



Presentation to GOSA:

The impacts of load shedding, and the risks of a national blackout in South Africa

by

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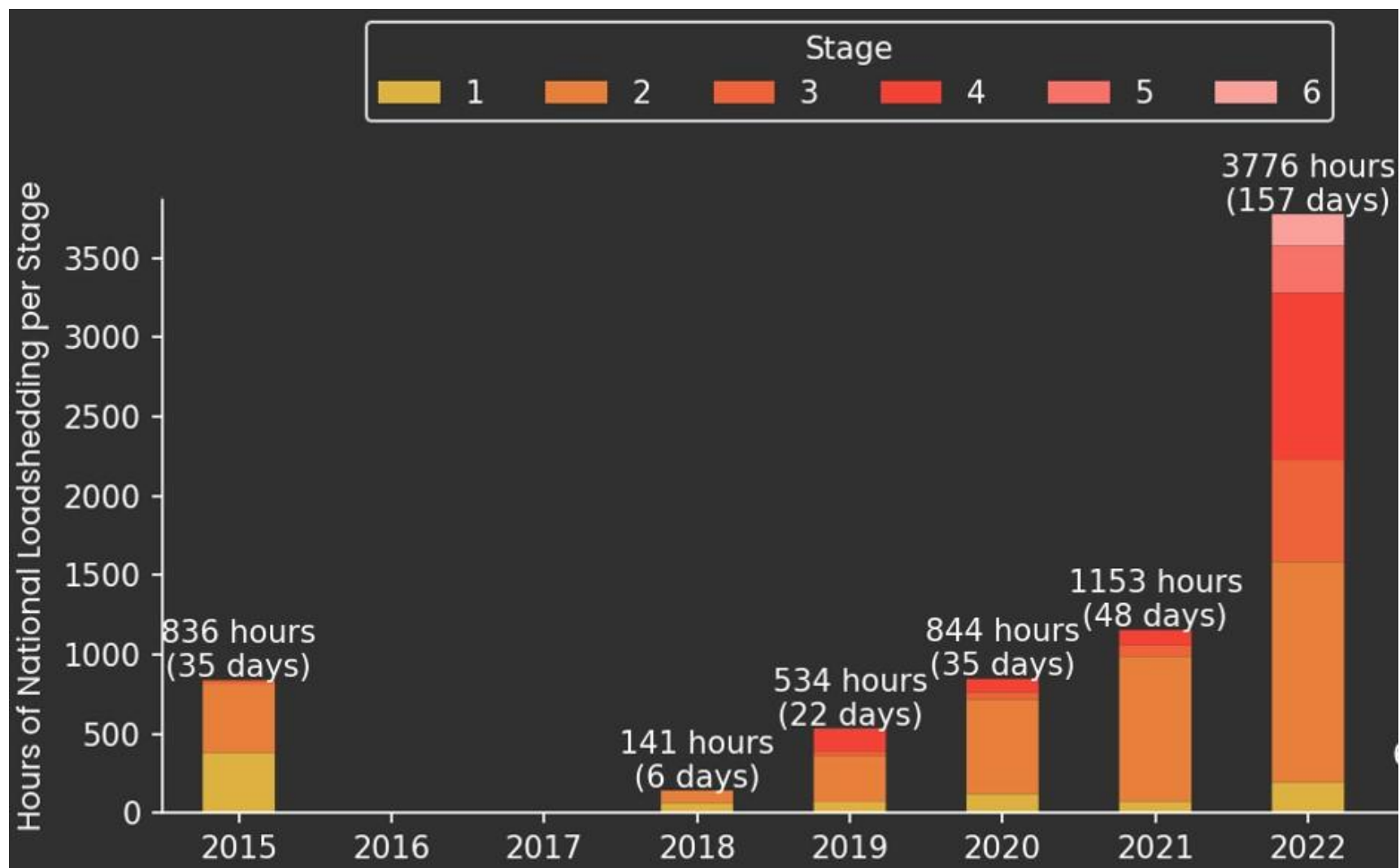




