Association of Municipal Electricity Utilities (Southern Africa)
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27th Technical Convention 2019

The 4th Industrial Revolution ("4IR") | *Building the Power Utility of the Future, Today*

Challenges of Planning Future High Voltage Power System Networks

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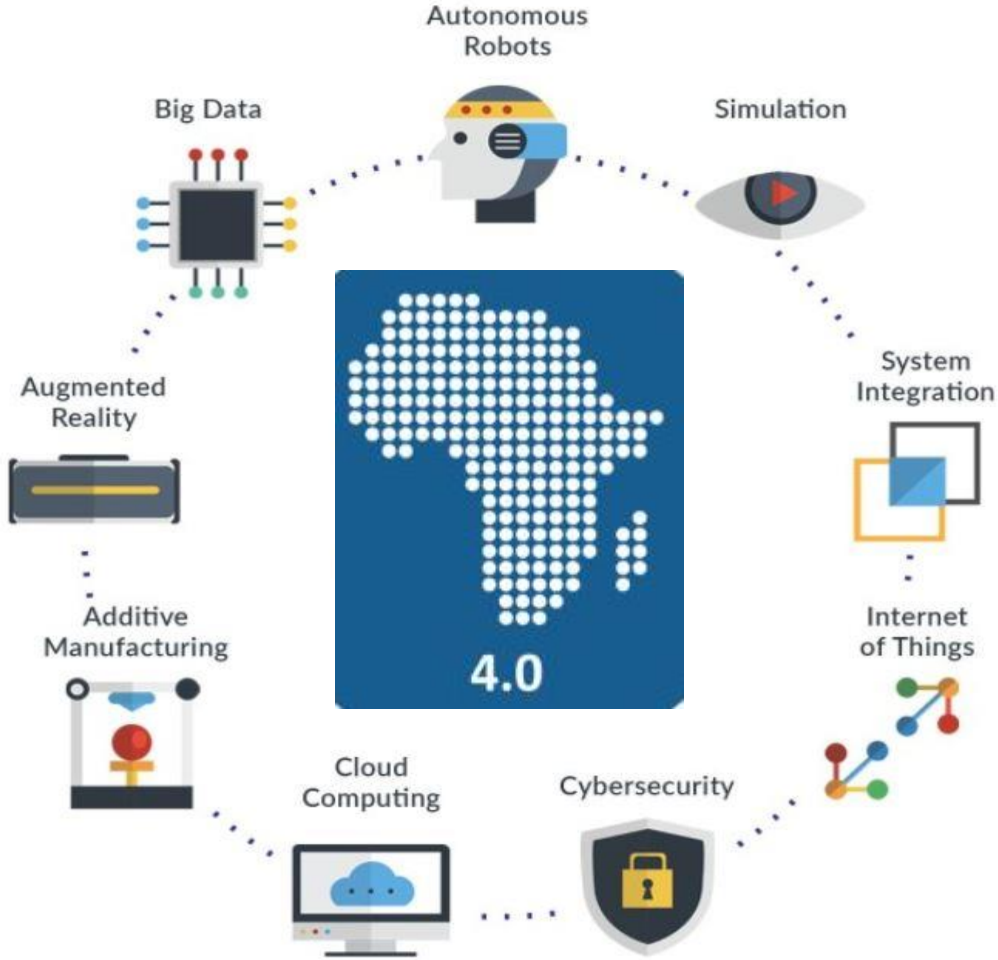
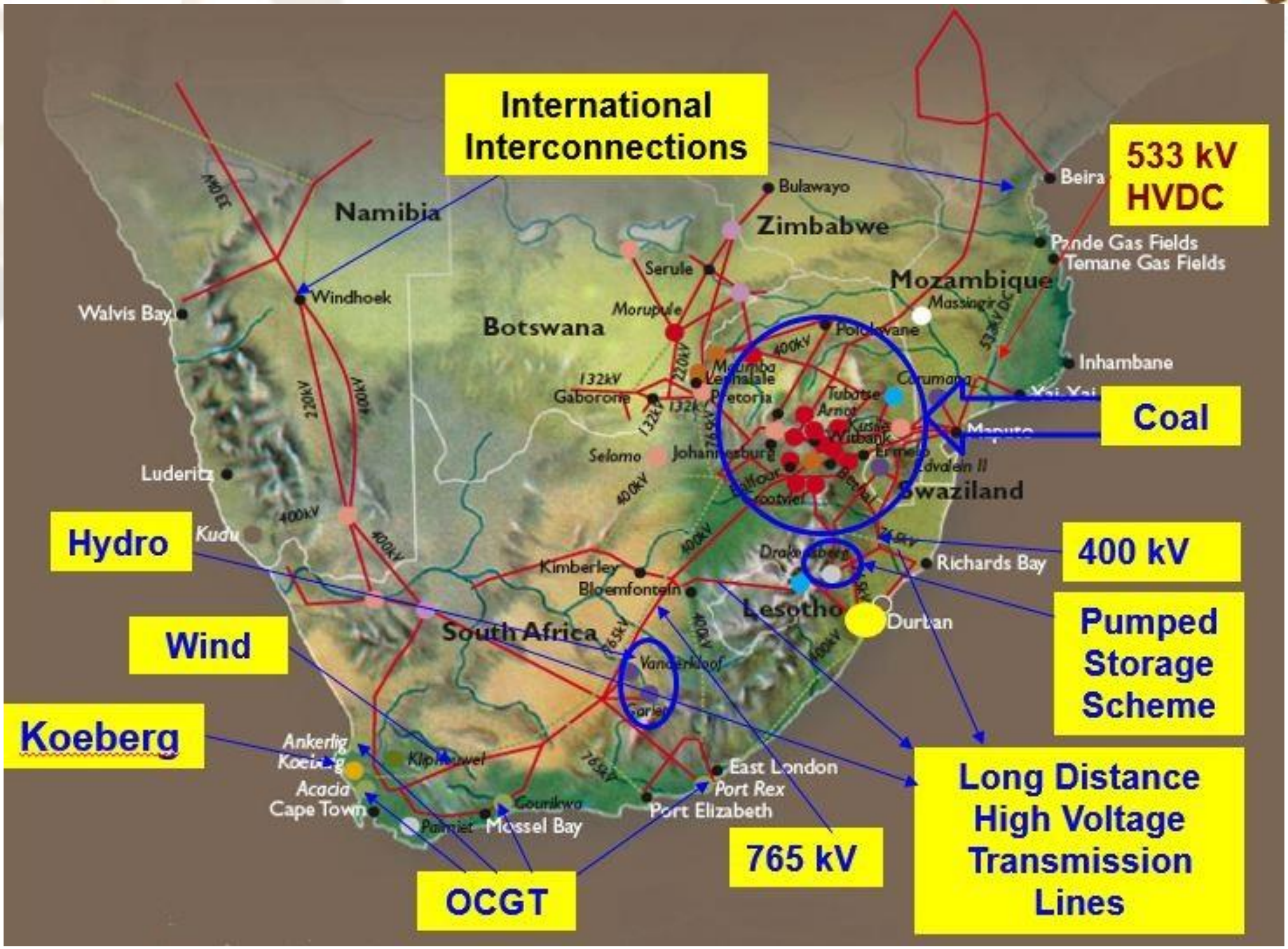
The 4^{th} Industrial Revolution

