

# Grid Code compliance tests of Renewable Technologies integrated on the NamPower Network

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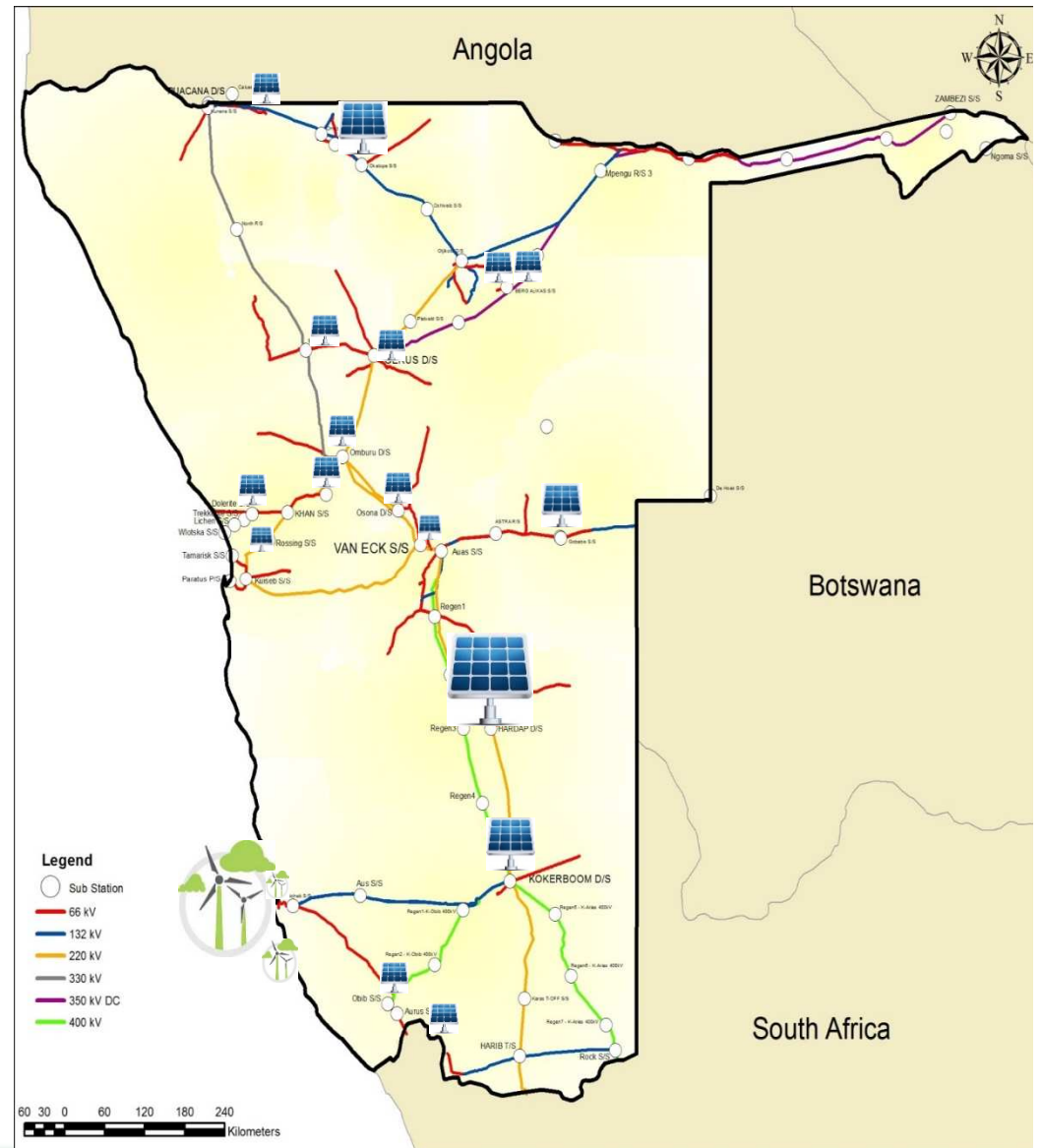
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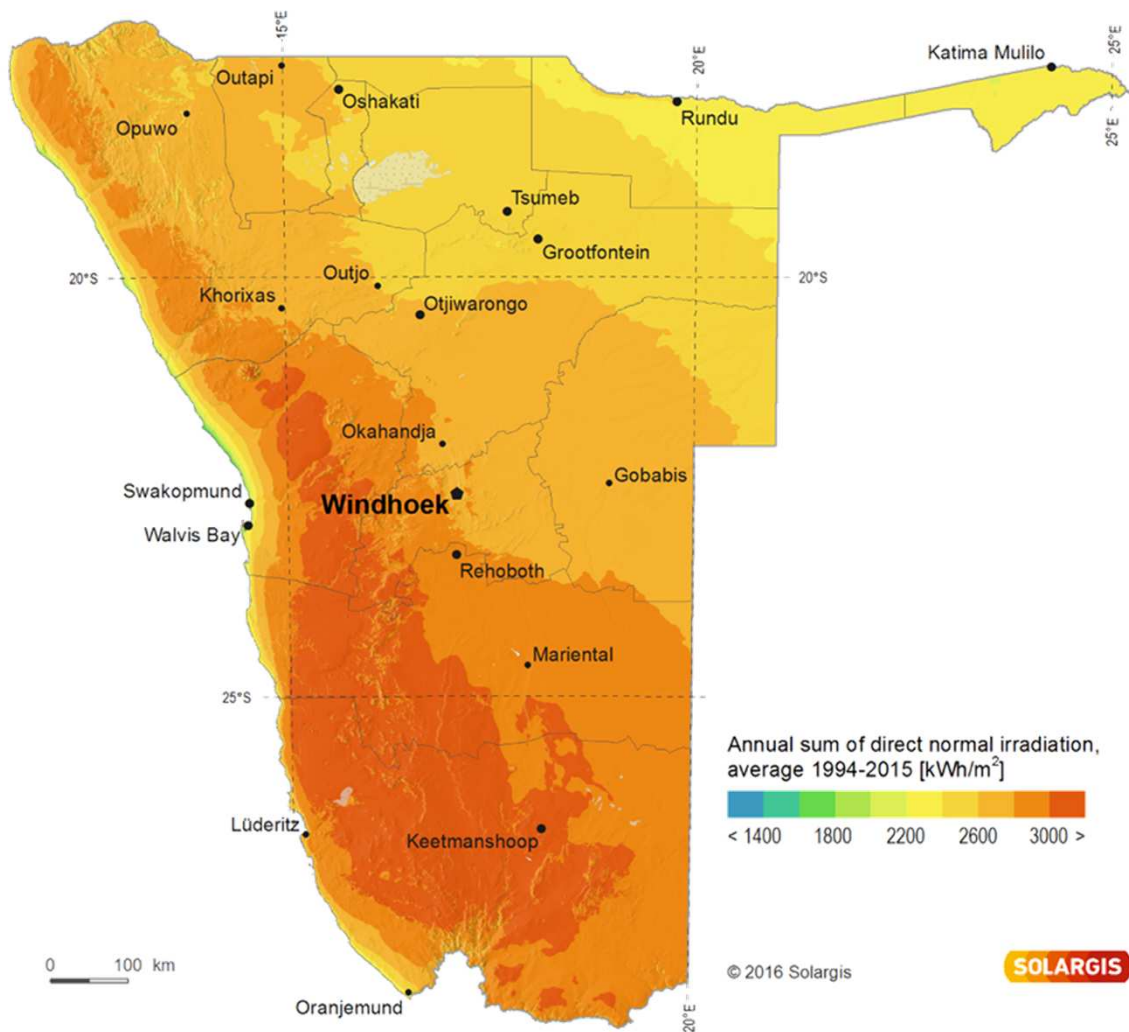
# Network Background