Energy in respect of agricultural sector

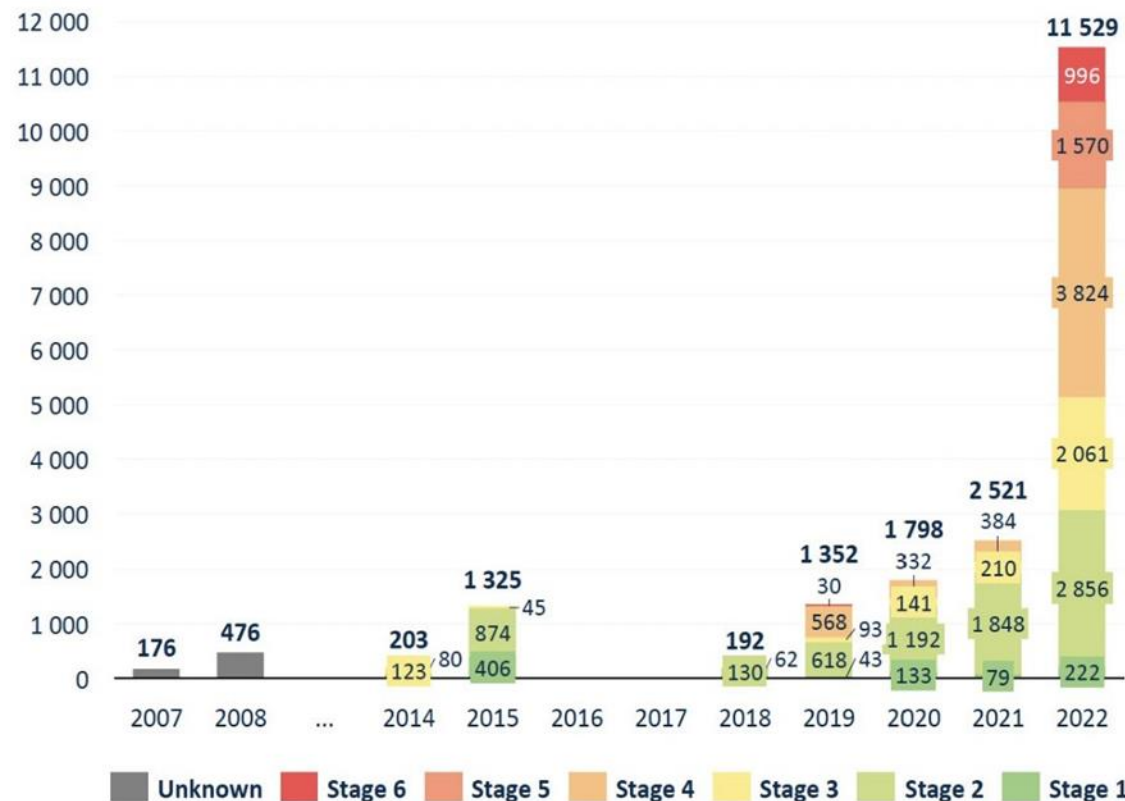
- Human energy
- Food
- Electricity
- Petrol
- Diesel
- Liquid petroleum gas
- Piped natural gas
- Liquified natural gas
- Biomass
- Liquid biofuel
- Biogas
- Fertiliser