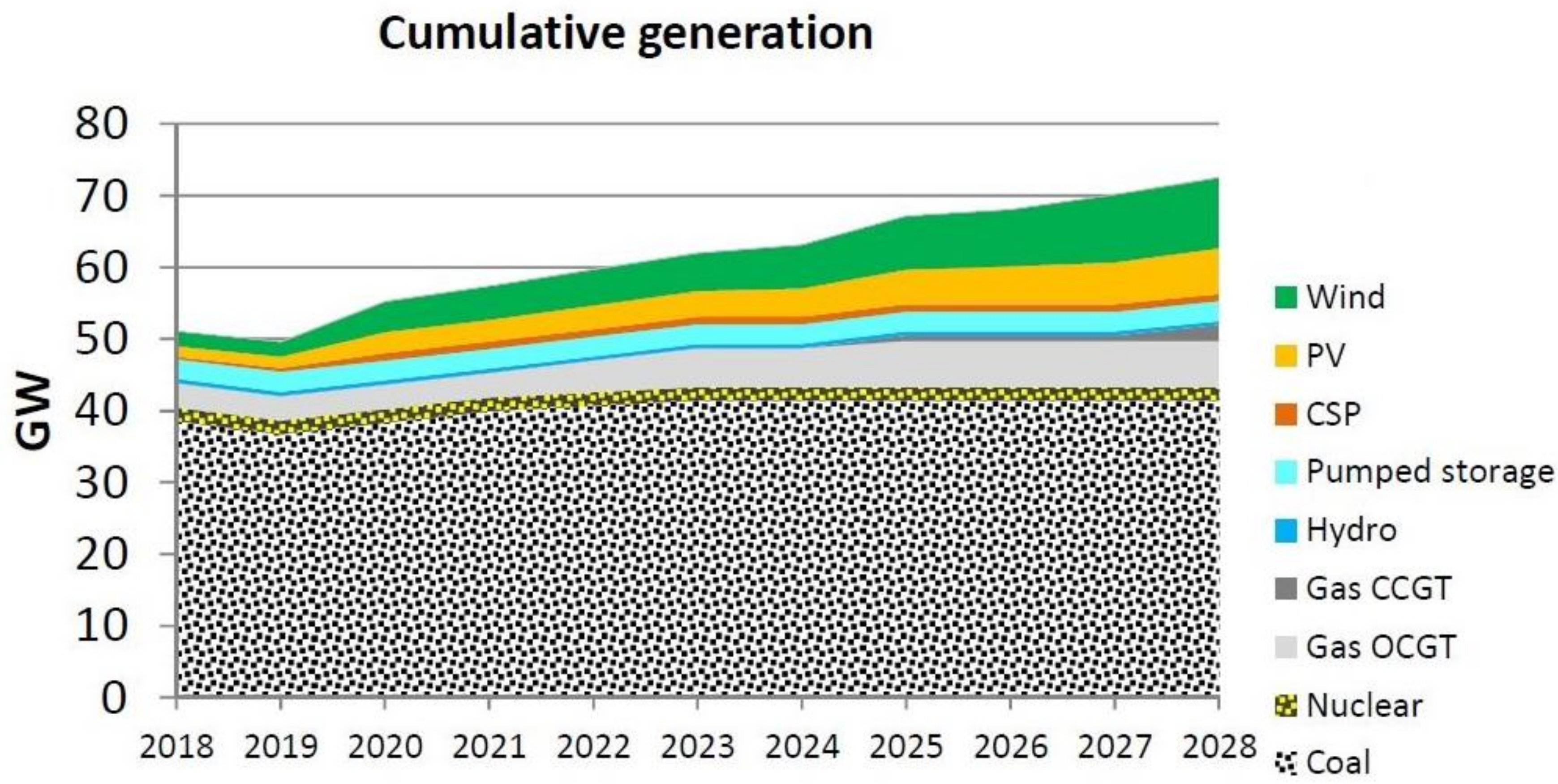
- Disruption of the existing practices
- Leads to change
- Affects the way in which we live, work and play
- Innovation challenges traditional practices
- Change is fueled by drivers
- If one can predict then one can plan



