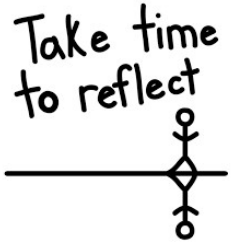
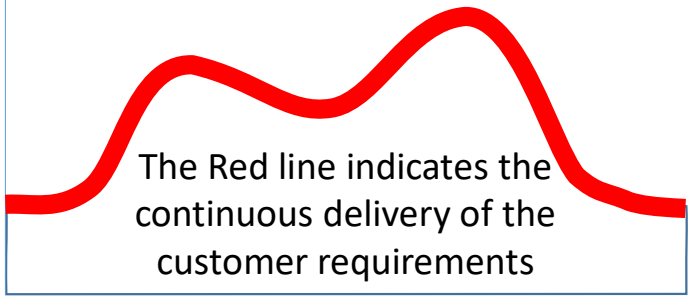
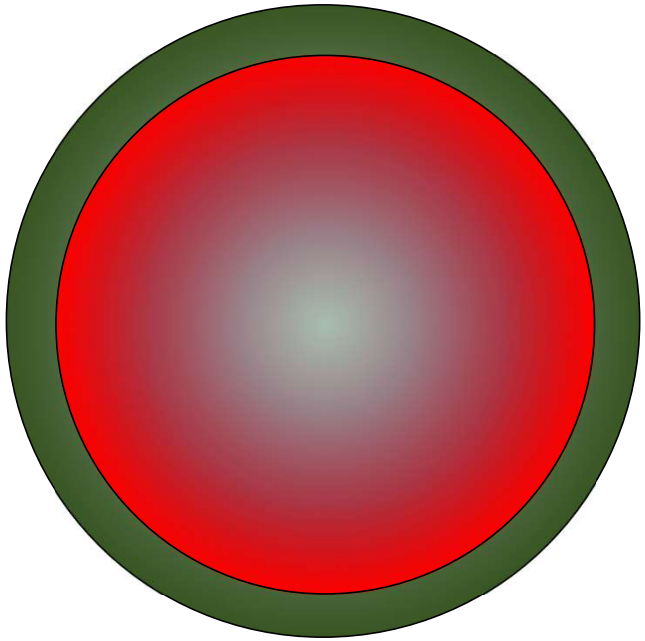
The importance of the grid
a
PCC Energy Dialogue

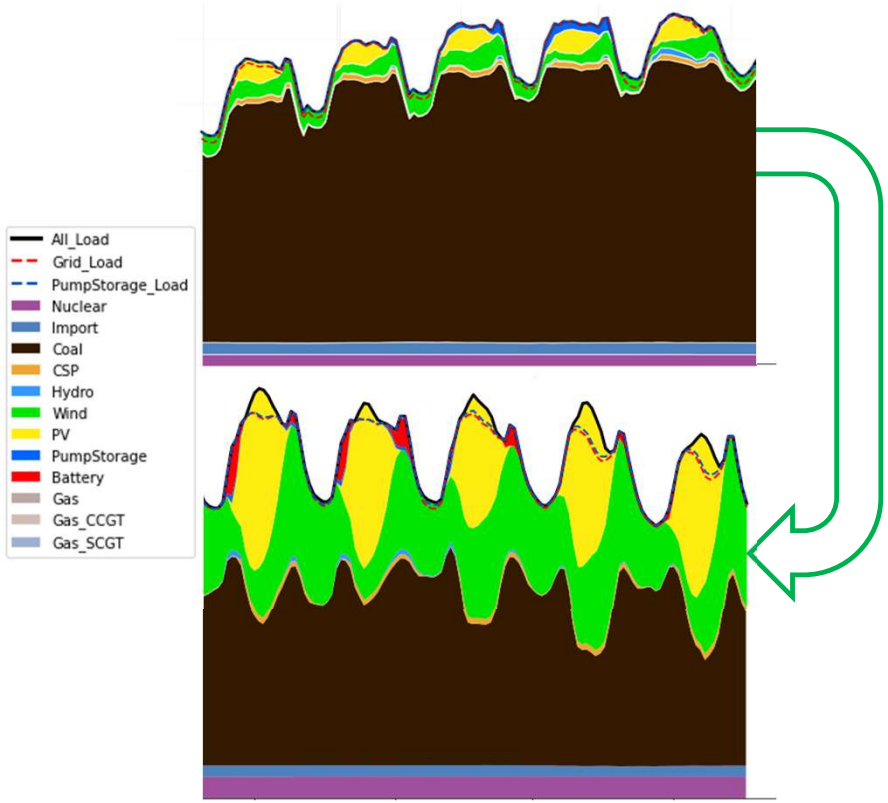


Tx Goal for Energy Balance



The Red line indicates the continuous delivery of the customer requirements





Tx Goal for Energy Balance

Principles of design

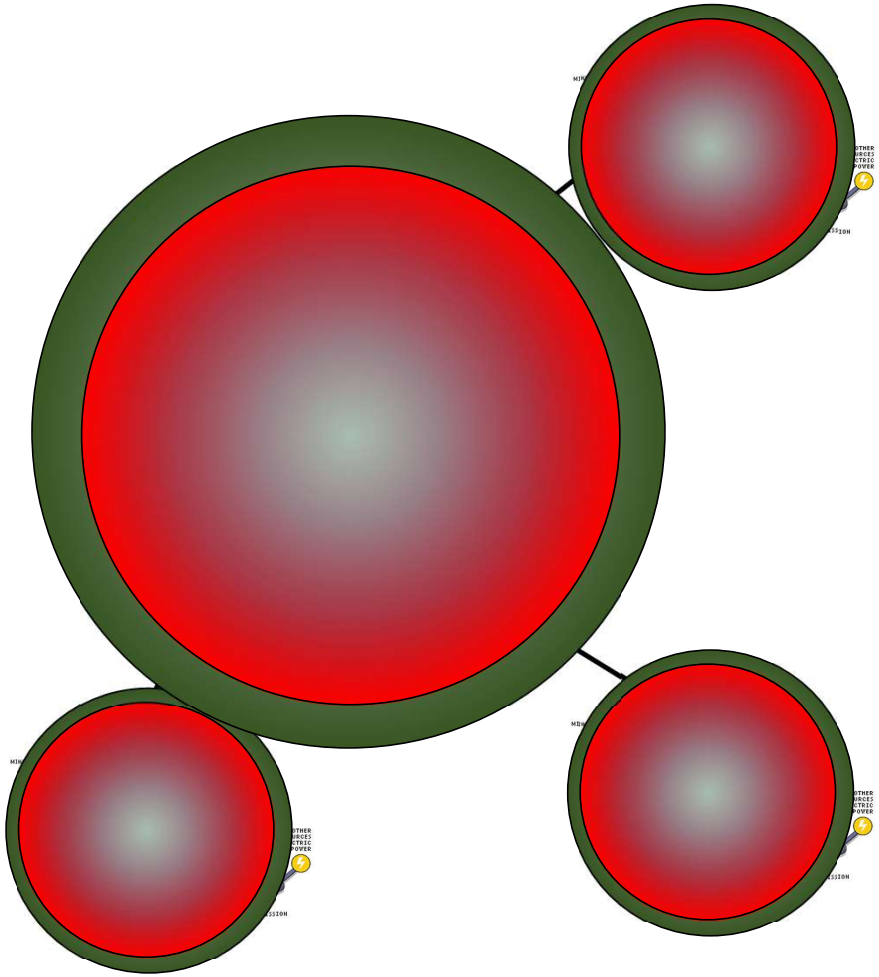
- Minimize distance between load & generation.
- Minimize network cost & losses
- Maximize load factor

If all things are equal

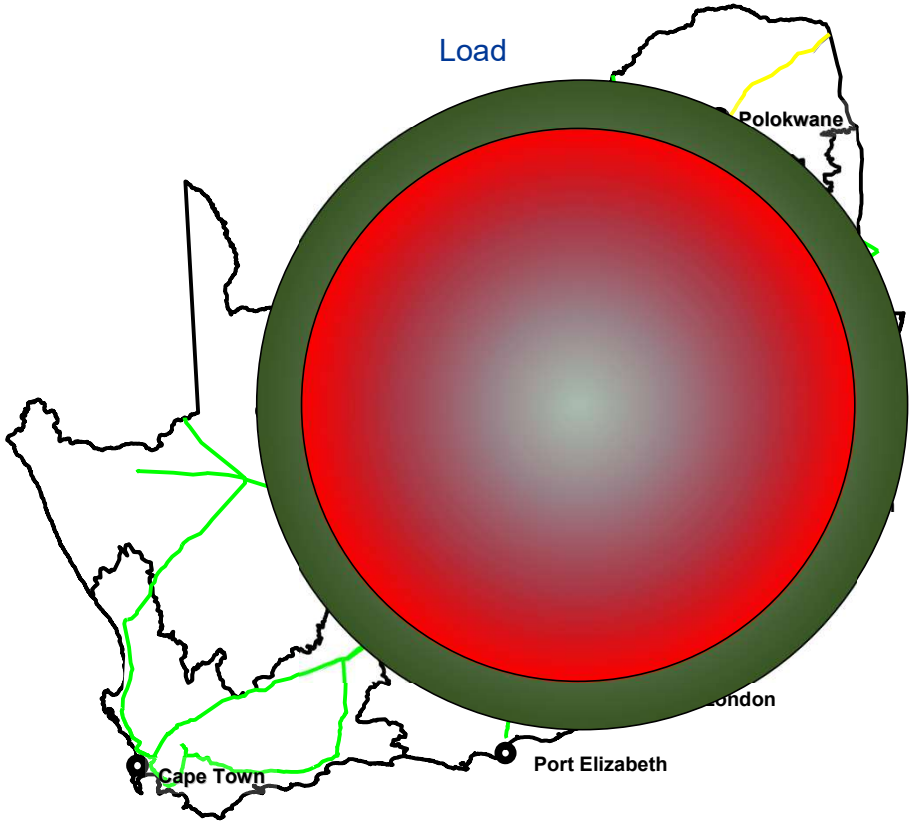
- Each load center self-sufficient (Gx / load balance)
- Tx mainly used for reserve capacity & robustness