Eskom load-shedding to date



Eskom load-shedding to date

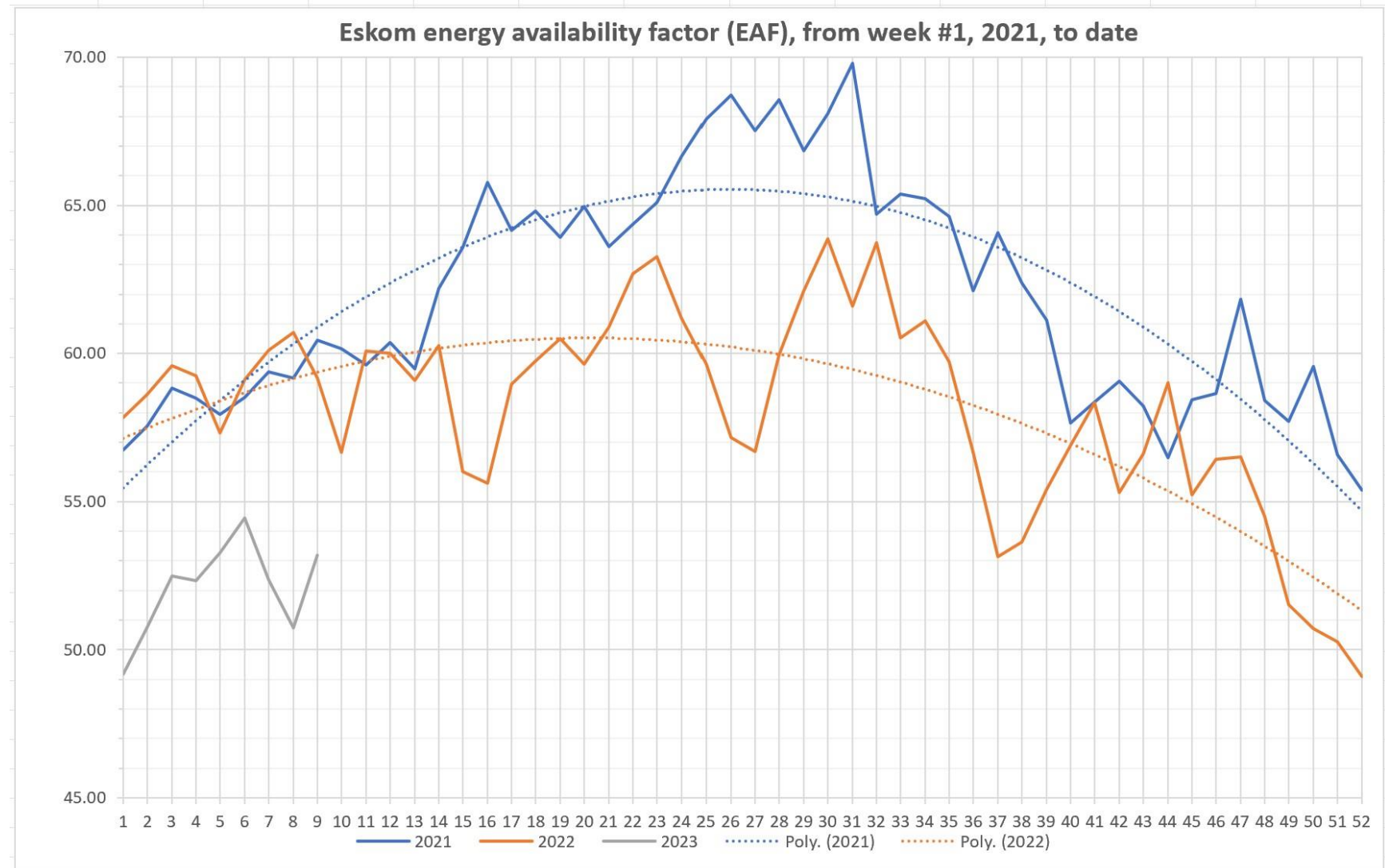
Load shed, upper-limit [GWh]