The South African High Voltage (HV) Network



Current and Future of Generation



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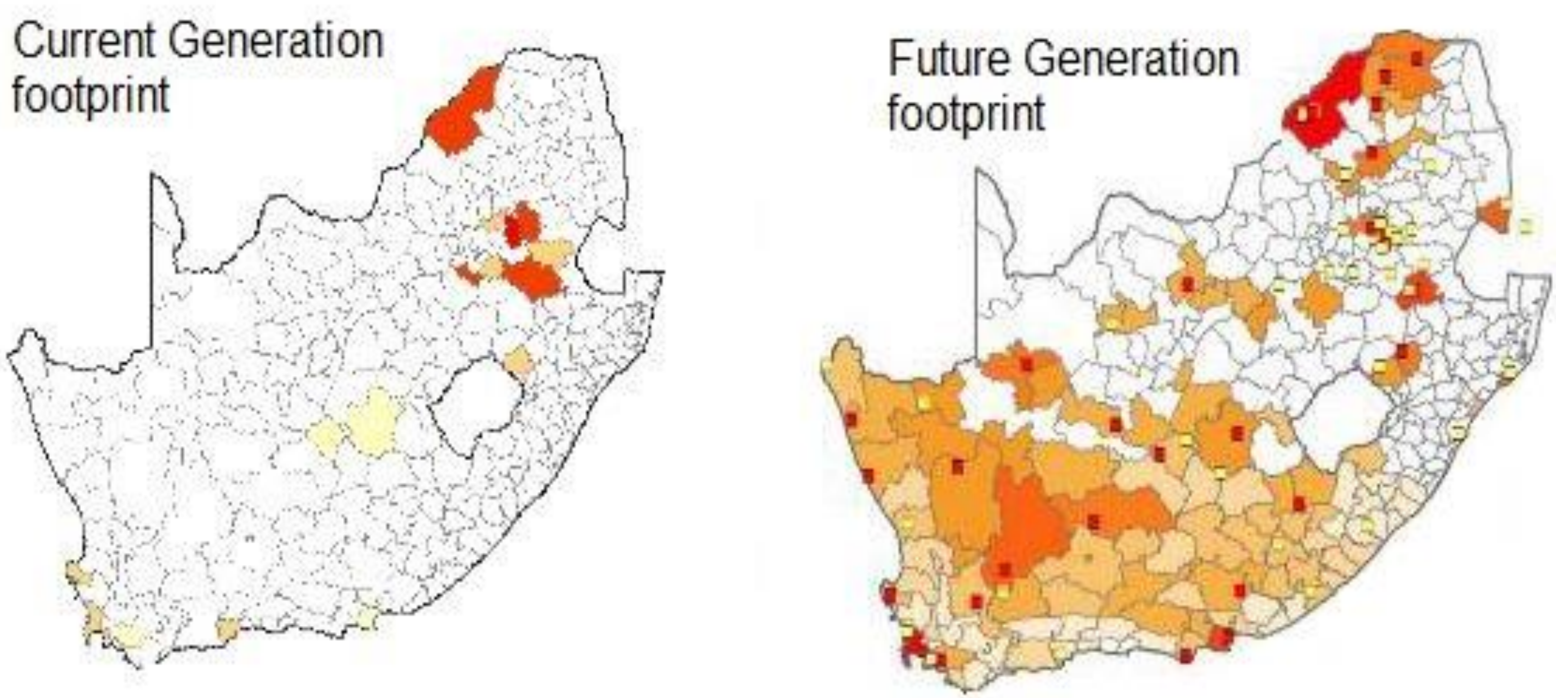
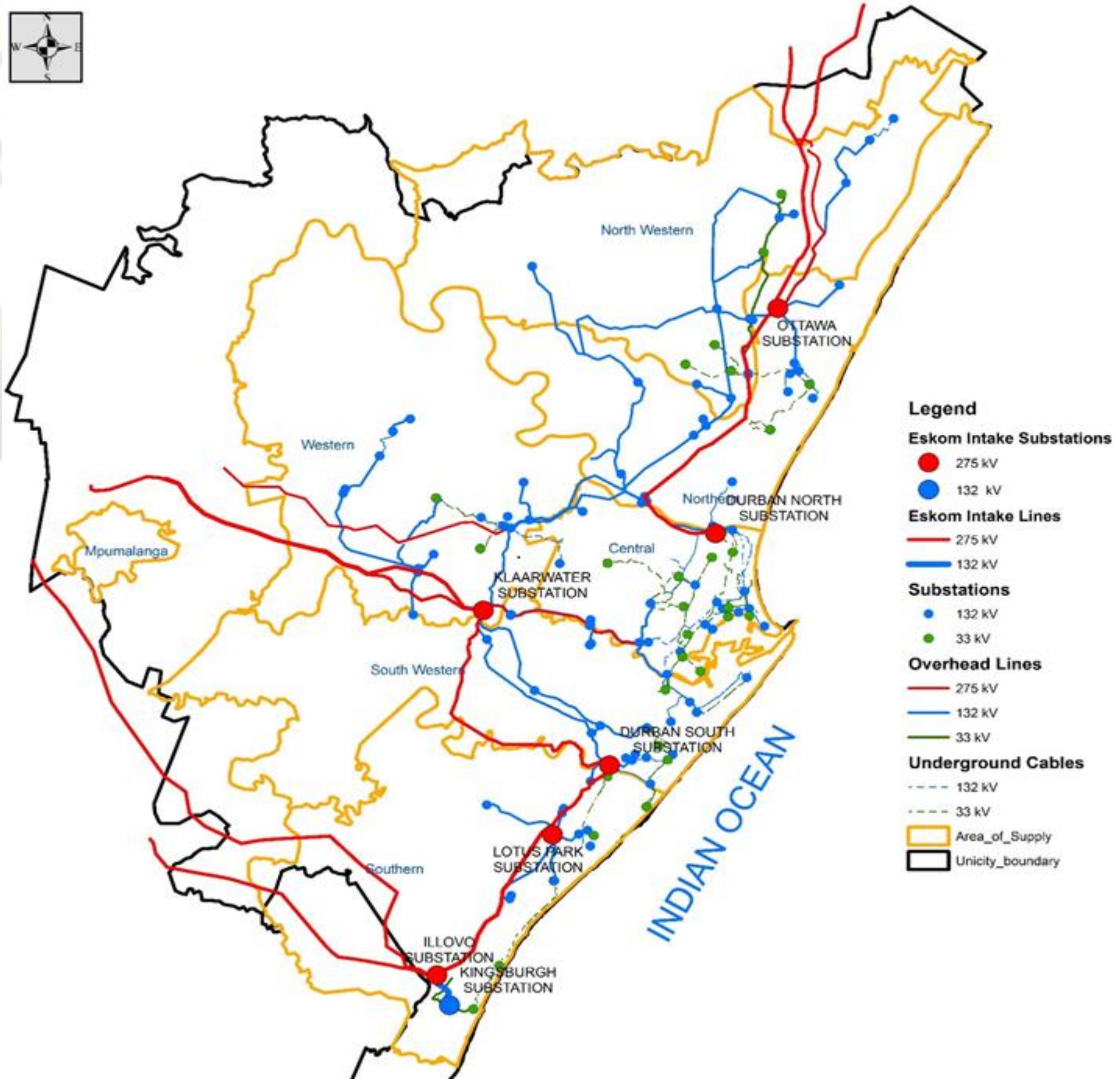