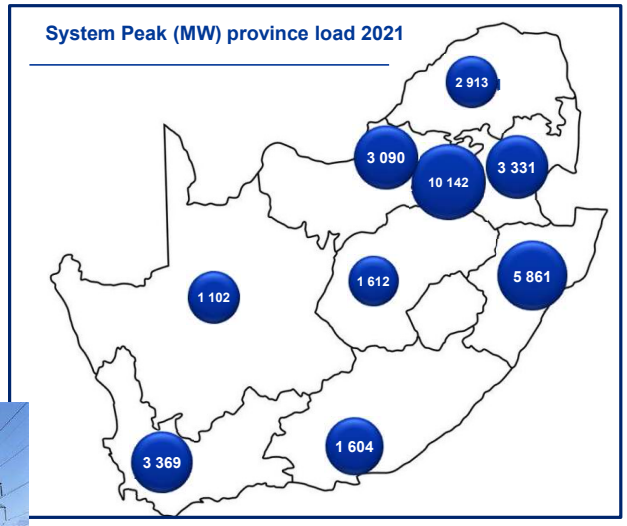
All things are not equal

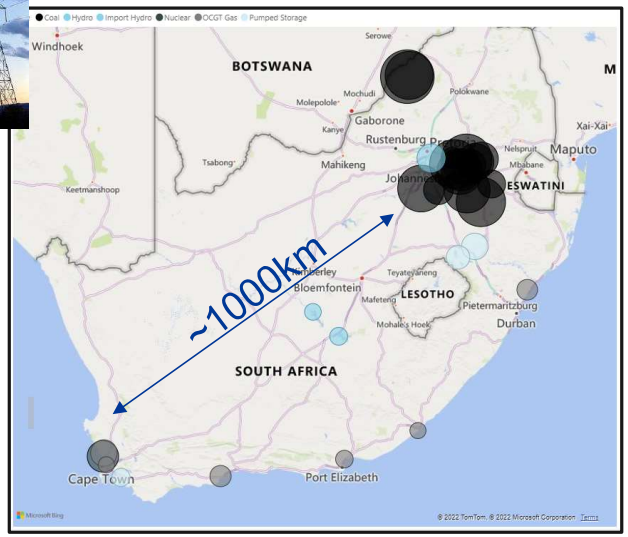
- Limited potential or high cost local Gx
- Long distances between load centers

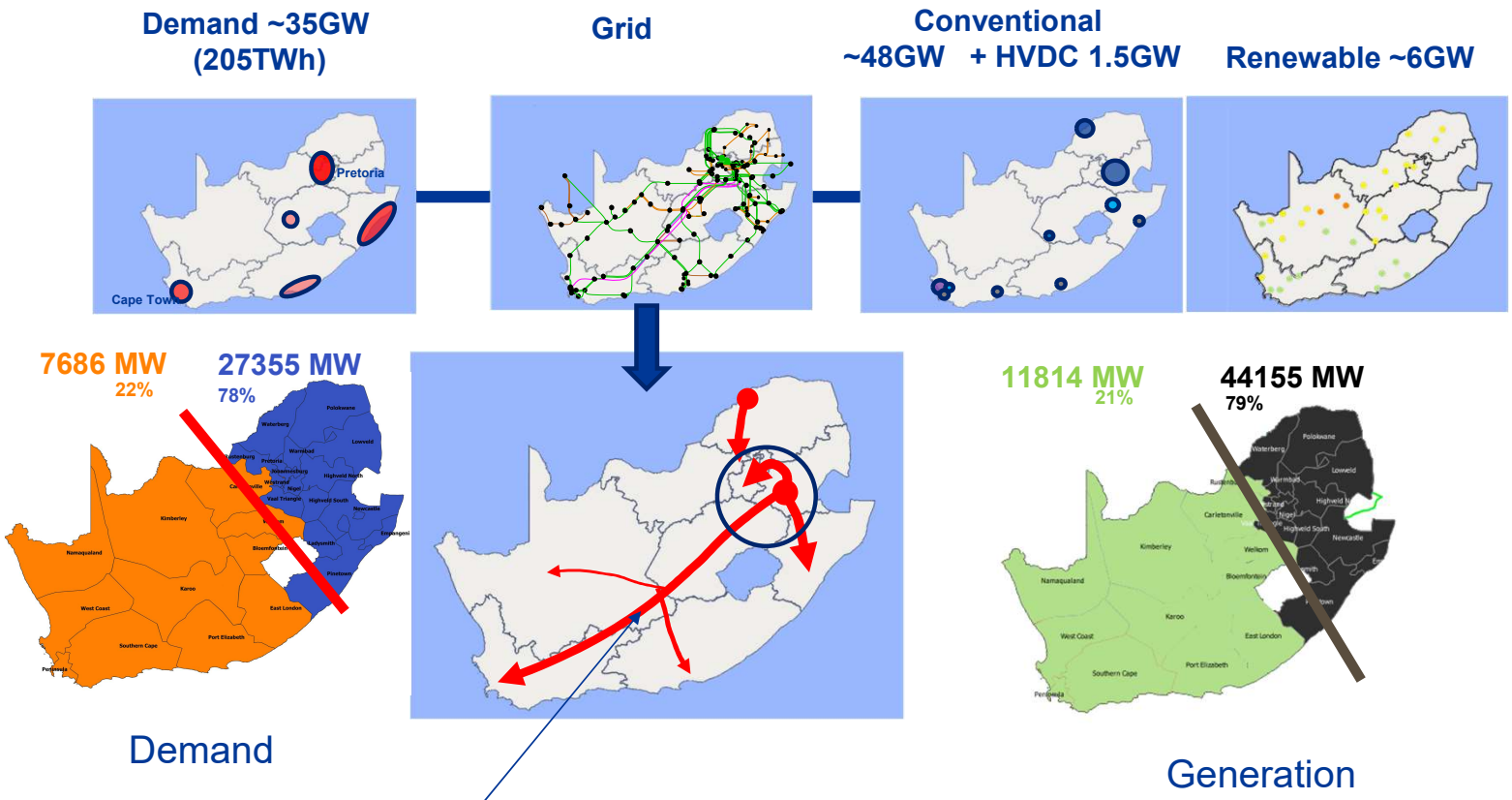


Capacity – Generation & Load distribution









Cape corridor capacity ~5GW - Historically supplied the ORANGE load less local generation (Koeberg)