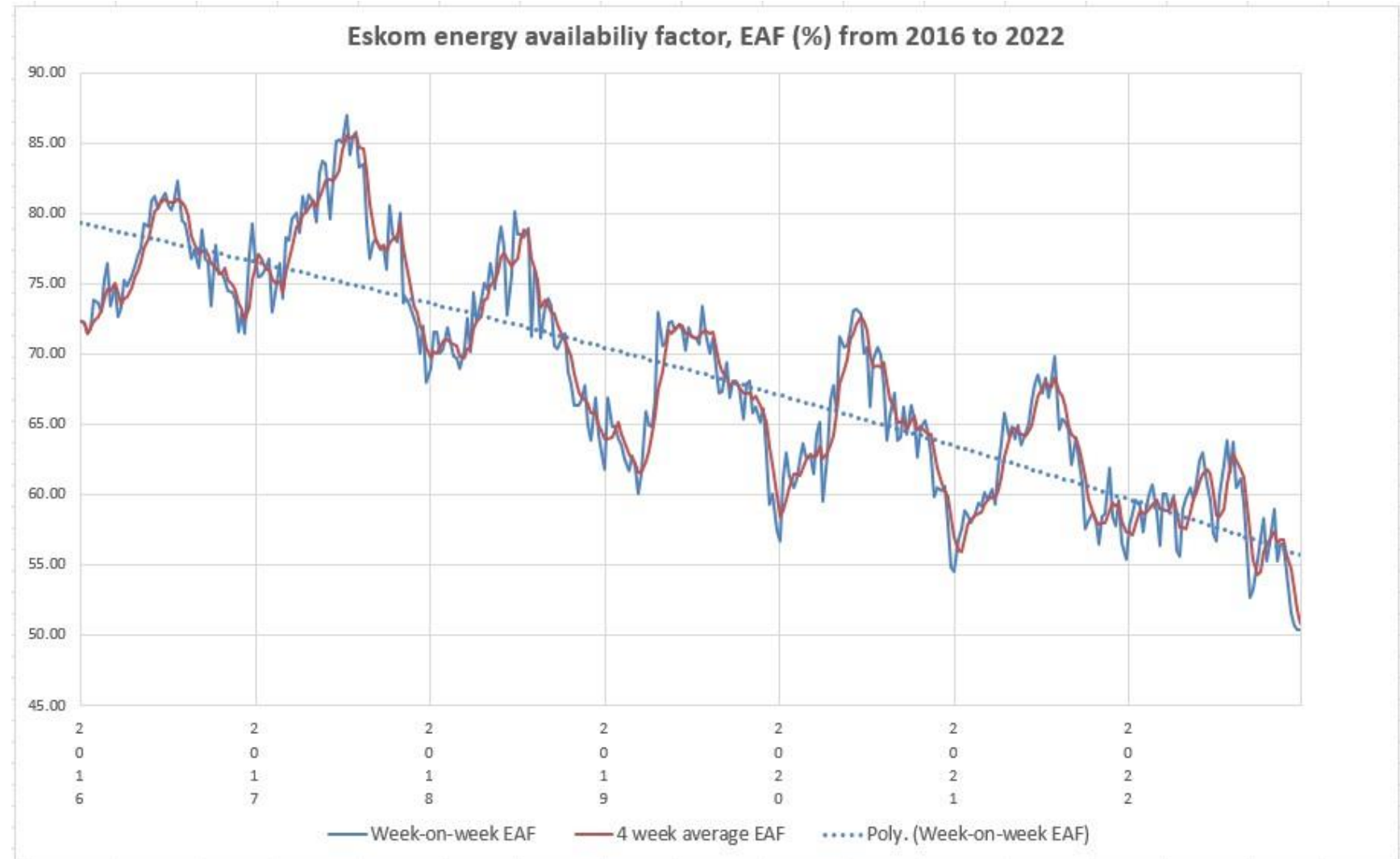
Year	Duration of outages (hours)	Energy shed (GWh)	DSR (GWh)
2007	-	176	Not available
2008	-	476	Not available
...
2014	121	203	Not available
2015	852	1 325	Not available
...
2018	127	192	392
2019	530	1 352	1 362
2020	859	1 798	1 426
2021	1 169	2 521	1 936
2022	3 773	11 529	8 301

Notes: Loadshedding assumed to have taken place for the full hours in which it was implemented. Practically, load shedding (and the Stage) may occasionally change/ end during a particular hour; Total GWh calculated assuming Stage 1 = 1 000 MW, Stage 2 = 2 000 MW, Stage 3 = 3 000 MW, Stage 4 = 4 000 MW, Stage 5 = 5 000 MW, Stage 6 = 6 000 MW
Demand Side Response (DSR) = Manual Load Reduction (MLR) + Interruptible Load Supply (ILS) + Interruption of Supply (IOS);
Sources: Eskom Twitter account; Eskom Hld SOC Ltd FaceBook page; Eskom se Push (mobile app); Nersa; CSIR analysis