## Namibian Transmission network characteristics:

- Long and radial topology (1800km)
- Extremely low fault levels with prominent parallel resonant points
- Inherent voltage instabilities
- No spinning reserve available locally
- Peak Demand:  $\pm 700\text{MW}$
- Voltage levels from 66kV to 400kV, -350kV VSC HVDC
- Near-50Hz resonance phenomena
- Recent distributed RE integration

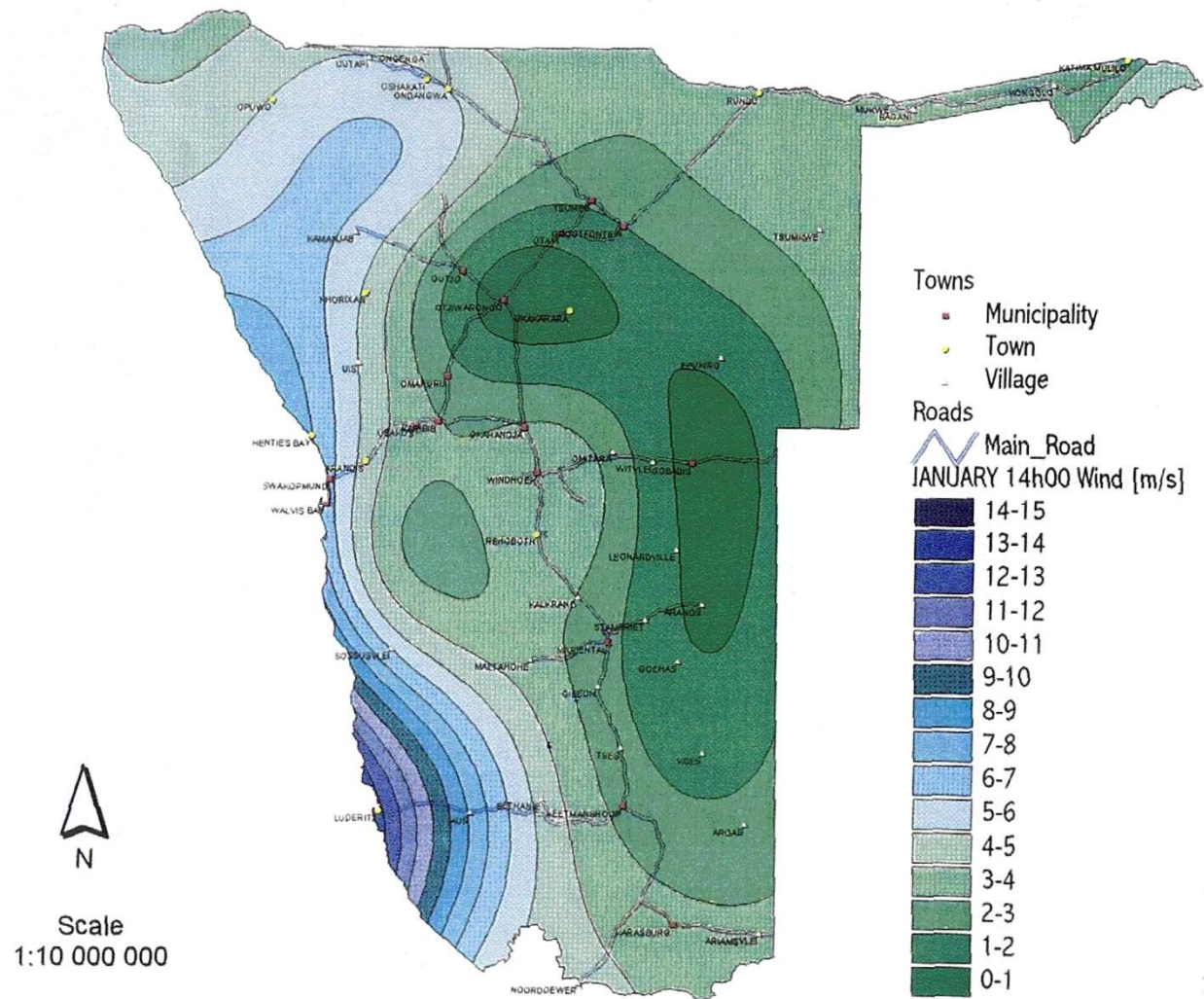