1 Identify generation in IRP

2 Identify resources base

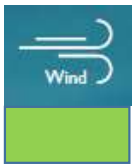
3 Environmental constraints

4 Positive development areas

69% Wind and Solar

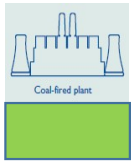
PV

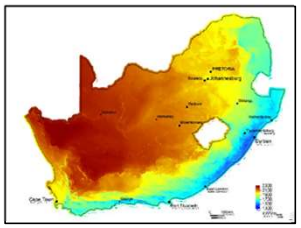
Wind

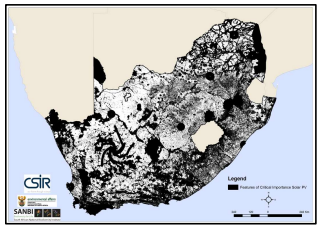


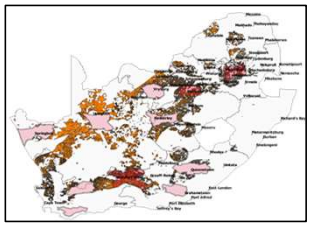
Gas

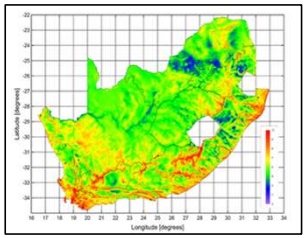
Coal

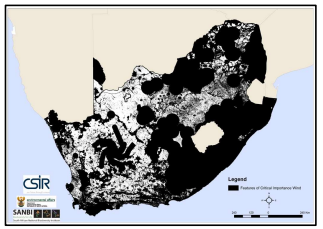


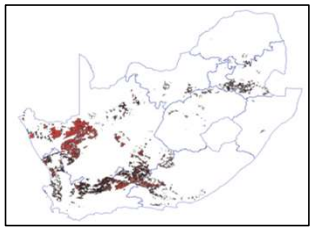


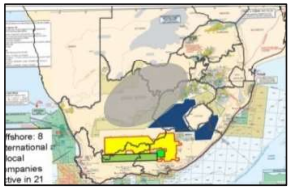


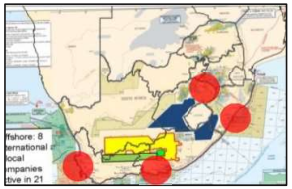


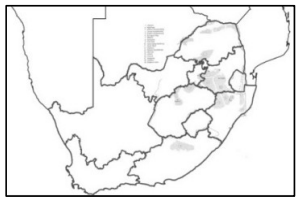


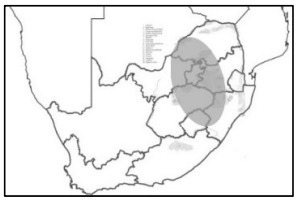


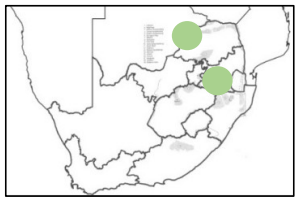






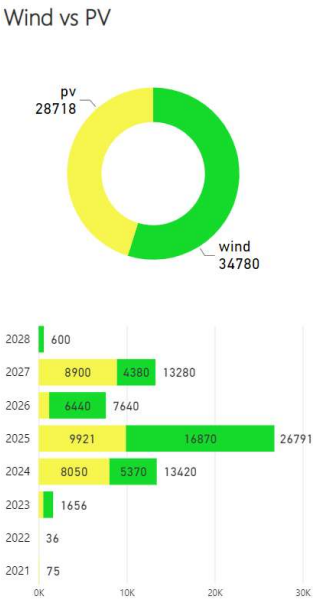


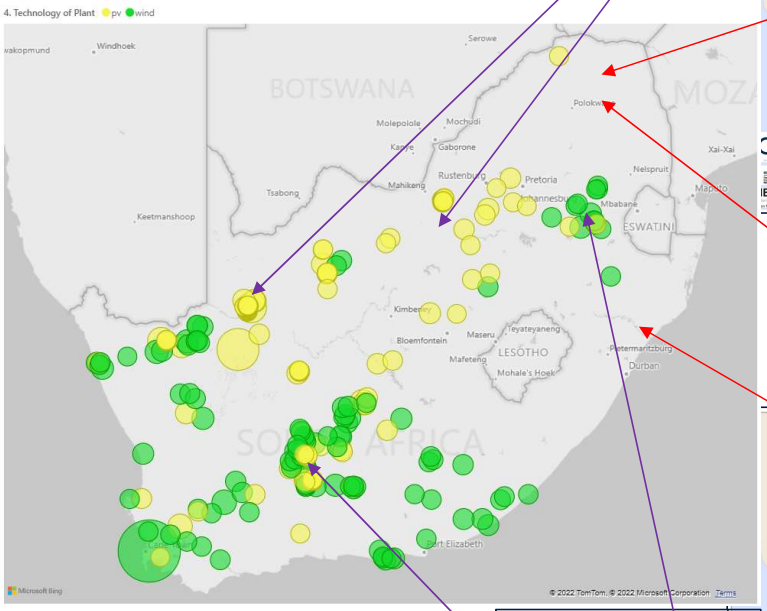


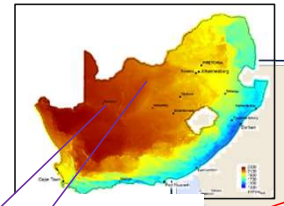


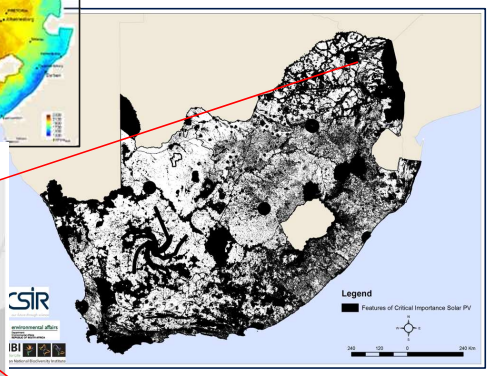
2022 Qtr. 1 - 242 contributions

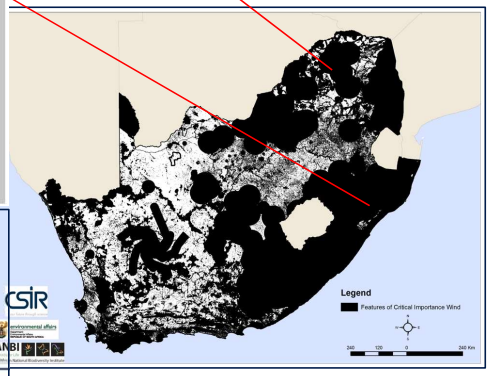
~64GW Wind and Solar

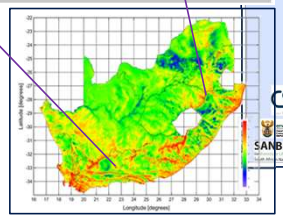




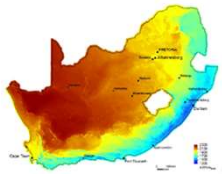








https://www.sapvia.co.za/gcca-2024-renewable-energy-grid-survey-report-back-session-recording-and-presentation-14-april-2022/

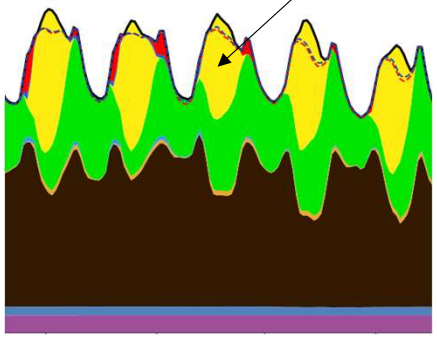


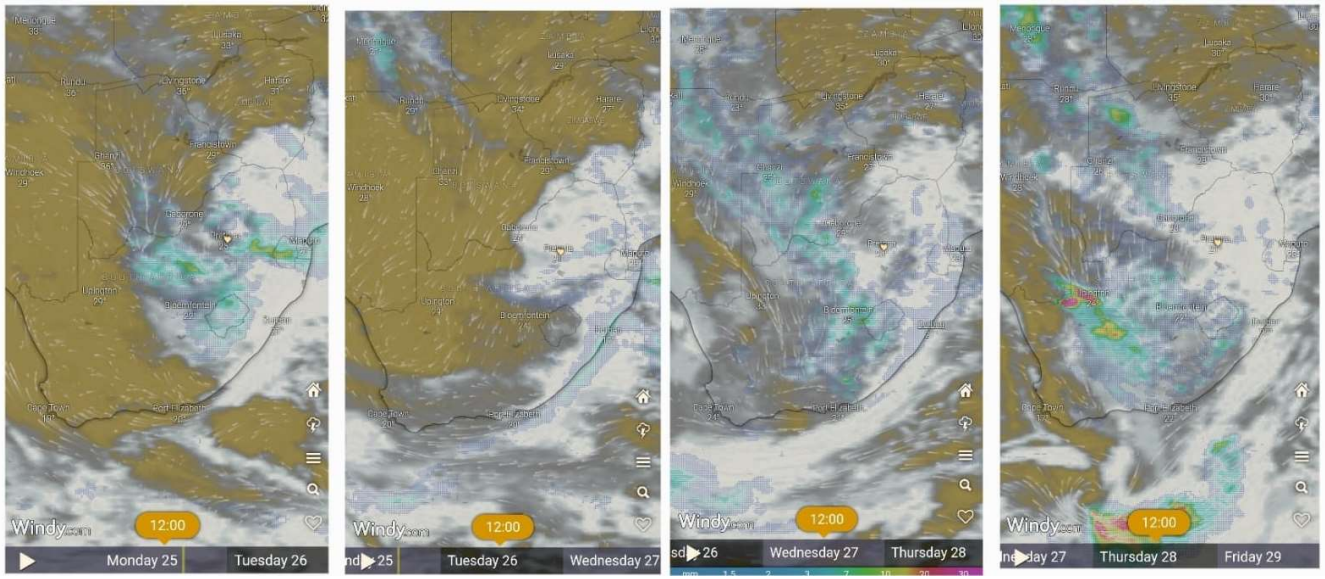
Solar - transmission and weather risks

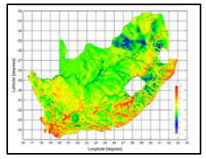
Seamless solar energy in the energy models are dependant on location and weather conditions.

Harvesting solar at multiple locations is critical and requires transmission

Frequent cloud cover days, particularly in the north west, creates increase dependency on transmission from the south





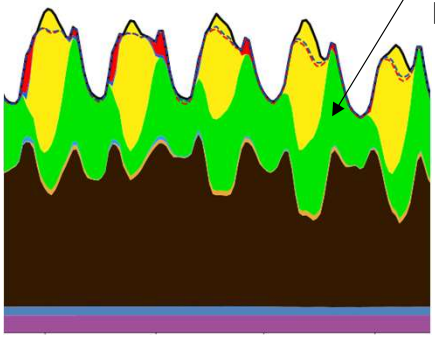


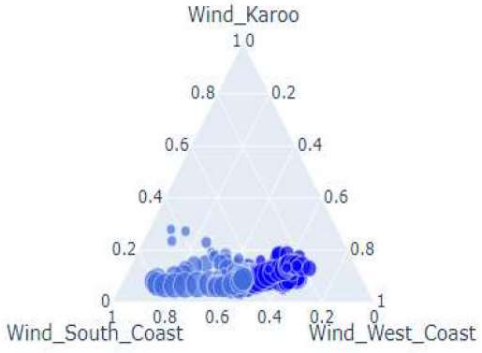
Wind - transmission and weather risks

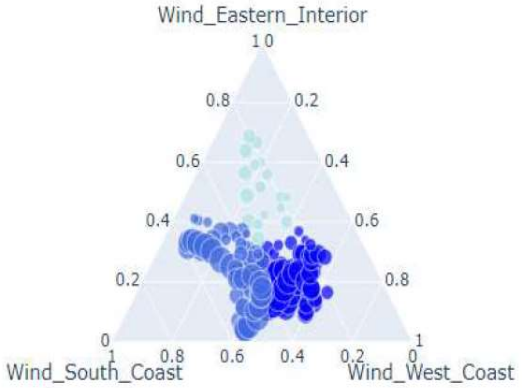
Seamless wind energy in energy models are dependant on location and weather conditions.

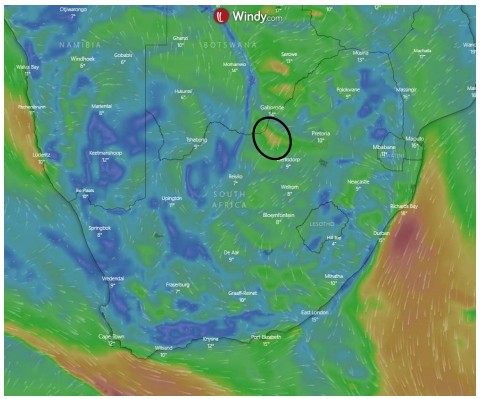
Wind has significant variation of location

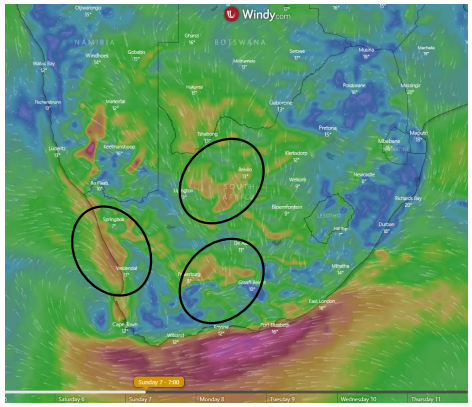
Harvesting wind at multiple locations is critical and requires transmission