Eskom energy availability factor



Eskom energy availability factor





Implications for the agricultural sector

- The agricultural sector is a particularly important sector of the SA economy, in terms of GDP, employment, food security and exports.
- Grain production is an key sub-sector within the agricultural sector of SA.
- The financial implications of load shedding at various levels are different for every different sector and sub-sector in of the economy.
- The agricultural sector of SA is particularly vulnerable to the impacts of loadshedding and loss of electricity supply.
- This includes electricity for irrigation, feeding, milking, cooling, heating, drying, milling, processing, packaging, storage, transportation and exporting.
- As the industry association representing grain producers in SA, GOSA is well positioned to understand the particular vulnerabilities of the grain sub-sector to load-shedding.
- An important role for GOSA is to formalise the particular issues faced by grain producers in respect of load-shedding, and to prepare mitigation strategies for its members.
- It is important that customers of electricity, including grain producers and GOSA, should take ownership of their own energy futures, and should become part of the solution.

President's plan to end load shedding

1. Fix Eskom and improve the availability of existing supply
2. Enable and accelerate private investment in generation capacity
3. Accelerate procurement of new capacity from renewables, gas and battery storage
4. Unleash businesses and households to invest in rooftop solar
5. Fundamentally transform the electricity sector to achieve long-term energy security





A state of disaster in respect of electricity

- Need to define specific short-term actions, timeframes and costs upfront to be addressed through declaration of a state of disaster – not a blank cheque.
- A state of disaster – to address load shedding, or to address vote shedding?
- A state of disaster – in the national interest, or the political party interest?
- Some specific short actions to be addresses through a state of disaster:
 - Bypass NERSA to promulgate a simple, national, municipal and Eskom feed-in tariff for commercial and industrial and agricultural customers for a 2-year period.
 - Bypass NERSA to promulgate a simple, national wheeling framework and wheeling tariff for IPPs and traders for a 2-year period.
 - Announce tax incentives for full cost of rooftop solar PV and battery storage to be offset against taxable income of residential home-owners in year of commissioning.
 - Increase the threshold from 1 MW to 10 MW for business customers able to depreciate the full cost of solar PV and battery storage in the year of commissioning.
 - Immediately announce rebate and tax incentives for the installation of domestic hot water and facilitate the restart of the solar hot water heating programme in South Africa.
 - Immediately announce that the independent National Transmission Company of South Africa will be made operational and commence trading in 3 months maximum.
 - Immediately publish and monitor progress against a set of sectorial targets for renewable energy and BES in the domestic, commercial, agricultural, municipal, mining and other energy intensive sectors.



National blackout: Consultation with experts

Mr Robbie van Heerden

Former System Operator and head of Eskom National Control.
Subsequently a technical specialist at CSIR Energy Centre.
Currently a power system consultant at Enertrag South Africa.

Mr Gavin Hurford

Former System Operator and acting head of Eskom National Control.
Currently National Control Manager: System Operator, Transmission, Eskom