Source ref: Eskom TDP 2018

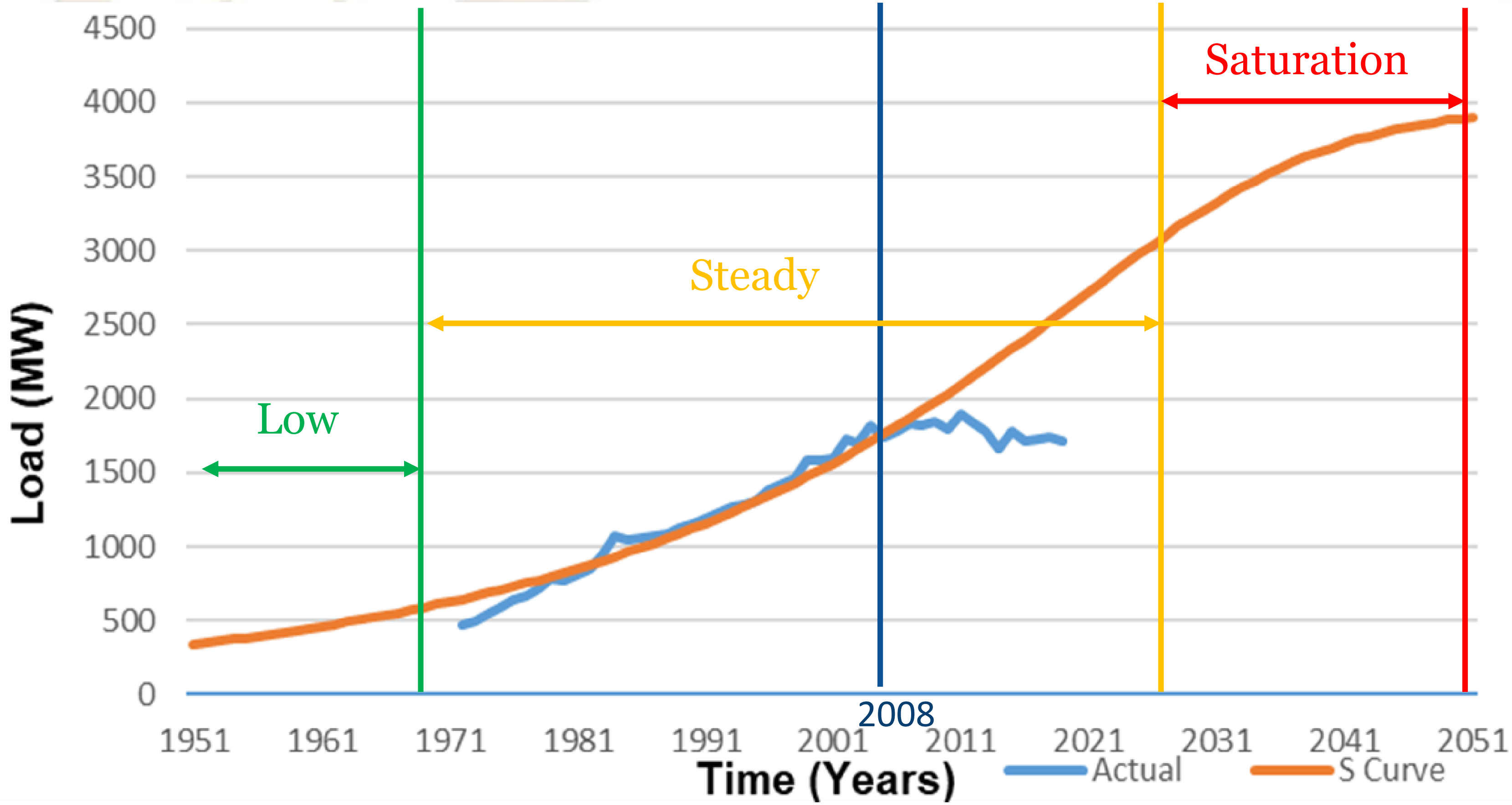
eThekwini Electricity's HV Power System



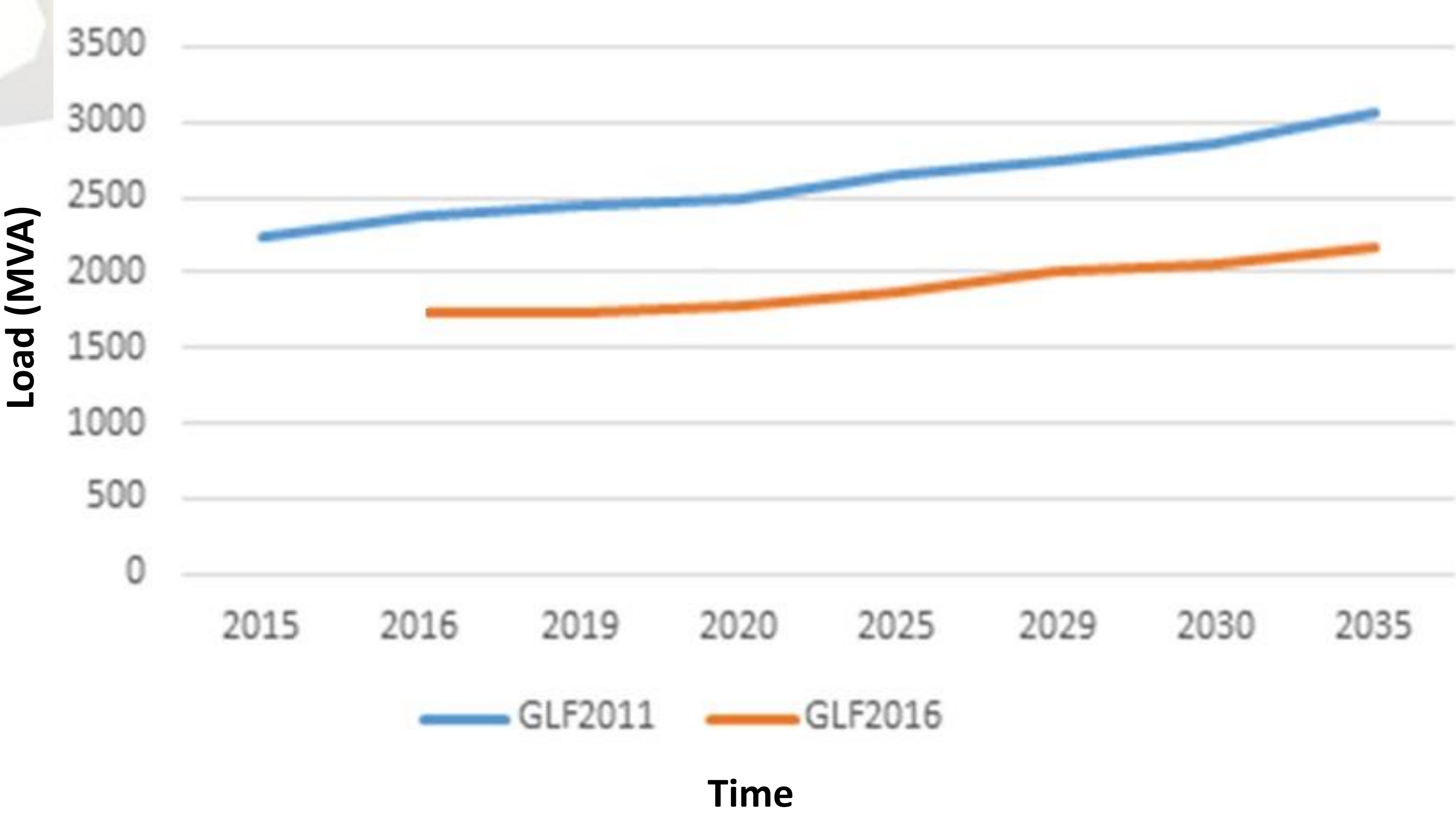
Current and Future Load Demands

- Tariffs have increased between 4,95% and 26,2%, year-on-year, effectively quadrupling since 2008
- Slow growth in load demand, more energy conscious customers and demand side management initiatives
- Development is driven by the economy
- 60 MW of privately owned distributed energy resources (DER) within eThekwini
- Urbanisation, formal and informal continue and
- Currently difficult to forecast growth using traditional load and load-forecasting models