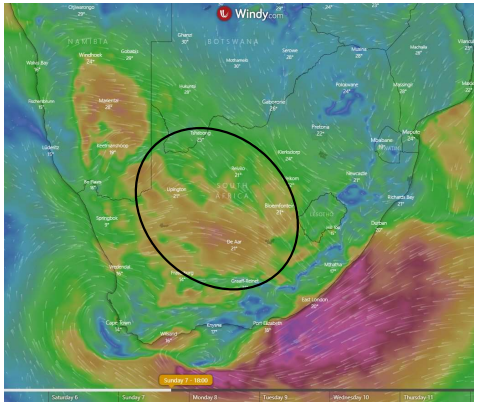


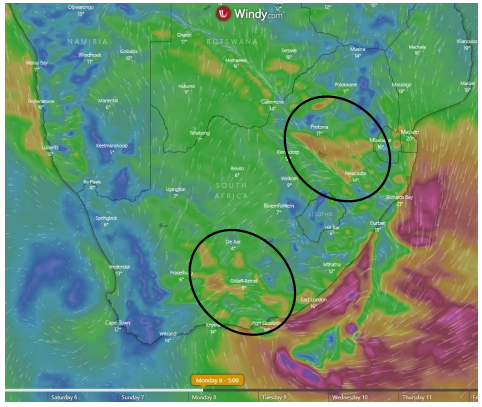






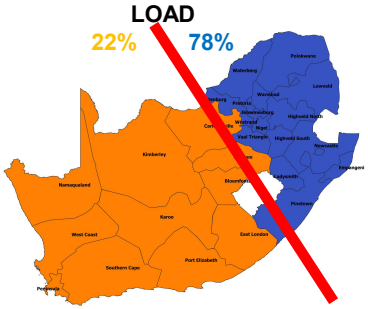




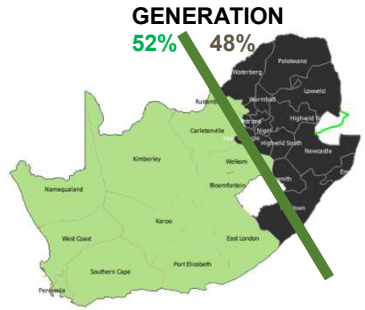


What does this mean for the Transmission network

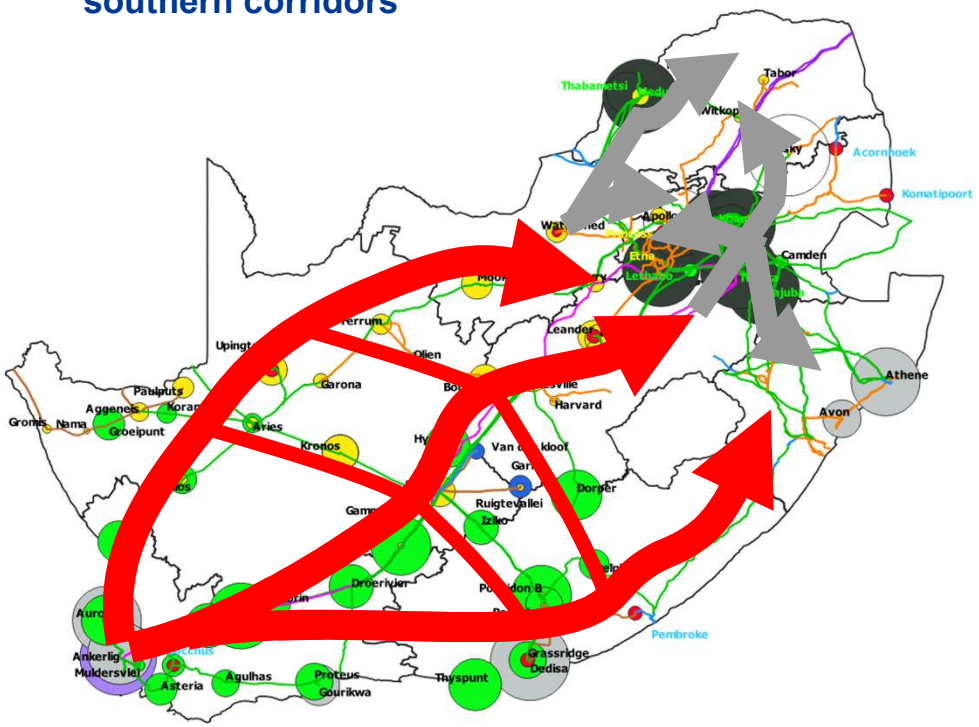
Significant transmission development is required in the northern, central and southern corridors



Lower load in the South remains



Generation increase in the South

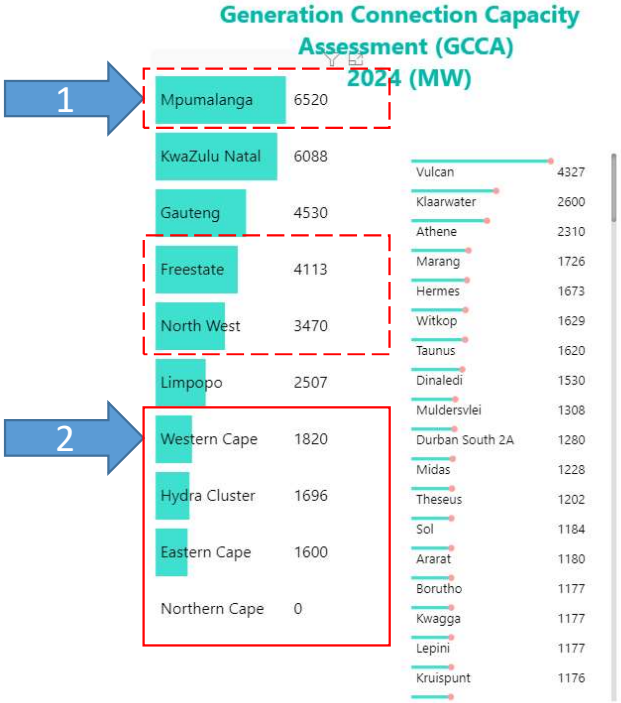


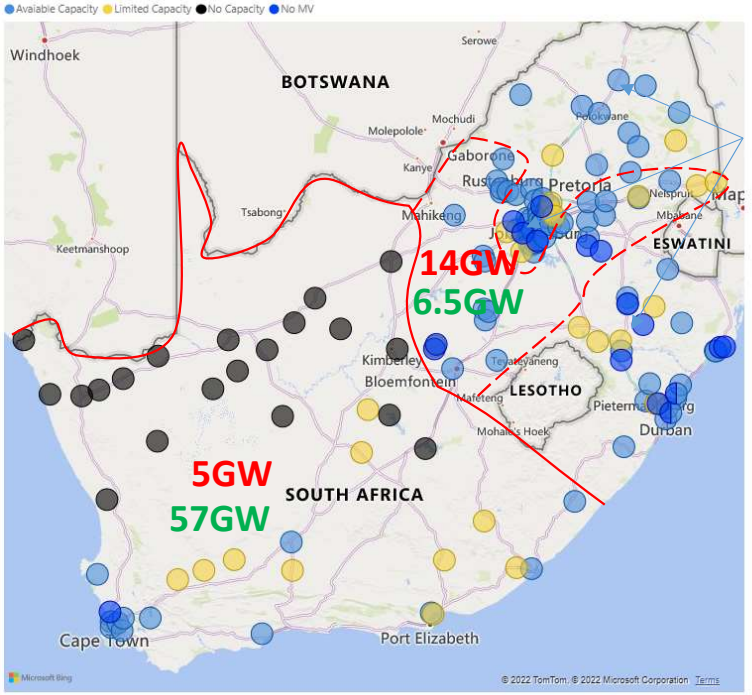
Existing grid capacity

1. Eskom grid unlocking - **Mpumalanga initiative** to encourage use of existing grid capacity
2. Enable additional capacity for renewables in the Western Cape by constraining of OCGT generation.
3. Access to grid capacity through local grid expansions.
4. Initiated major corridor strengthening.

32 GW of Existing Tx Grid Supply Area Capacity

Max ~19 GW likely for Utility Scale Renewable Grid Capacity

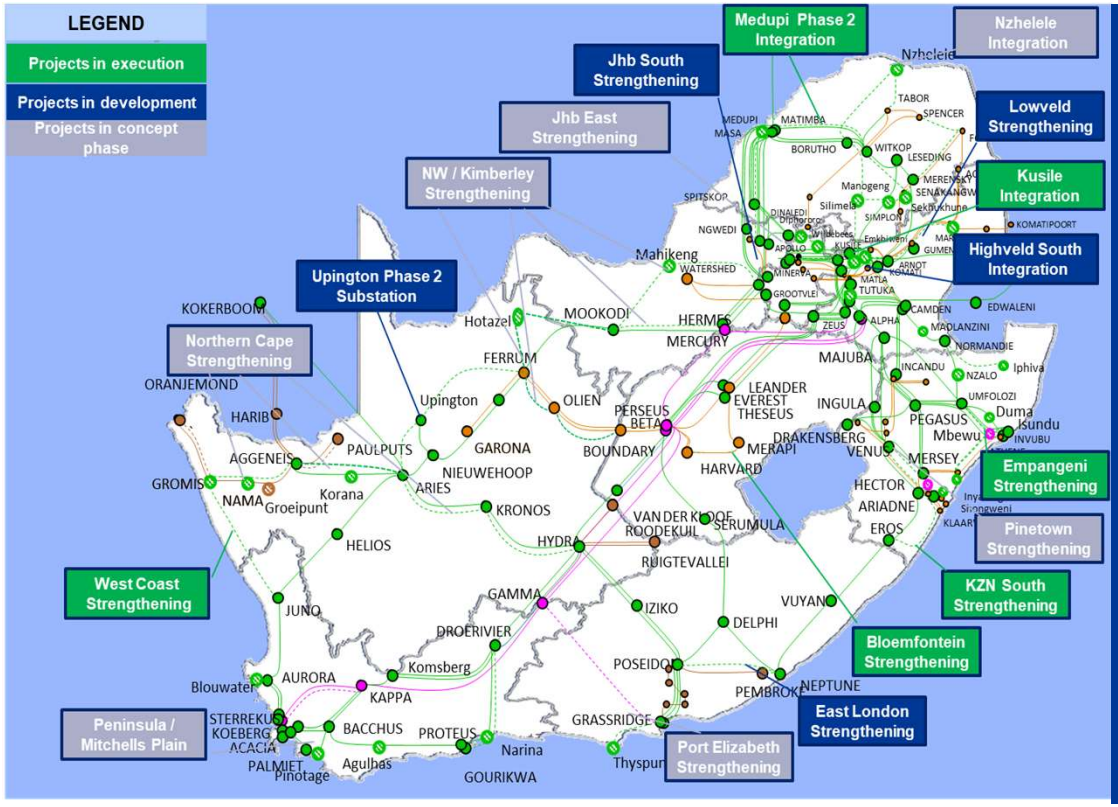




GCCA **RE Survey**

Unlocking future capacity

Major projects planned in the Transmission Development Plan period



Key Issues to be addressed

1. EIA
Outside of Strategic corridor - longer duration, Obtaining Water Use licenses, tree removal permit, etc.

2. Acquisition:
Difficult landowners and obtaining rights to build. Eskom does not have expropriation rights.

3. Community interference:
Several projects hijacked by aggressive community protest and actions.

4. Encroachments of servitudes:
Several projects where our servitudes are encroached by informal settlements of even more formal developments.

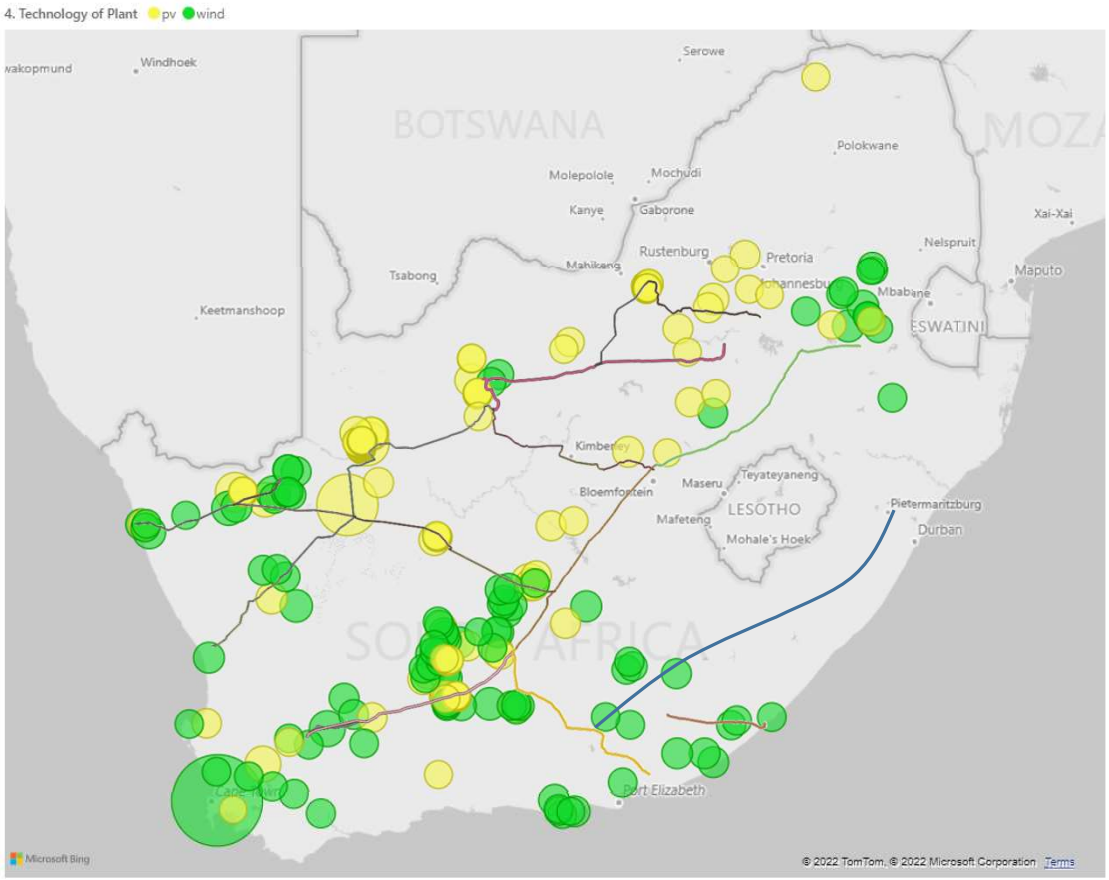
Insights

- Significant collaboration with government departments and provincial support to facilitate EIA, and all land and rights issues.
- However this remains a major risk and uncertainty

