• Smaller customer: grid costs blended into kWh tariff</td>
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<td>DSO unbundling</td>
<td>None</td>
<td>• Eskom is the state-owned monopolist TSO</td>
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<td>Power exchange</td>
<td>No</td>
<td>• Eskom and municipalities are the DSOs</td>
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<td></td>
<td>Planned</td>
<td>• They all have their own, distinct distribution area</td>
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<td></td>
<td>Yes</td>
<td>• Eskom-internal power market existed in the early 2000s, but was abandoned; no plans to revive</td>
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<td>End-user price³</td>
<td></td>
<td>• Fully regulated market</td>
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<td>HH</td>
<td>Regulated</td>
<td>• “Willing buyer, willing seller” concept in principle existing, but not really implemented yet</td>
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<td>Regulated</td>
<td>• Energy can even be wheeled</td>
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<td>Choice of supplier¹</td>
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Sources: design from BCG; CSIR analysis
## Separating Eskom into three legal entities is first step in the dimension TSO/DSO

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Advantages of splitting Eskom into three legal entities

Eskom today is already unbundled accounting-wise

However, budgets and people can easily be moved from one division to another (e.g. budget for transmission grid being re-allocated to the new-build programme in generation)

Creating separate legal entities brings accountability and transparency

**Accountability:** Easier to assign KPIs to individual legal entities, their boards and executive teams

**Transparency:** Clear visibility on financials of individual companies

What should be clarified:
- Where are the planning functions located (IRP and transmission-grid planning)? → independence of planning is important
- Where are the peaking and pumped storage plants located? → innovation in flexibility provision might be slowed if in the TSO
- Where should the Single-Buyer Office reside? → large, increasing cash flows will have to be managed, distort the asset business

Mandate and governance structure of the new “Eskom TSO” entity are key for the success of the split!
Generation has by far the most revenues of all Eskom segments

Eskom revenues per segment for the financial year 2017/18; source: Eskom AFS
Proposal:
Eskom Generation should be horizontally split into different competing entities too

Electricity generation in TWh/a

- Non-coal existing
- Non-coal new
- Coal

Demand

Declining Coal Budget

Timing and magnitude of non-coal new-build options optimised by the Integrated Resource Plan (IRP)

1. Replacement of own coal-TWh by GenCo 6 with cheaper non-coal TWh from new-build
2. Sale of coal-TWh from GenCo 3 to GenCo 2, transaction causes conversion of allocation to non-coal TWh
3. Participation of GenCos in the competitive space for non-coal new-builds

Proposed allocation of Eskom power stations to different GenCos:
- GenCo 1: Tutuka + Duvha
- GenCo 2: Lethabo + Matla
- GenCo 3: Matimba + Kriel
- GenCo 4: Kendal + old five
- GenCo 5: Majuba
- GenCo 6: Medupi
Example GenCo1: New owner refines the purchase of asset/PPA package on the back of the guaranteed annual offtake and the predefined, guaranteed, fixed tariff

GenCo 1
- GenCo takes operational and performance risk from point of taking over asset/PPA package
- Obligation: set aside & ring-fence rehab funds

PPA with
- Predefined (by government), guaranteed and fixed tariff
- Guaranteed annual offtake

Total: 490 TWh budget

Single Buyer Office
- Buys power from all GenCos/IPPs
- Forward sells it to customer service

Location today: Eskom Transmission Division
Location future: to be determined, could be
  - In the TSO legal entity or
  - Entirely ring-fenced and separately regulated

GenCo 1 buys the package asset (coal power station) + PPA at a lump-sum price

New owner could be state-owned entities like the PIC

Current Eskom debt providers could transfer their debt to the new GenCo (package of asset + PPA)

Tariff (guaranteed, fixed)

Equals R320 billion total revenue at 0.65 R/kWh
Example of Kriel power station, with assumed 0.65 R/kWh (real) predefined tariff

Revenue
Tariff = 0.65 R/kWh until 2028
Tariff = 0.00 R/kWh from 2029

Cost and Margin
- EBITDA
- Operations & Maintenance
- Coal
Inefficiencies during operations will reduce EBITDA to the new owner

The sale of package asset/PPA to a new owner is possible at a lower lump-sum price – but tariff remains unaffected.

Revenue
Tariff = 0.65 R/kWh until 2028
Tariff = 0.00 R/kWh from 2029

Cost and Margin
Margin is a result of revenue – cost
Eskom case: inefficiencies will lead to requests for tariff increases

In case of cost increases, Eskom will have to push for higher tariffs (increase the bottom-line). That’s the obligation of any prudent Eskom director.

Plus: No incentive for Eskom to orderly decommission, because its return comes from the asset base itself, not from the electricity / value that those assets generate.

Revenue is a result of cost + return

Cost and Margin

- EBITDA
- Operations & Maintenance
- Coal
Summary

South Africa is confronted with two energy-sector disruptions at the same time:

- Increased need to unbundle and liberalise the electricity market
- Beyond the tipping point of renewables being the least-cost new-build option

There is a large alliance between business and government in terms of restructuring Eskom: The chances have never been better

Challenges:

1) Define and aim for the optimal end state, but manage the art of the possible in the here and now
   - National political buy-in
   - Rating agencies and international investors need to buy in

2) Ensure excellence in execution

Financing of the transition is important and South Africa will certainly need support in that
Thank you

Ha Khensa

Siyathokoza

Enkosi

Re a leboha

Ro livhuha

Dankie

Siyabonga

Re a leboga

Note: „Thank you“ in all official languages of the Republic of South Africa