Transmission Development Plan (TDP) 2015 - 2024 Public Forum

Transmission Strategic Grid Study 2040

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Powering your world

The Different Development Plans

Integrated Resource Plan

- The Department of Energy (Energy Planner) is accountable for the Country Energy Plan as per recently published regulations.
- The Country Plan is also termed the Integrated Resource Plan (IRP).
- The Integrated Resource Plan (IRP) is intended to drive all new generation capacity development.
- NERSA licences new generators according to this determination.

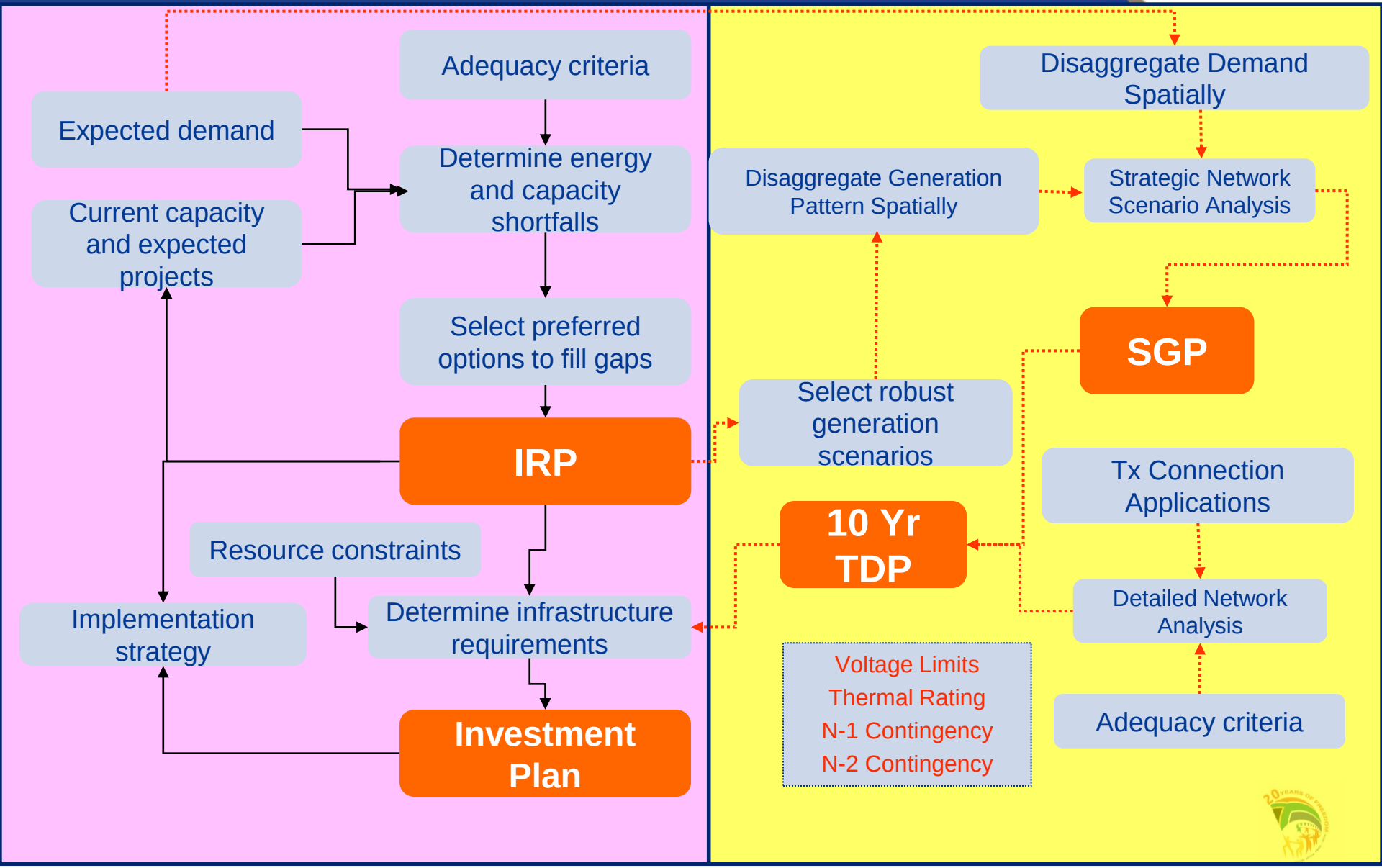
Strategic Grid Plan

- The Strategic Grid Plan formulates long term strategic transmission corridor requirements
- Plan is based on range of generation scenarios, and associated strategic network analysis
- Horizon date is 20 years
- Updated every 2-3 years

Transmission Development Plan

- Transmission Development Plan (TDP) presents transmission corridor requirements
- Plan covers a 10 year window
- Updated annually
- Indicates financial commitments required over 10 year period