Initiatives Underway – Servitudes for new grid capacity

Collaboration with government departments and provincial support to facilitate EIA, land and rights issue

However this remains a major risk with much uncertainty



Eskom network size

- Overlay of Eskom network on Europe stretches from Gibraltar to Brussels

Transmission of large volumes of power over longer distances increases grid challenges

Grid Stability is more complex and requires a strong grid to ensure renewable inverter stability which is becoming more challenging

Short lines and more local generation / load balancing creates a stronger grid

Hence comparison of grids of other countries is not always appropriate

Each Grid has unique and different challenges

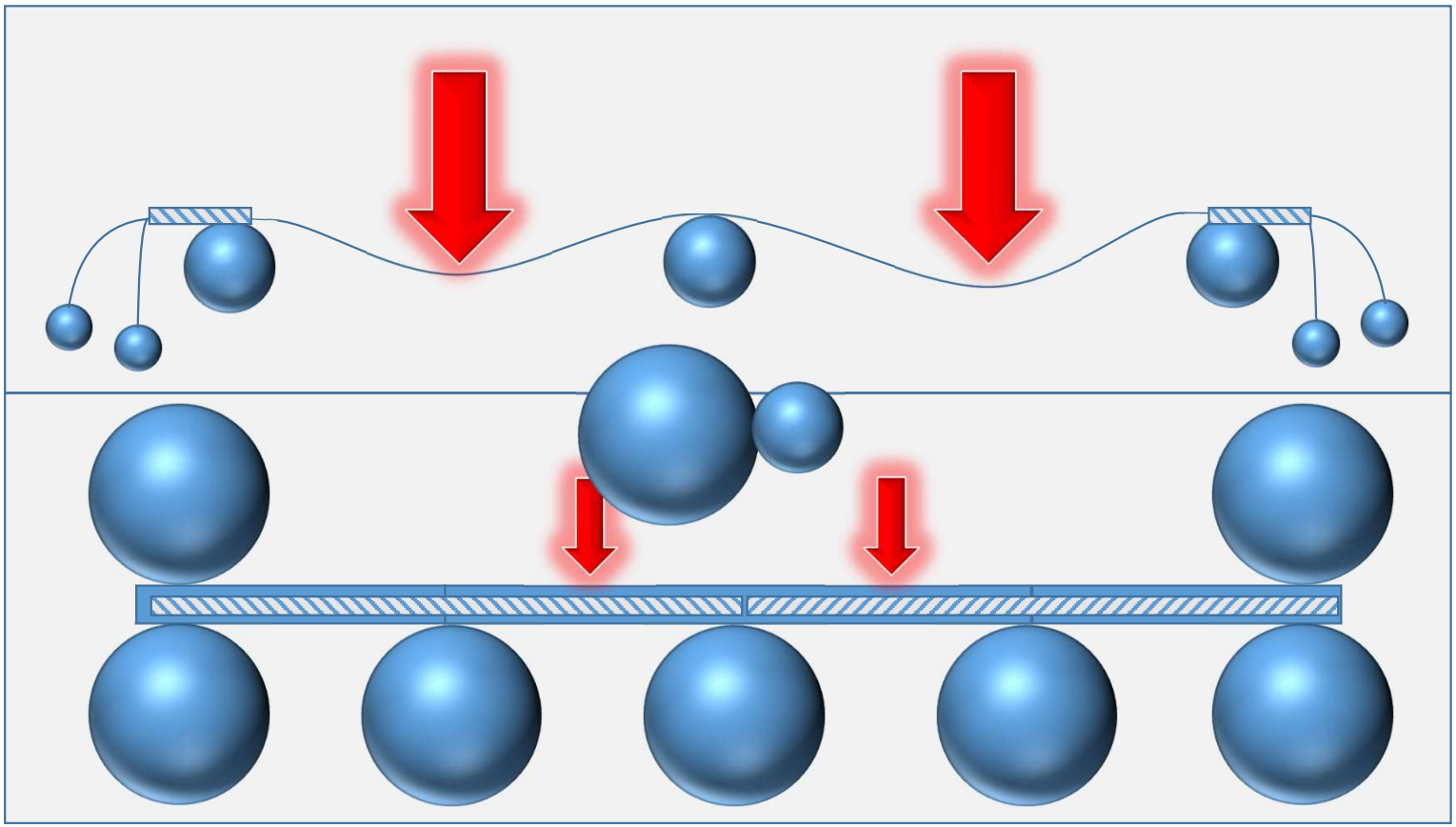
What to look out for?

Capacity – Size, Mix, Dispatch

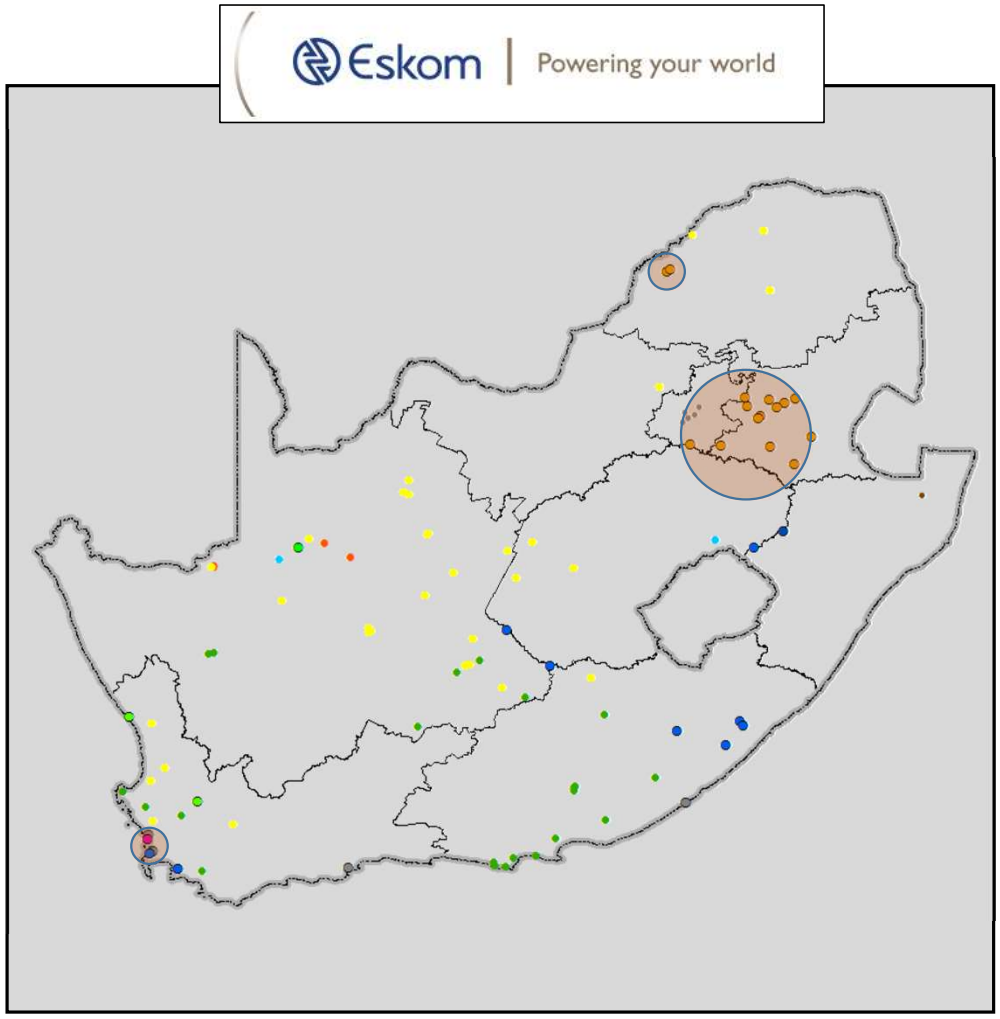
Spatial – Distribution, Spread, Distance

