Weather and climate change impacts on the power generation utility: Eskom Adaptation Case Studies

Kgaugelo Chiloane, Lwandle Mqadi and Maria Couto

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Overview

- Eskom Climate Change Strategy
- Eskom Climate Change Adaptation Strategy
- Eskom Vulnerability and Adaptation Research Projects
- Eskom Case Studies
- Case Studies Research Findings
- Conclusion

Eskom's Climate Change Strategy (*Under Review*)

Eskom Climate Change strategy seeks to address the challenge through a comprehensive **Eskom Climate Change Six Point Plan**

1. **Diversification** of generation mix – clean coal, nuclear, renewables, gas, imports.
2. **Energy efficiency** – reduce demand by 3038 MW in the 2012-2017 period and Internal Energy Efficiency measures (billion kWh programme)
3. ***Adaptation** to the impacts of weather, climate variability and long term climate change (including extreme weather events)*

4. **Innovation** through R&D, examples include solar thermal plant, smart grids, underground coal gasification
5. **Carbon Financing** and opportunities for trading in the global CO2 market. Eskom's Green Financing strategy will be completed this year
6. **Advocacy, partnership, and collaboration** with national and international stakeholders

Eskom Climate Change Adaptation Strategy

Objective: To improve current Eskom's **adaptive capacity and resilience** to adverse climate-related impacts, including the long term climate change

Strategic Initiatives:

1.Establish Eskom's Centre of Excellence on **Climate Change Research** i.e. climate science, climate modelling and downscaling, impact scenarios etc.

2.Define **Eskom's Adaptation Baseline through case studies** i.e. Vulnerability assessment, thresholds and costs research, Capability Assessments, Change Management Processes.

3.Compile and implement **Divisional (Generation, Transmission and Distribution) Plans of Action** on Adaptation to climate change.

4.Assess and outline quantified **Eskom's exposure to the impacts** and effects of climate change.

5.Continued international and national **partnerships** on climate change adaptation.

Eskom Vulnerability and Adaptation Research Projects

Projects/Tasks	Objective
Eskom's vulnerability , adaptive capacity and long term resilience assessments: Case Studies (Eskom Research)	Visit identified business units to undertake a survey to assess Eskom's vulnerability and adaptation to weather and climate extremes
Regional information on climate change and variability in relation to Eskom's thresholds (UCT)	• Provide projections of regional climate information for Eskom business units • Evaluate the implications of the regional climate change and variability in terms of thresholds and exceedance,
High-resolution Predictions and Projections of Weather and Climate Extremes over the Eastern Interior and the South-Western Cape of South Africa (CSIR)	• To develop an ***operational forecast system*** that can provide guidance, on a variety of time scales from days to seasons, to support Eskom operations • To perform ***high-resolution projections of future climate change*** • Parameters: winds, rainfall, thunderstorms and lightning

Eskom Vulnerability and Adaptation Research Projects *cont…*

Projects/Tasks	Objective
Impacts of climate change on water in the Waterberg (UCT)	To asses the historical and future regional climate change of the Waterberg area; and projecting the future climate change envelope through empirical downscaling
Modelling of summer convection over southern Africa (CSIR) ***Completed***	• To project the changes in the attributes of summer-time **convective storms** over Southern Africa that may occur in response to enhanced anthropogenic forcing
Hydrological Modelling of the Waterberg Catchment areas (UKZN) ***Completed***	• To assess impacts of current and envisaged future land use developments and water engineered systems under present climatic conditions as well as projected future climate scenarios
Adaptation Cost Curve Review of Methodology to cost Adaptation (Eskom Research)	• To conduct literature survey investigating *how adaptation cost curves are developed* in other countries • To derive the *methodology for costing adaptation* for Eskom

Eskom Vulnerability and Adaptation Research Projects *cont…*

Projects/Tasks	Objective
Modelling precipitation over the Lesotho Highlands (North West University)	• To model the impacts of climate change on future water availability in Lesotho Highlands
Historical impacts of extreme climate/weather events on Eskom (Dr Zhou)	• To geographically display weather data and corresponding system faults in or der to identify hot spots (country wide for Gx, Tx and Dx)
Assessment of climate risks, impacts and corresponding adaptation/mitigation measures and projects to ensure sustainable hydroelectric power generation in Zambia (Dr Yamba)	• To engage utilities (ZESCO and Lunsemfwa hydro power) and assess climate risks and impacts, identification of opportunities for adaptation, formulate strategies for business sustainability in view of climate risks and impacts, and together formulate bankable proposals and policies for implementation.

Adaptation Research Case Studies

Objective: To gather information through *assessing historical and current vulnerability*, identify *key climate parameters, impacts*, costs, *thresholds, existing adaptive capacity*, *processes in place for reporting and responding* (e.g. incident management, insurance, risk and resilience).