Linkages between the various plans

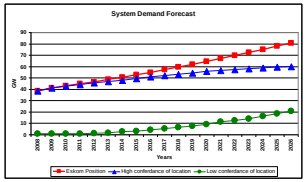


Capacity Planning vs Transmission Planning

Volume & type

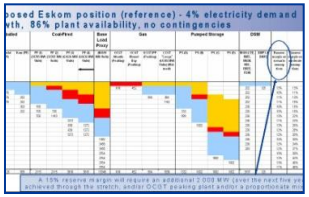
Spatial & transportation

(a) Load Demand Forecast



40 GW

(b) Capacity Plan



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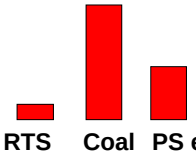
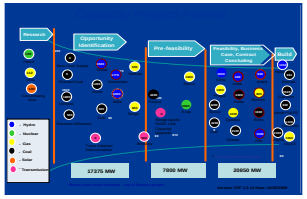


(c) Capital project funnel



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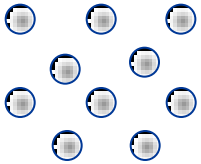
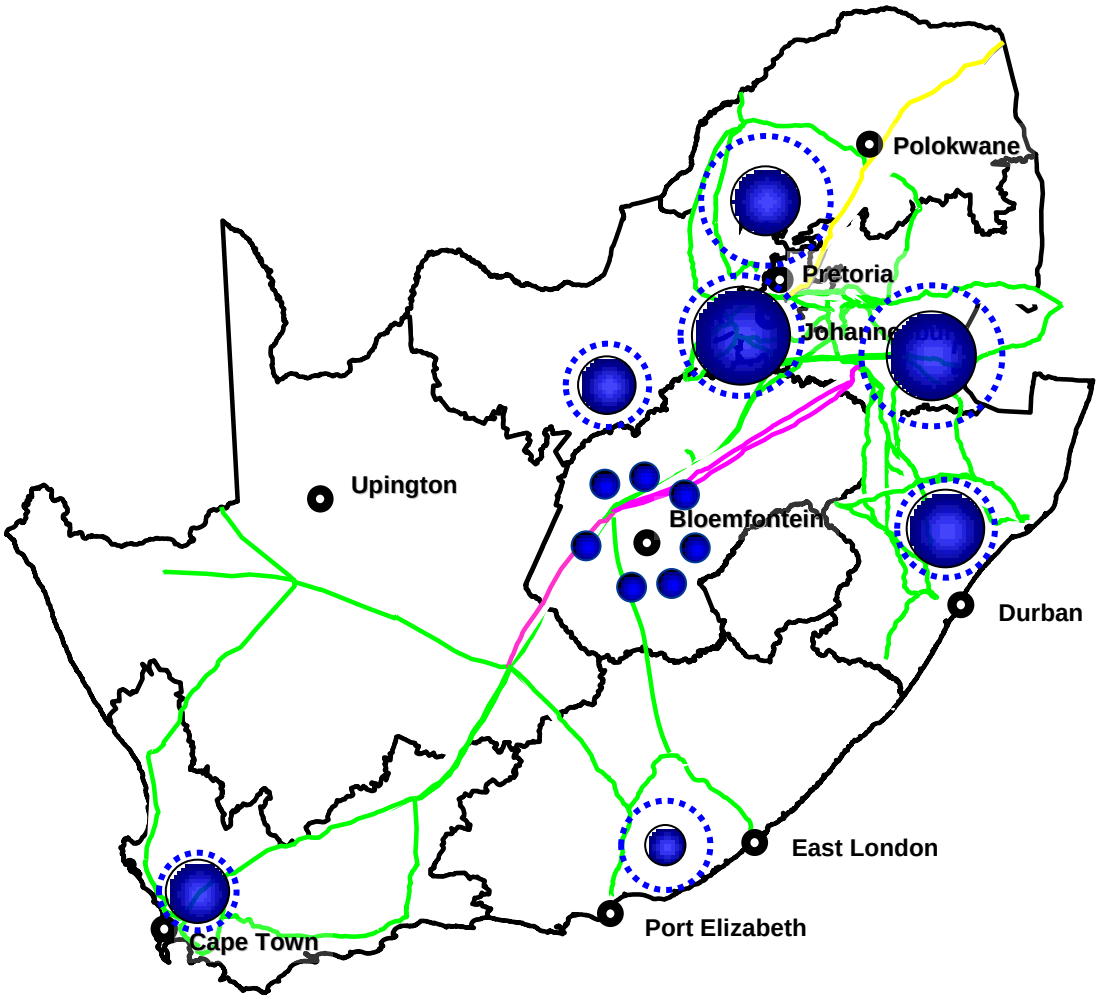


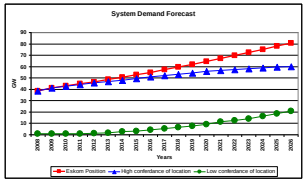


Current Transmission power flow

Current power pool

- Generation exceeds local load
- Other load centres require imports
- Tx designed to feed load centers from power pool