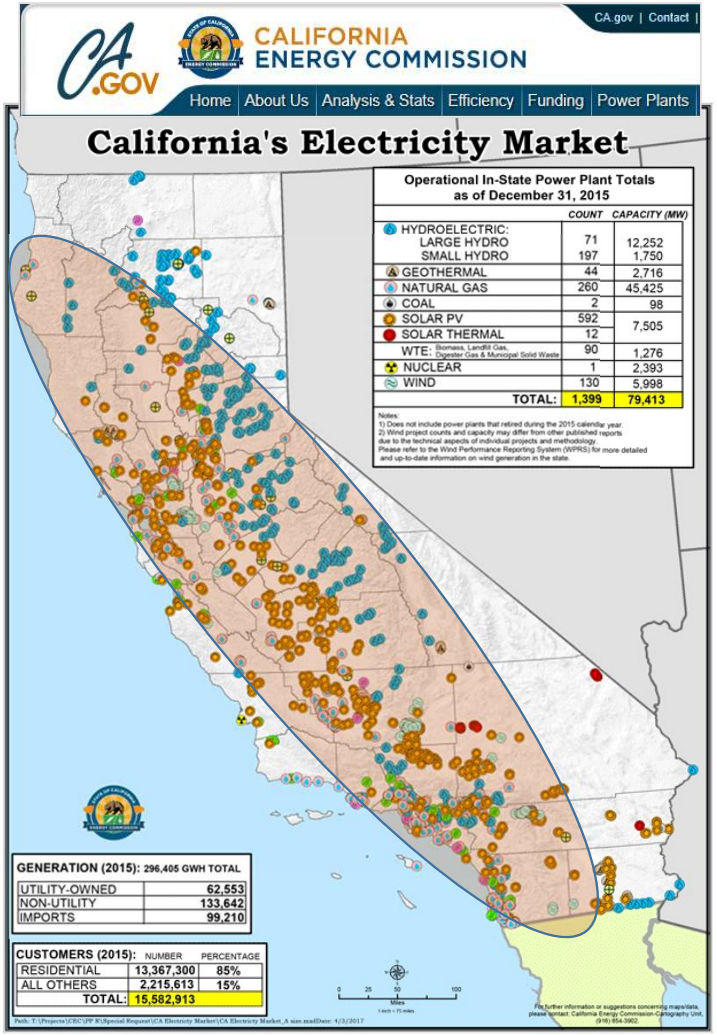
Network – Topology, Strength

Interconnectivity - Strength

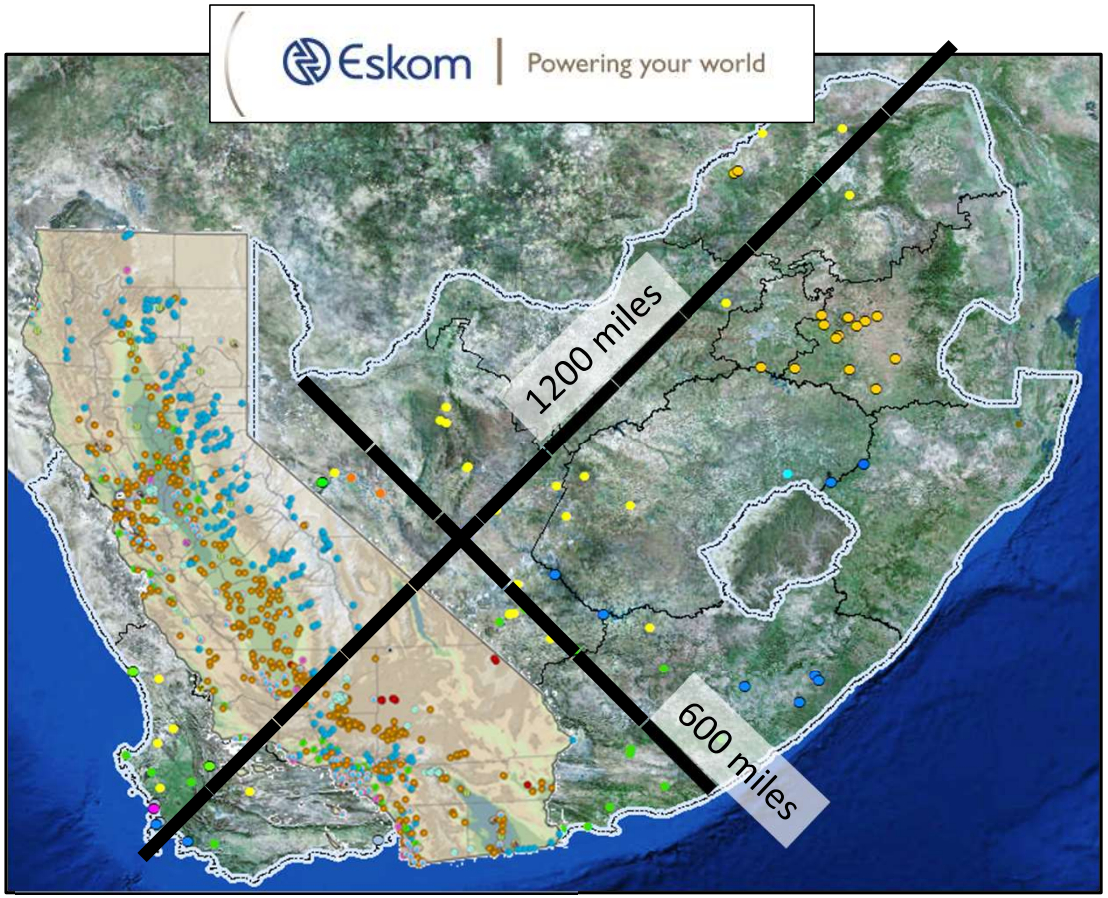


Gx Spatial Distribution - Spread

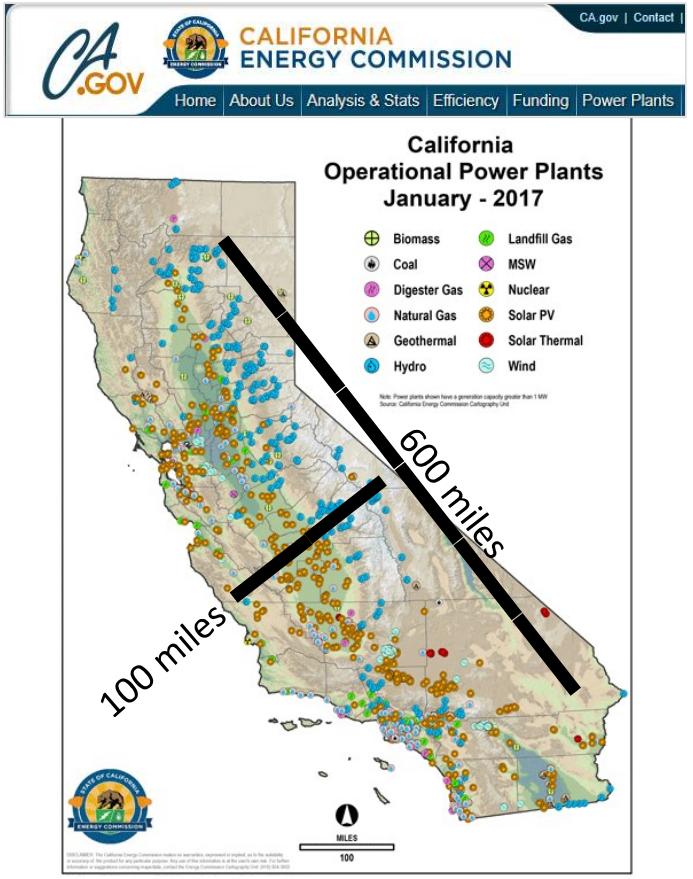




Gx Spatial Distribution - Distance

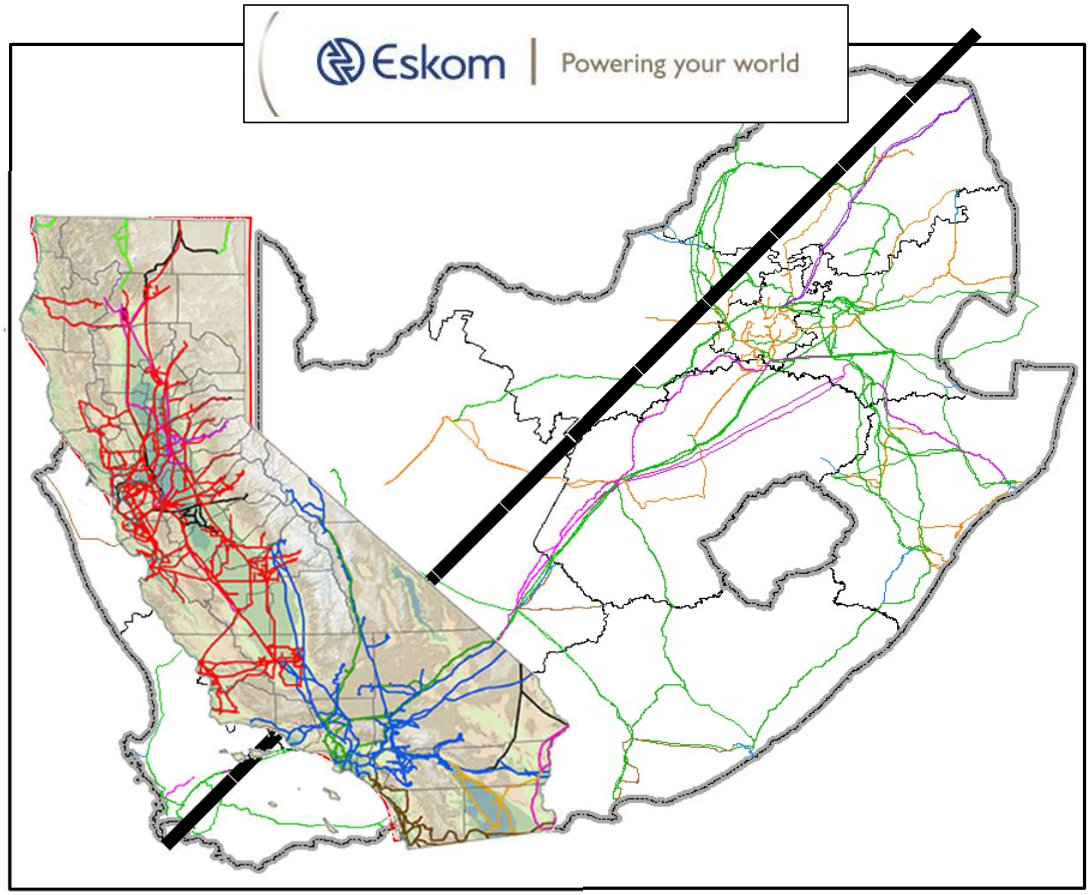


1200	=	1931.213
Mile		Kilometre

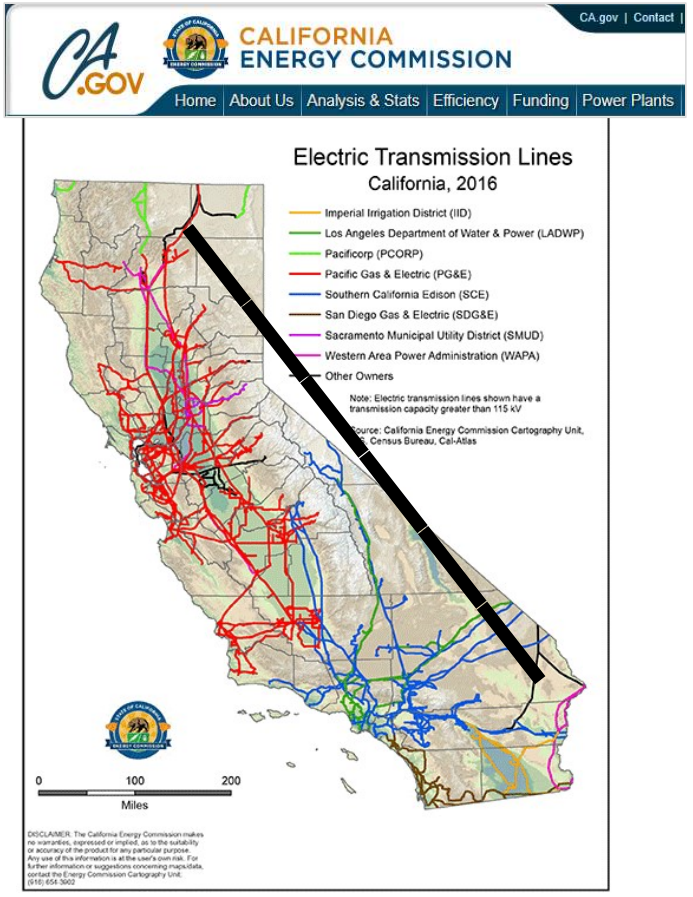


600	=	965.606
Mile		Kilometre

Network Topology

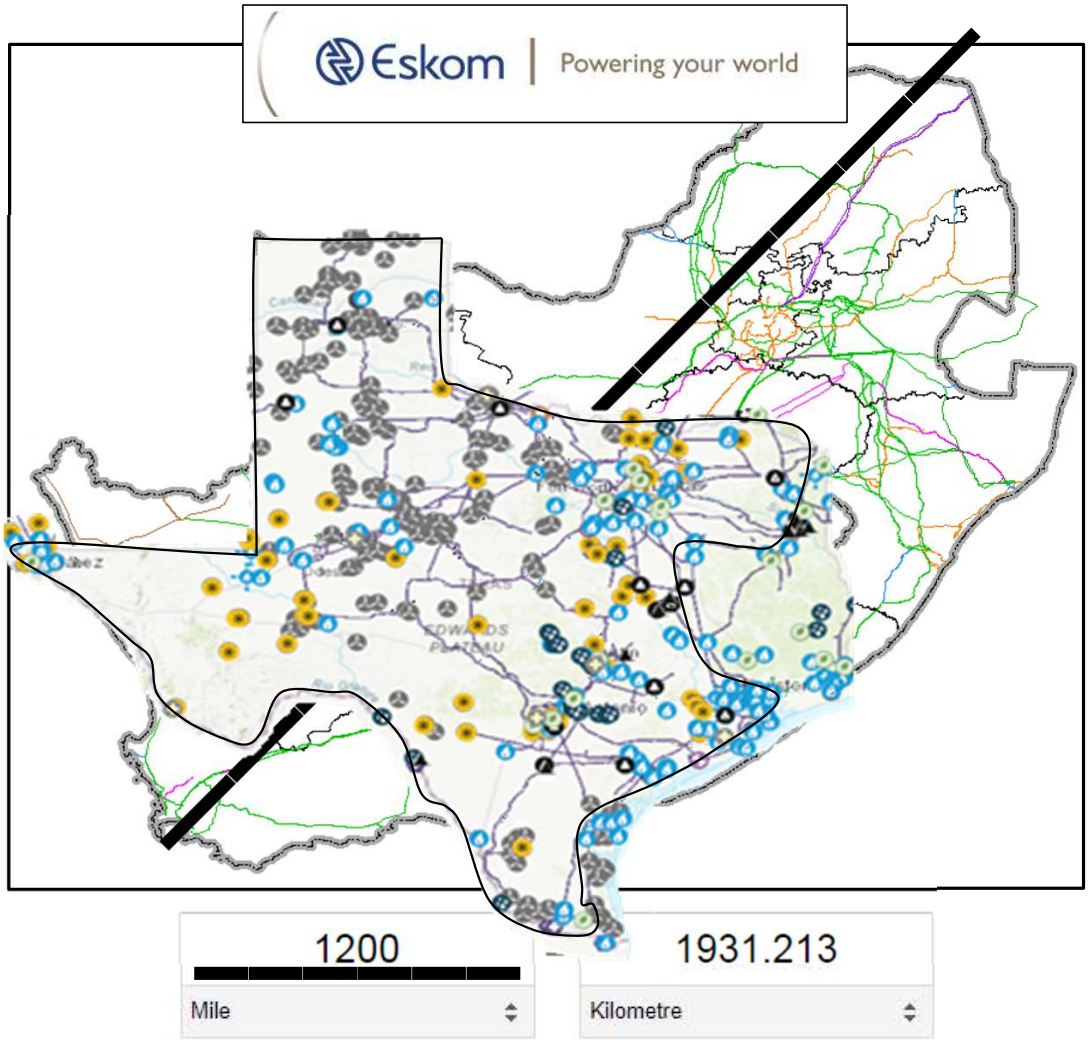


1200	=	1931.213
Mile		Kilometre



600	=	965.606
Mile		Kilometre

Network Topology Texas



South Africa