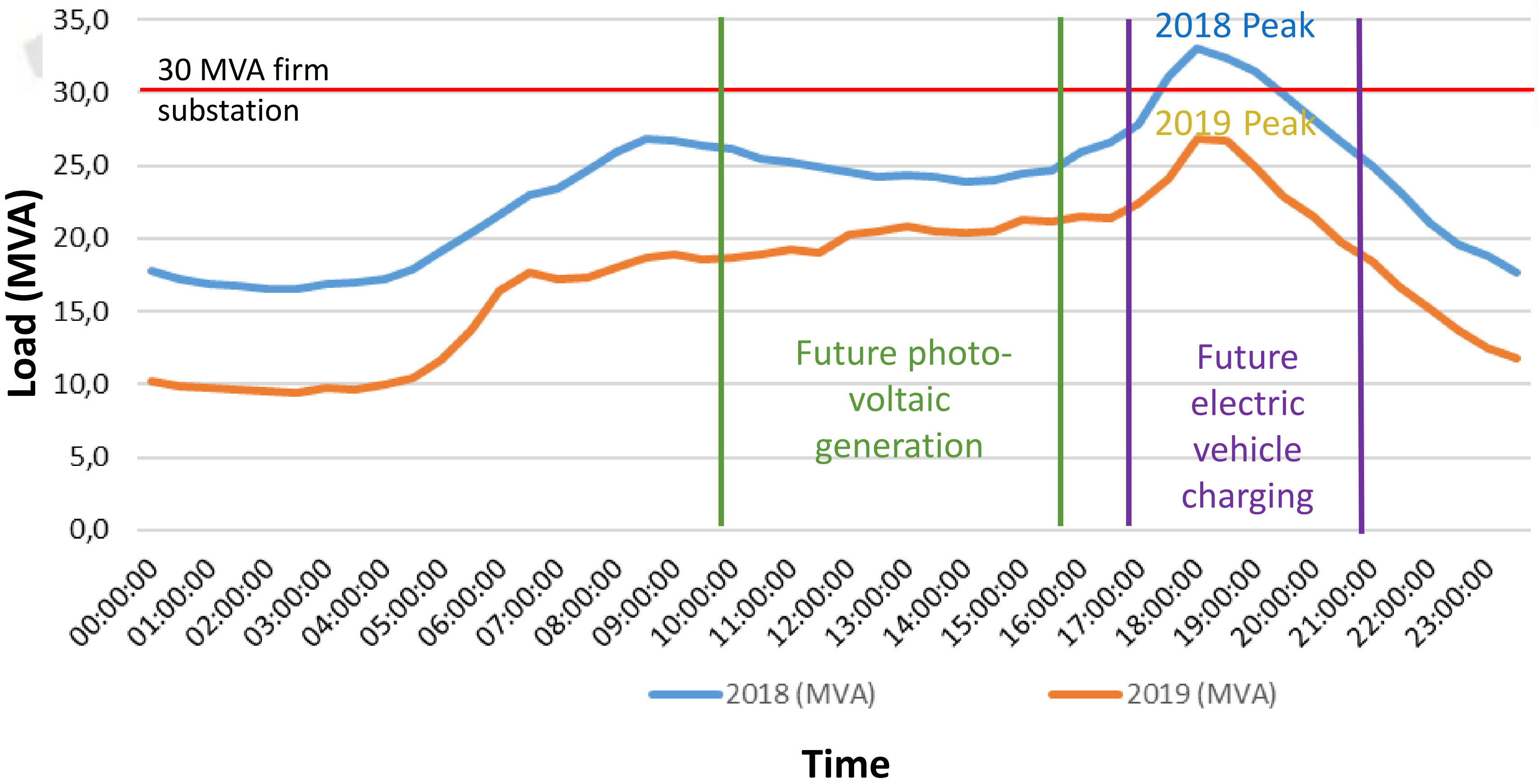
eThekwini Historic Load



Geographic Load Forecasts (GLF)