# Solar Resource



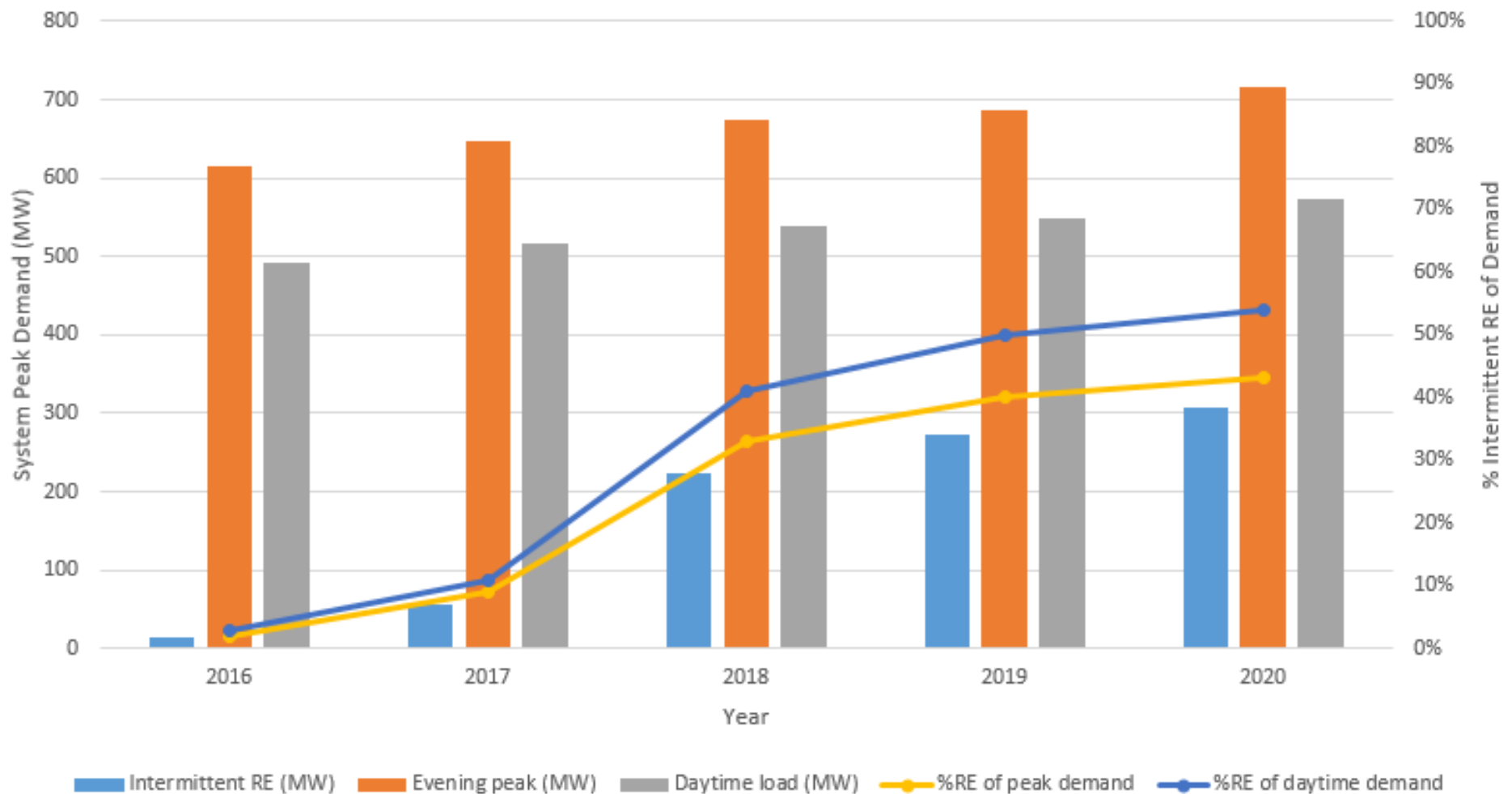


# Wind Resource

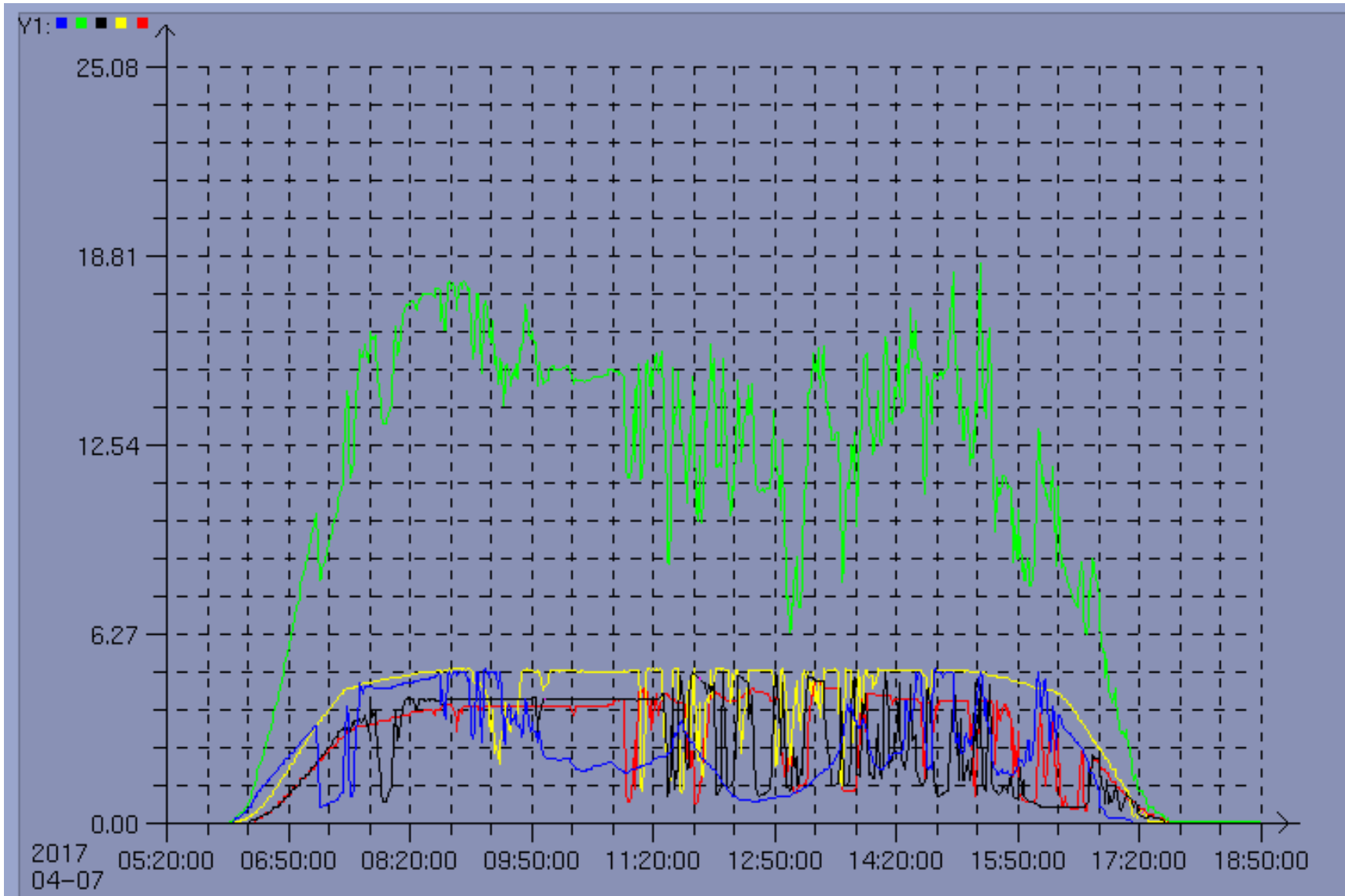


# Growth in RE installed capacity

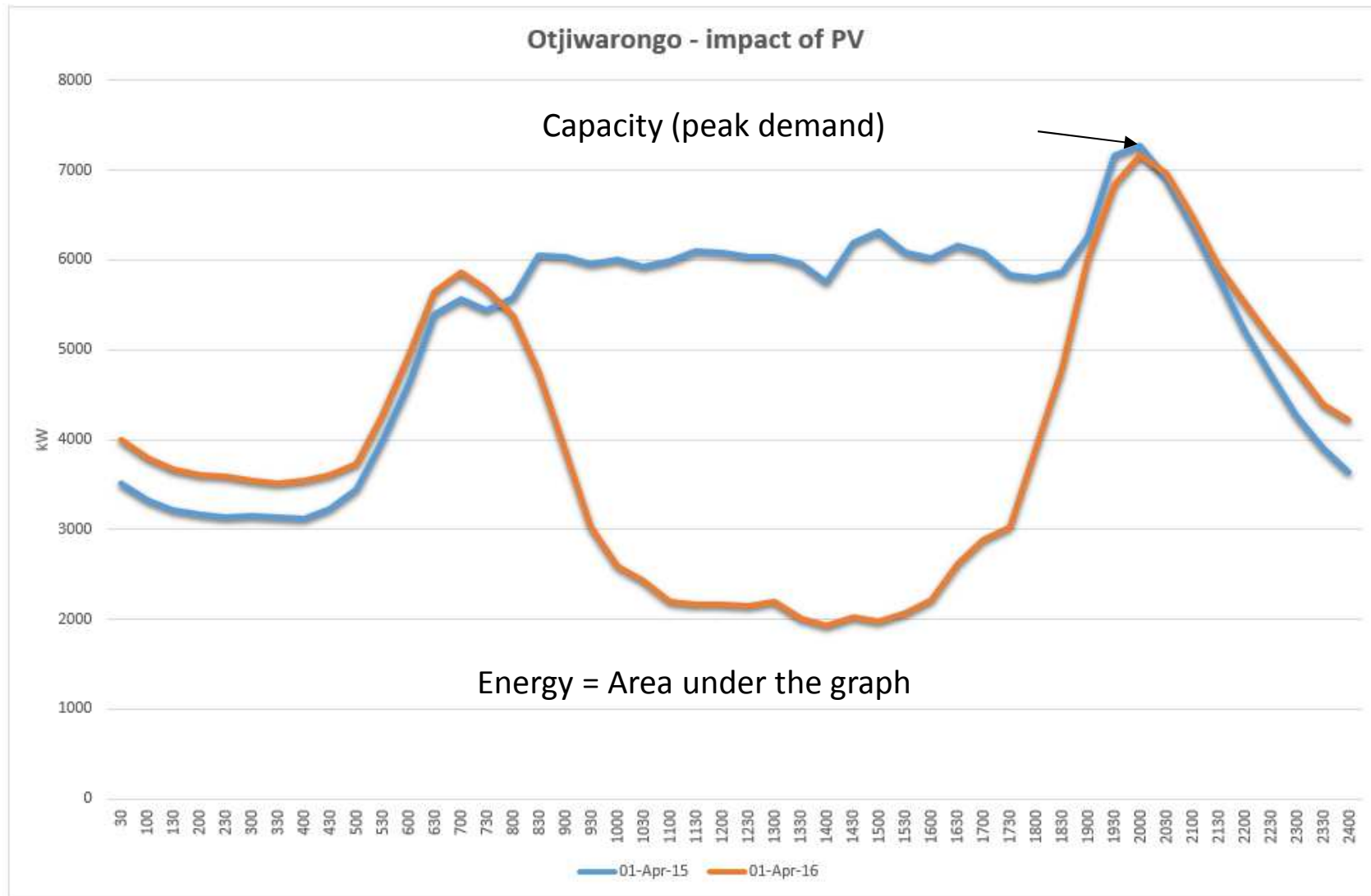
## % Intermittent RE of System Demand



# Intermittency of solar Plants



# Typical town load with embedded PV





# Managing intermittency

- Utilize control area ancillary service in the absence of local quick spinning reserve (limited, results in intermittency in tie-line flows to Eskom, backbone voltage fluctuations)
- Design RE plants with overcapacity DC-side
- Allow existing plants to add battery storage to manage own intermittency locally
- Small-sized geographic diversification of future intermittent RE plants
- Implement sufficient quick spinning reserve capacity
- Accurate forecasting for RE plants

# Grid Code requirements and Compliancy Testing

- Certified dynamic model required including certified harmonic currents
- Anti-island testing performed under equal load/generation conditions (real and reactive power matched)
- Both voltage control and power factor control are required for all plants larger than 500kVA with set-points controllable from the National Control Centre.
- Power vs frequency response, LVRT, HVRT, QV curve, Iq injection, etc required
- Harmonic performance measured over period of time