1,22M km²

Texas
695,662K km²

https://www.eia.gov/state/maps.php

California
423,97K km²

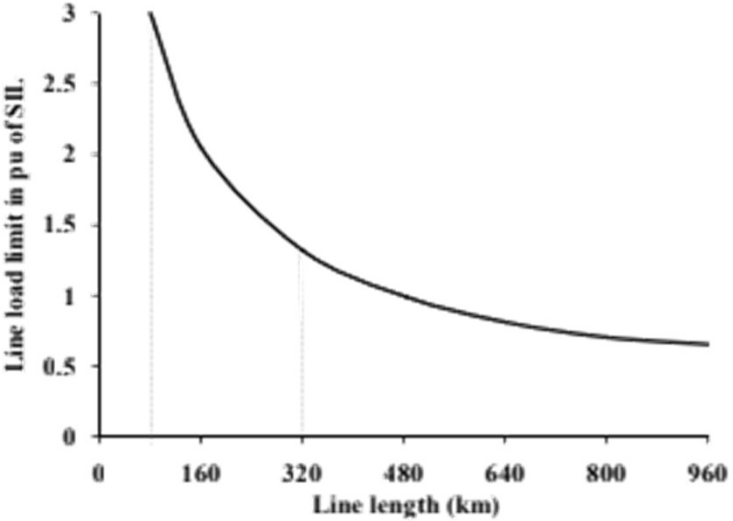
https://cecgis-caenergy.opendata.arcgis.com/app/ad8323410d9b47c1b1a9f751d62fe495

Germany
357,386K km²

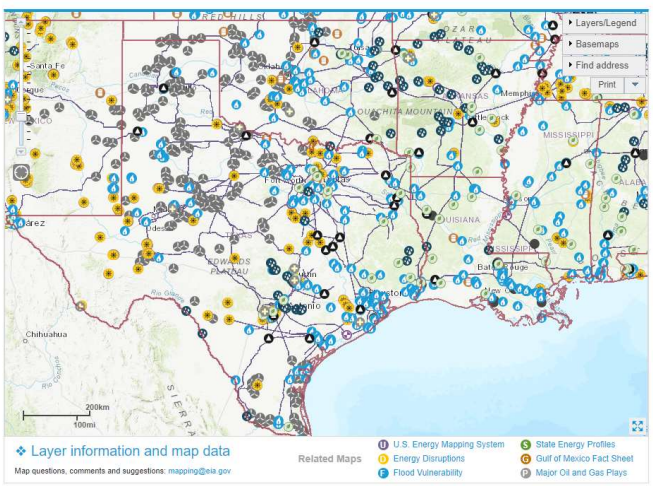
https://energy-charts.info/map/map.htm?l=en&c=DE&tab=powerplants&country=DE&state=0&datasource=bnetza&show=all&tml=&tso=

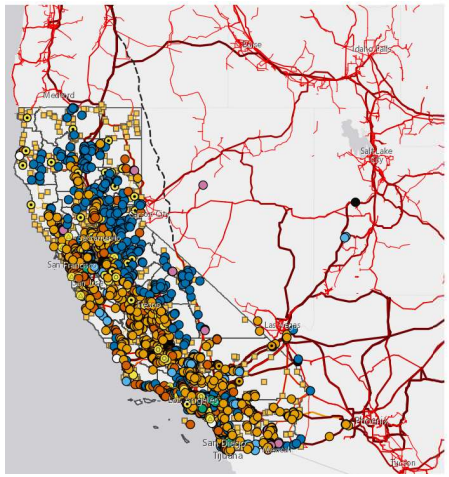
United Kingdom
242,495K km²

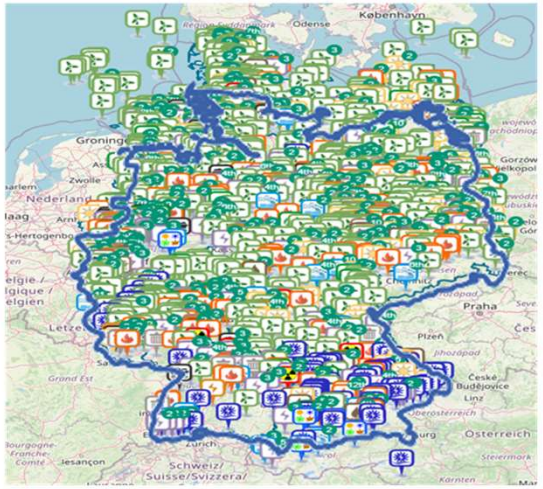
https://www.carbonbrief.org/mapped-how-the-uk-generates-its-electricity