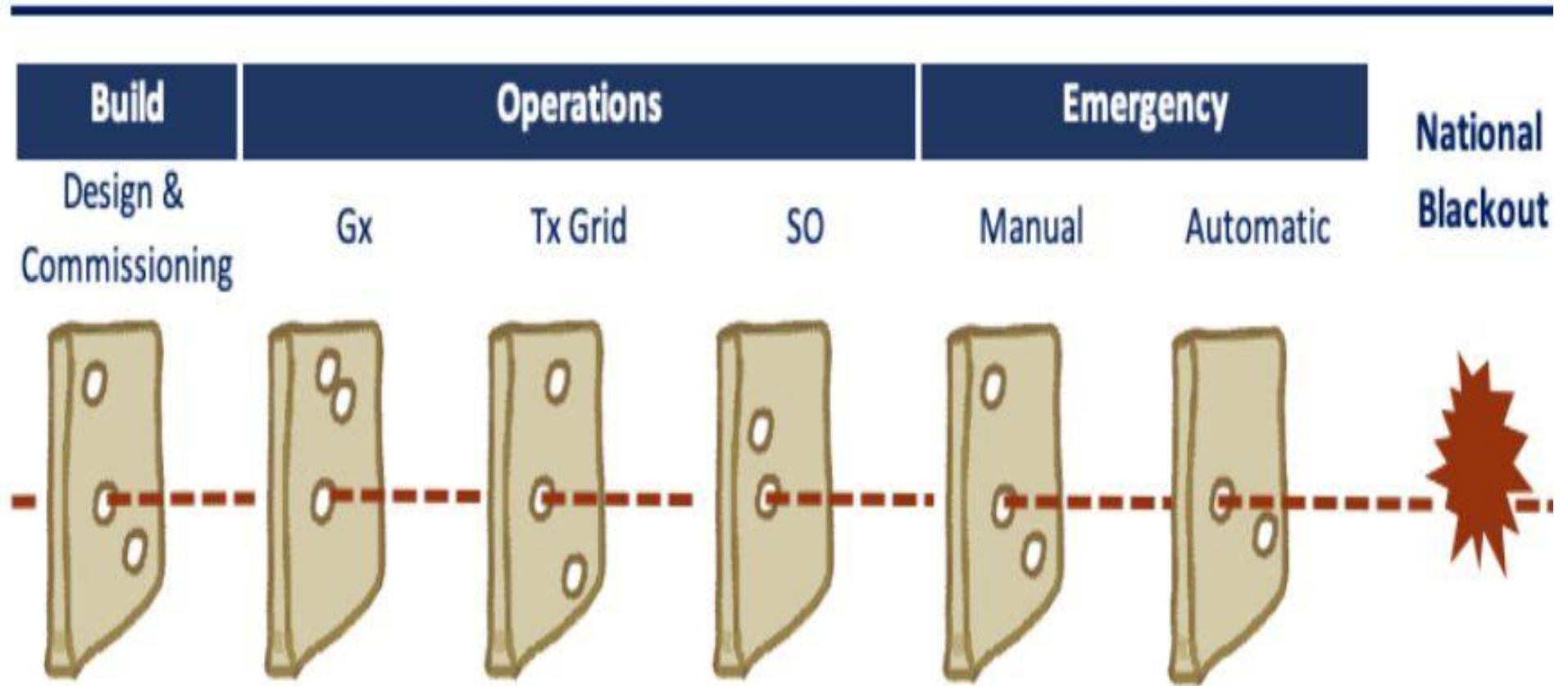
Mr Robert Koch

Former head of Risk Management at Eskom and architect of the emergency, loadshedding and black start protocols for Eskom and NRS 049.
Currently risk management specialist/manager at EirGrid, the national grid company of Ireland.

Presentation by Gavin Hurford:

<https://youtu.be/vxq9fUlk0KA>

Swiss cheese risk management



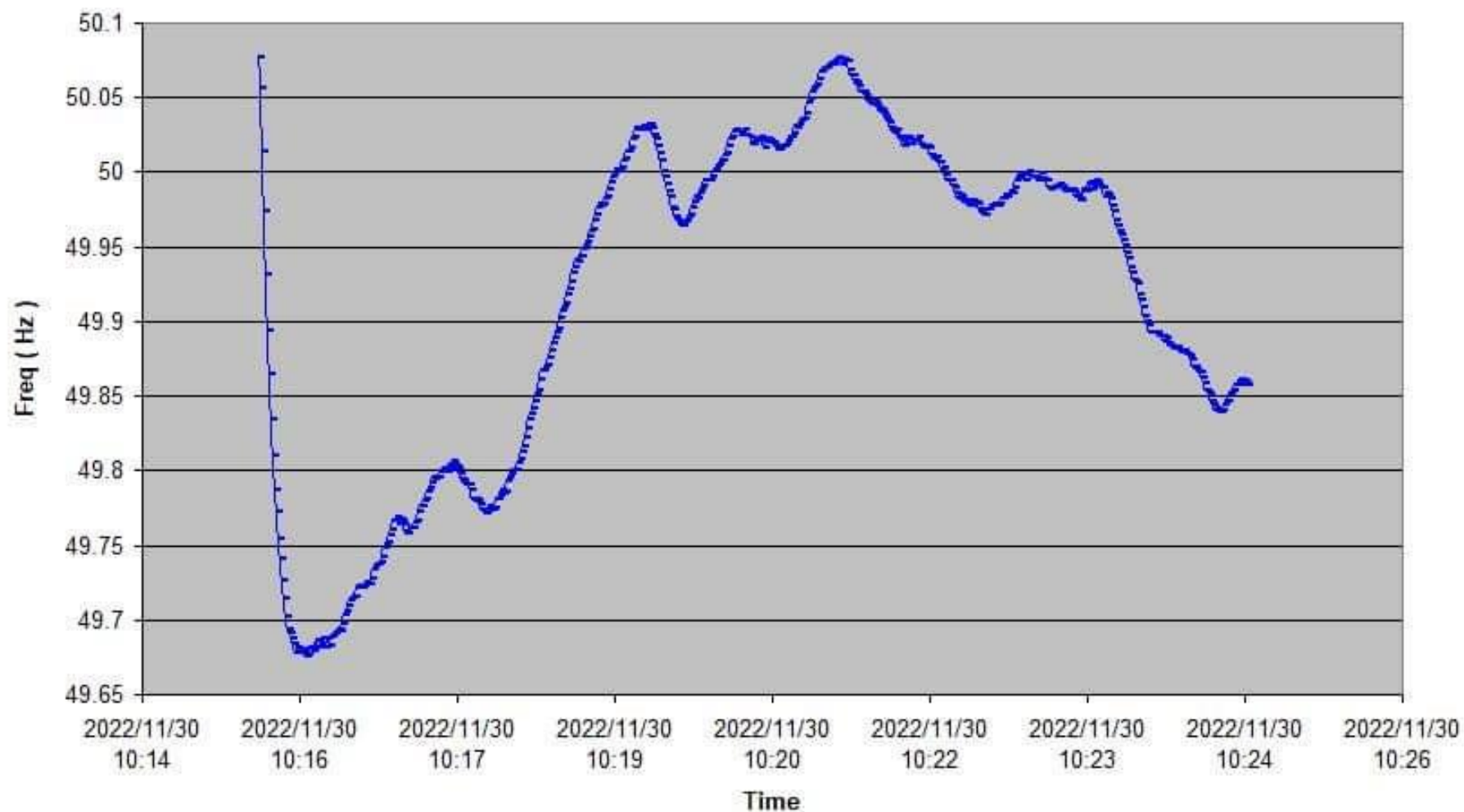


The levers to pull before blackout

- PowerAlerts: 250 MW reducing to 50 MW
- Load reduction: 200 MW (Eskom) + 200 MW (municipalities)
- Ripple control (for hot water geysers); and Smart meters (for load management)
- Power imports (from neighbouring countries): 250 to 350 MW
- Demand market participation: 1000 MW
- Loadshedding: Stage 1 to 8: 1000 MW to 8000 MW
- Interruptible contracts (South32 Mozal and Hillside): 900 MW + 1200 MW
- Automatic instantaneous demand response (IDR) from spinning reserves
- 49.65 Hz; 49.6 Hz; 49.55 Hz: Voluntary demand response: 3 x 450 MW 10 minutes
- 49.5 Hz: Auto start of OGCTs; auto stop PS pumping; auto start PS generating
- 49.2 Hz; 49.1 Hz; 49.0 Hz: 3 blocks each reducing by 3.3% of country demand (10%)
- Further 5 blocks of automatic underfrequency loadshedding to 50% country demand
- 47.5 Hz: first turbine trips, leading to cascading turbine trips and blackout