Structure of case studies :

- **Phase I (2010-11):** ***Vulnerability Assessment*.** Sites covered - Hendrina, Kendal, North East Transmission Grid and Eastern Region Distribution
- **Continuation of Phase 1 (2013-14):** Hendrina, Kriel, Kendal, Matla, Matimba, Koeberg, Palmiet, Gourikwa, Ingula, Eastern Region Distribution , Southern Grid Transmission Region
- **Phase II (2010 - 15)**: ***Modelling*** - Identification of Eskom climate change hot spots, through modelling of future climatic trends studies.(CSIR, UCT, UKZN and NWU)
- **Phase III:** Integration and Implementation within Eskom.

Phase 1: Summary Findings Case Studies

- Sites covered: Hendrina, Kendal (Generation) , North East Transmission Grid and Eastern Region Distribution

- **Key weather parameters identified:** Temperature , rainfall , snow, ice, frost, storms, wind speed and direction, tornados, lightning, floods, sea swells, solar radiation, relative humidity, fires, vegetation growth, air pollution, etc.

Results Poster:
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➢ **These parameter's informed phase 2 (modelling) scope of work**

Phase 1: Summary Findings Case Studies cont..

- Extreme weather/climate events have always occurred and caused widespread disruption.
- Study identified some of the types of weather related events that affect utility Gx, Tx and Dx assets and the results indicate that some **increases in frequency of occurrence, MWh losses** and **intensity of faults** have occurred recently.
- Increasing amplitudes for **floods, strong winds, heavy rain, lightning and fire**
- Weather events have started to show up in later years (post 1990) with some increasing intensity of **snow, heavy rain and rough seas**

Generation

- Most significant events of those of resulting in poor condenser vacuum conditions and wet coal
- **Energy losses of over 60000MWh were experienced in 2010 due to poor vacuum**

Phase 1: Summary Findings Case Studies cont..

Transmission

•**Bird streamers and lightning** have caused the largest incidents in the last decade.

•Typically Insulators, transformers, circuit breakers are affected with **significant replacement costs**

•Incidents of all faults seem to be reducing in recent years corresponding to a reduction in annual insurance claims. This could be due to improved management of the assets.

•However incidences of max impacts ito MWH losses appear to have an increasing trend.

Distribution

•Based on distribution of impacts for central region, the largest occurrences were recorded in 2007 and 2008

•Impacts that seem to be increasing over the years are those that occur due to **rain, storm and overcast conditions**

•Impacts due to lightning appear to be decreasing in a similar way as Transmission faults

Phase 2: Future Trends Modelling Research Findings

- **Temperature (Diagram 1)**

- **Strong warming is projected for the southern African region**, with an increase in maximum temperatures of more than 4ºC plausible for large parts of the western and central subcontinent.

- Southern Africa is simultaneously projected to become generally drier during the summer half-year presumably in response to a strengthening of the subtropical high pressure belt over the region.

- **Rainfall (Diagram 2)**

- The central interior of South Africa is projected to become slightly wetter, with an increase in extreme convective rainfall events over most of South Africa.

- Over South Africa, **a slight increase in rainfall for the central interior is projected .**

Phase 2: Future trends modelling: Research Findings cont..

- **Summer Extreme Rainfall Events (Diagram3)** :

- **Extreme rainfall events are projected to increase** over most of South Arica .

- Potential for an **increase in the frequency of occurrence of flash floods, damaging winds (storms) and lightning (fires**).

- The largest increase in the frequency of such events is projected for **Lesotho**, the Highveld of Mpumalanga, Gauteng, the Free State and KwaZulu-Natal.

End Deliverables

1. Define Eskom Divisional ***Adaptation Baseline***
2. Divisional Adaptation ***Action Plans*** *to be d*eveloped
3. ***Adaptation Cost Curve*** for Eskom to be developed
4. **Impacts Scenario** studies (based on modelling findings) to be undertaken

Conclusion

- Current Eskom infrastructural design and specifications is informed by historical weather information
- Need to demonstrate how Eskom uses these research findings to inform infrastructural/asset design and planning. Thus translating these findings into information to inform infrastructural investment decisions
- Impact Scenario Studies to be undertaken based on the projected future trends
- *Eskom infrastructure is vulnerable to the negative impacts of weather , climate variability and the long term climate change, therefore it needs to invest in adaptation*
- *Weather , climate variability and extreme events compromises Eskom's strategic objective to "keep the lights on"*
- *Weather and climate related impacts costs Eskom business millions of rands*

Thank You

Contact details:

kgaugelo.chiloane@eskom.co.za
lwandle.mqadi@eskom.co.za
maria.couto@eskom.co.za

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