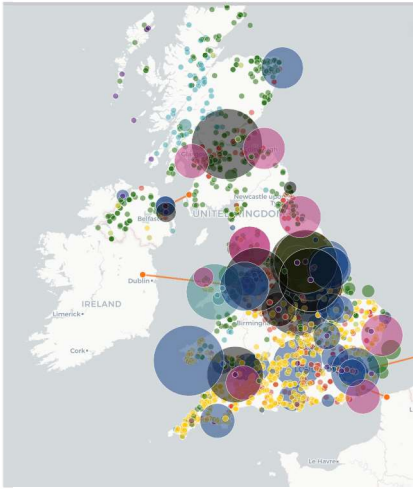


U.S. Energy Mapping System

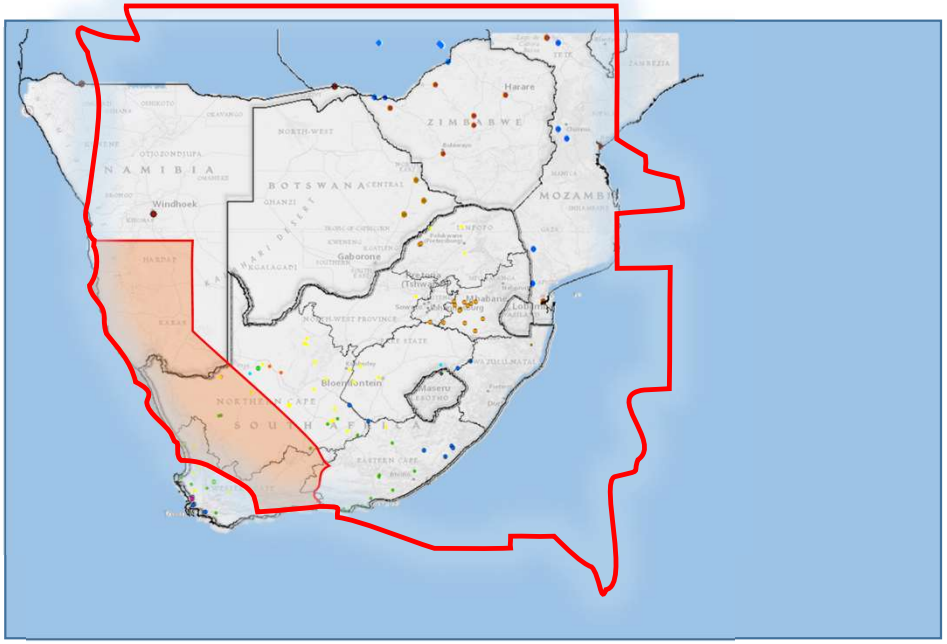


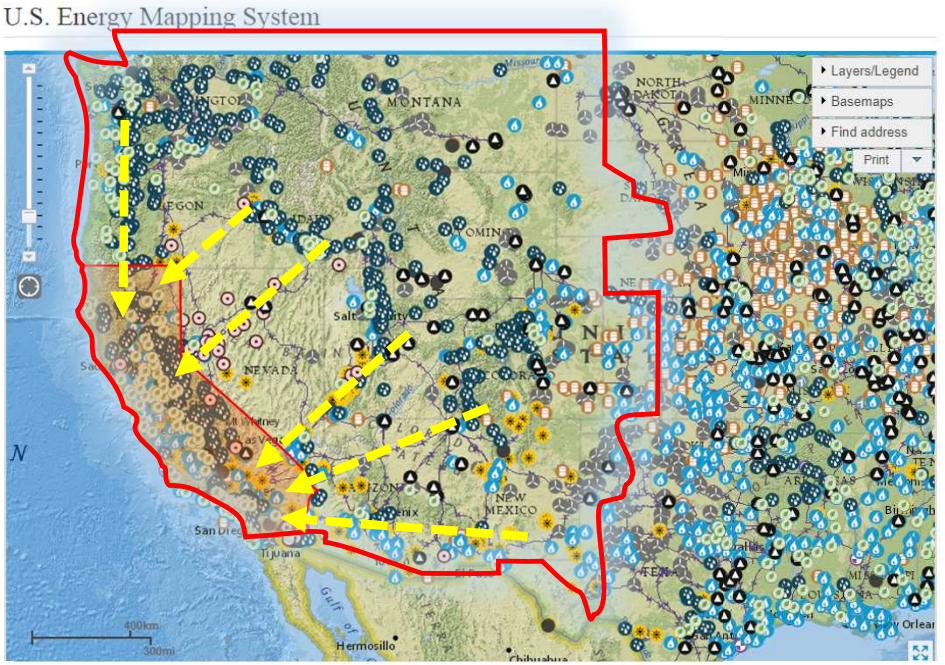


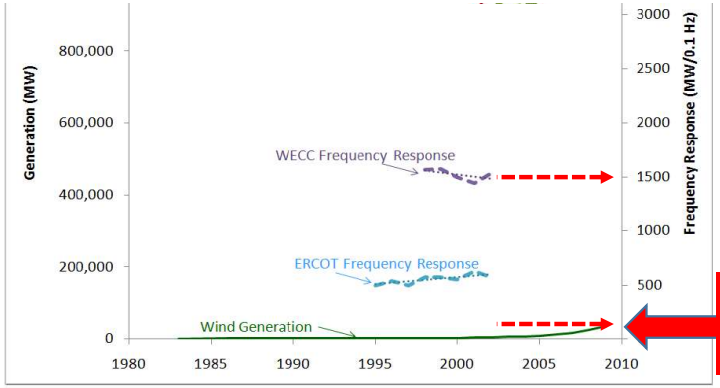


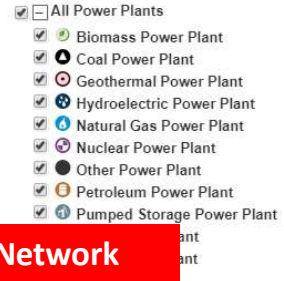


Network Interconnectivity







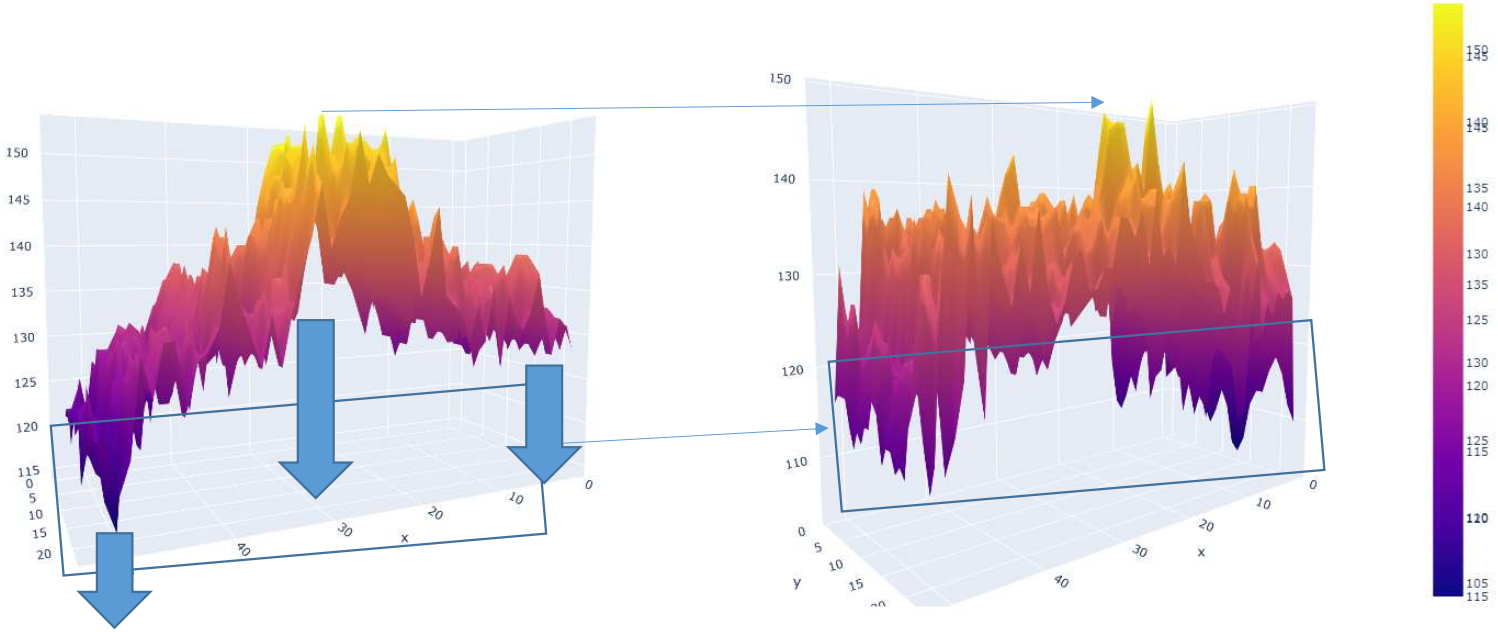


ESKOM Network
187 MW/0.1Hz

AMERICAN WIND ENERGY ASSOCIATION

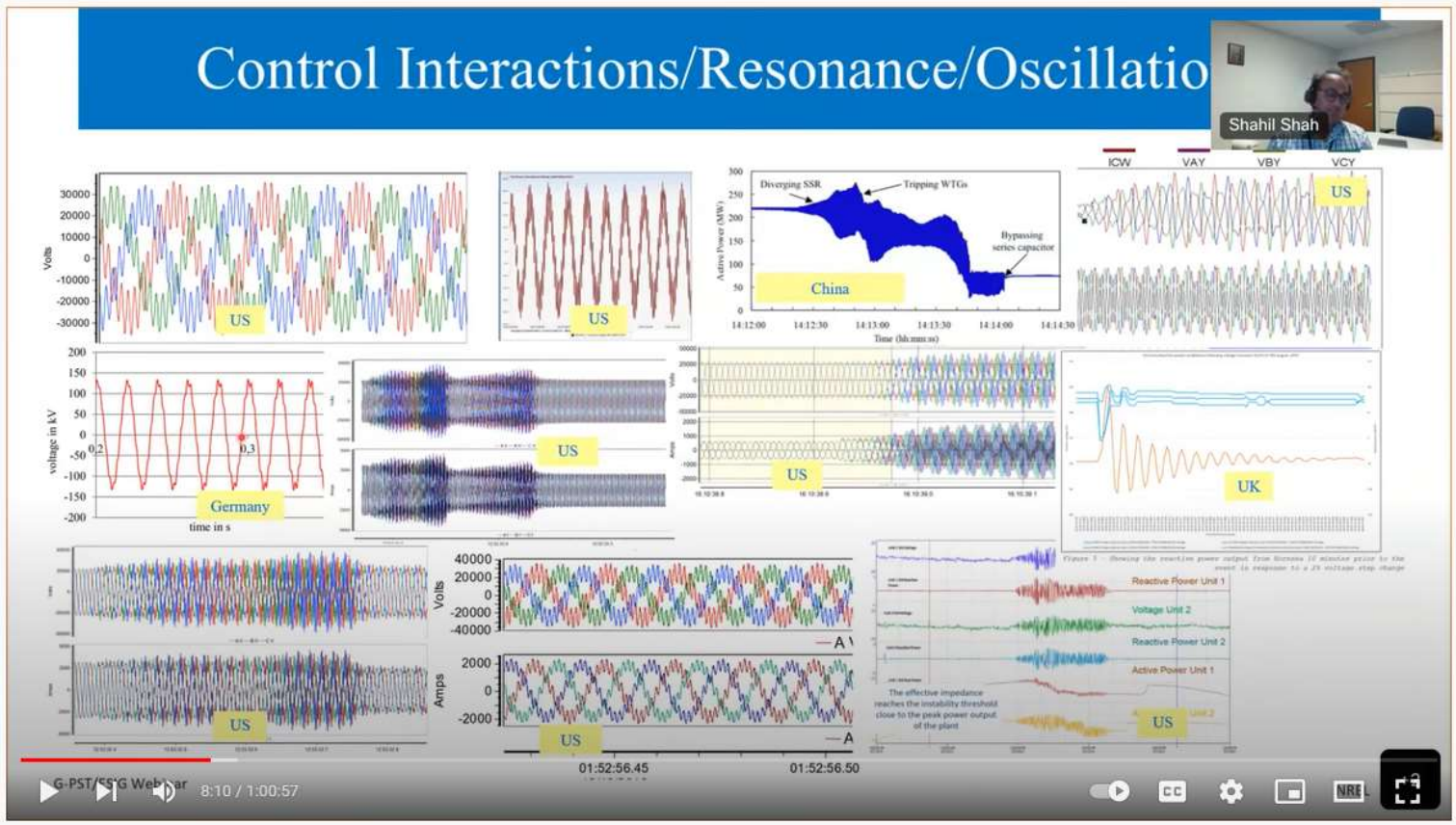
3D System Inertia GW.s for 2010 & 2019

Least amount of time at max inertia



Drops across all of the weeks
Winter is lowered the most
Summer more hours - low inertia

Lower inertia than traditionally
many more periods
predominantly in summer
months



https://www.youtube.com/watch?v=_XA5PpK0LAY&t=488s

Transmission and a strong grid is fundamental