Swiss cheese risk management

Grid freq 30-11-2022



Consequences of an extended blackout

- No power, no lights, no refrigeration
- Mobile phone batteries and telecom towers batteries go flat
- Credit card machine batteries go flat, no purchases
- ATMs batteries go flat, no money
- Standby generators run out of diesel
- No telecommunications, radio or TV
- Petrol and diesel filling stations stop operating
- Transportation ceases
- Shops close, no food, no drinks
- Water in taps run dry
- Social unrest and looting on a massive scale across the country
- Theft and vandalism of infrastructure, cables, lines, copper and steel
- Anarchy





Recovery from a national blackout

Mitigating factors

- Multiple technical defences
- Islanding mode for new generation stations
- Regular testing of black start generators
- Digital simulator practice and training of System Operator staff
- Centre of excellence, strong leadership by National Control System Operator
- Well established and well practiced emergency and recovery protocols in place

Complicating factors

- Poverty, inequality, unemployment; social instability and poor service delivery
- Social unrest, violence, vandalism, theft and looting is not uncommon
- Labour unrest even at Eskom is not uncommon
- Political and economic “warfare” and “sabotage” is not unheard of
- Blackout occurring in conjunction with Eskom labour strike



National blackout recovery scenarios

Scenario 1: Optimistic: First up in 2 hours, last up in 1 week

- Islanding of key power stations and regions works perfectly
- No failures in restoration which proceeds smoothly
- Impact of civil unrest and looting not a factor

Scenario 2: Realistic: First up in 2 hours, last up in 2 weeks

- Some failures in islanding
- Some failures in restoration
- Hampered by some unrest and looting, but no electrical infrastructure damage

Scenario 3: Pessimistic: Extended blackout, last up in 4 weeks

- Blackout takes place at time of Eskom labour and/or civil unrest
- Significant islanding failures and major logistical reconnection issues
- Line, cable, switchgear, transformer and electrical infrastructure theft and vandalism



Opportunities in the agricultural sector

- Renewable energy, wind, solar PV and battery storage systems.
- Micro-grids with solar PV, wind power, BESS and diesel generation, and an Eskom grid supply.
- Containing or reducing grid electricity costs to ensure greater electricity cost certainty.
- Improving security of supply and business continuity.
- Passive income from land use contracts with renewable energy developers.
- Creation of carbon sinks via forests, plantations and vegetation.
- Carbon credits as a source of finance.
- Agri-voltaics on damaged or unused land beneath ground-based solar PV installations to improve water efficiency and agricultural yields.
- Other?



Advantages for RE in the agricultural sector

- Space and land is available for rooftop and land-based solar PV and BESS systems.
- Farmers are mainly supplied Eskom, and Eskom is more advanced than municipalities.
- No licensing is required from Nersa, and there are no insurmountable regulatory hurdles.
- Eskom is now more encouraging and open to RE and BESS by farmers.
- There are no insurmountable technical hurdles imposed by Eskom.
- Time-of-use metering with import and export metering capability is available.
- There is a need for feed-in tariffs to incentivise overbuilding and generation into the grid.
- Banks will fund self-generation, as there is a balance sheet to secure the finance.
- Farmers are practical, hands-on people able to cope with operation and maintenance.
- Tax incentives exist for solar PV and BESS less than 1 MW and greater than 1 MW.
- The rapidly rising price of grid electricity is making the RE + BESS business case better and better.

Eskom microgrid installation in Free State



Microgrid installation in Zimbabwe



Agri-voltaics installation





Conclusions

- Loadshedding should not be accepted or become the new normal for South Africa
- With commitment by all stakeholders big, medium and small, loadshedding can be ended within two years from green light to proceed.
- But the plan has to be more than only words – it must contain specific actions to be delivered upon.
- The national priority project to end load shedding should be an undivided mission of government, Eskom, municipal metros and all customer segments,
- The agricultural sector has a key role to place, and should announce measurable new self-generation targets.
- This will not be an easy task, but it is most definitely achievable if government, Eskom, municipalities stakeholders and customers, are committed and determined.
- Customers, including those in the agricultural sector, should take ownership of their energy future and become part of the solution.