Case study : 132/11 kV Waterfall 2018-19 Daily Load Analysis



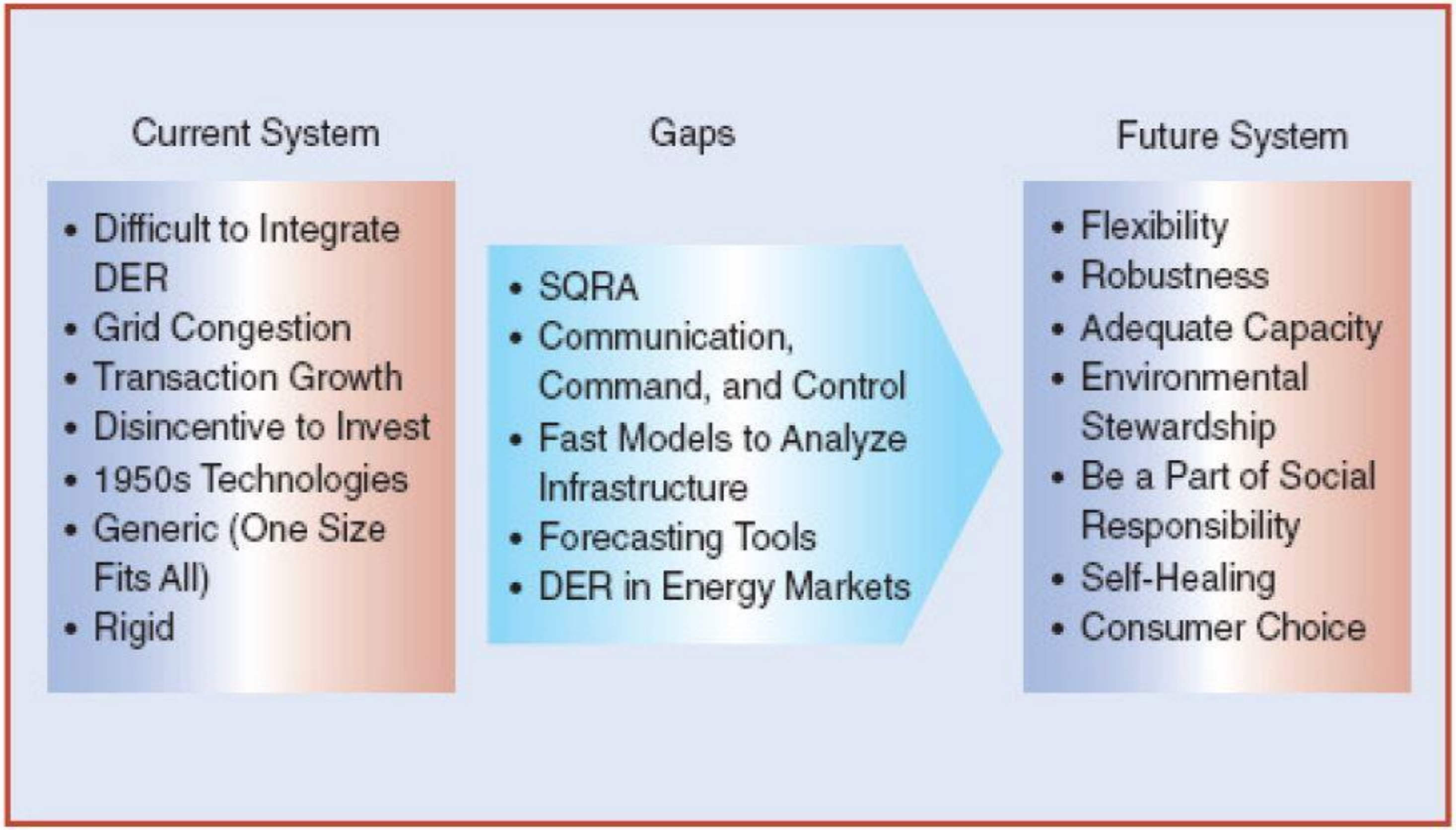
Technical Challenges

- Embedded generation: More small scale and large-scale DER integration
- Power flows that could change
- Changing power quality due to the increase of renewable energy generation: fault current levels, flicker, harmonics, etc.
- The focus on cyber security will increase as network connectivity increases
- In-depth knowledge of MV network changes is required, a bottom-up approach

Non-Technical Challenges

- Sites and Servitudes: difficult to acquire, expensive and encroached
- Decreasing revenue
- Theft of electricity, cables and overhead lines
- The constant pressure to reduce carbon emissions and produce green energy
- Long project planning and execution timeframes and work stoppages
- Variance in the demands of customers, due changing usage patterns and shifts in the load curves
- High costs for the transmission projects and the ability to raise capital
- Effects of climate change on infrastructure and network resilience
- Human resources and changing skill sets of employees
- Alternative energy sources

Grid Transition



The transition from the current grid to the future grid (SQRA: Security, Quality, Reliability and Availability; DER: Distributed Energy Resources)

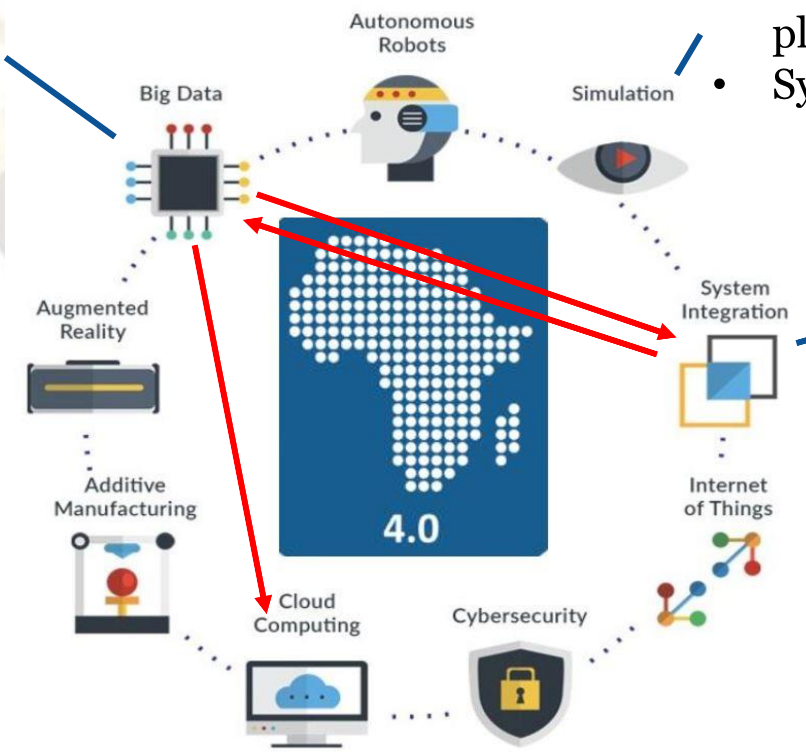
Source: The future's smart delivery systems, IEEE, Gellings et al

4IR in HV Power System Planning

- New load models
- Load forecasting

- Multiple scenario planning
- System resilience tests

- Economic data
- GIS
- Smart meter data
- Development data
- Weather patterns



Conclusion

- Disruption, volatility and unpredictability likely to continue
- HV plans need to be agile and adapt to change (modular or mobile substations)
- More customer-centric service is required with stakeholder participation
- Sustainable revenues models and policies (inclusive of DER) are required to ensure a reliable network
- Knowledge sharing between utilities and benchmarking against leading networks
- Future proof technology to enable a smooth transition
- Electricity or Energy?

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Thank you

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