(a) Load Demand Forecast



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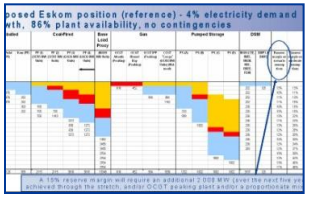
(b) Capacity Plan



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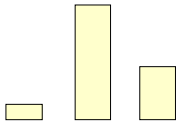

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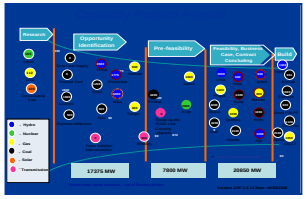

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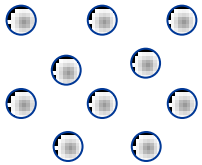
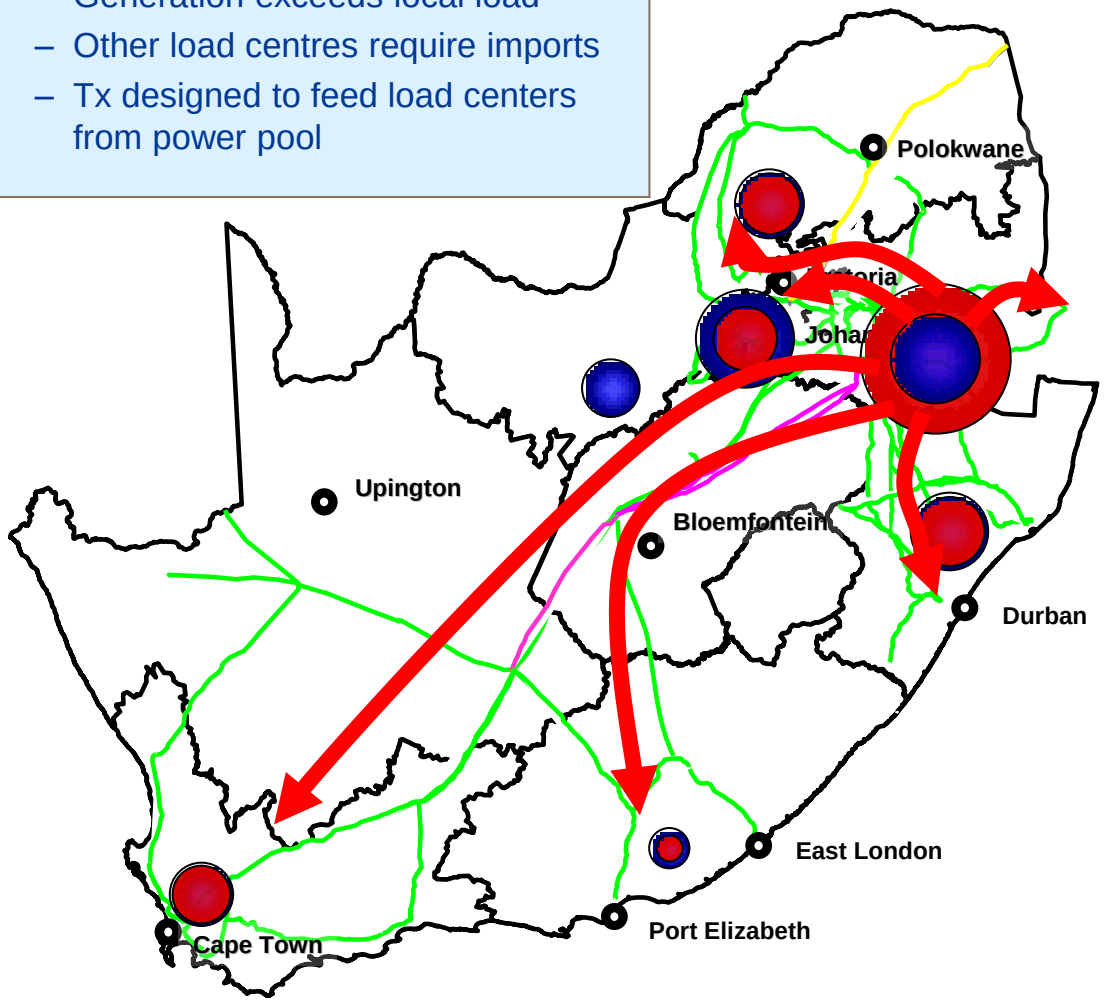


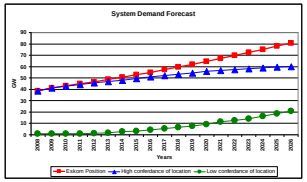


Impact of location on corridors - Inland Scenario

Capacity Roll out

- Matching capacity scenario plan with available project

(a) Load Demand Forecast



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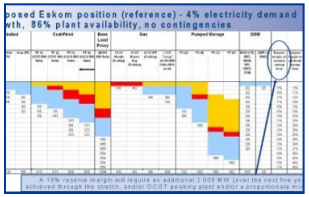

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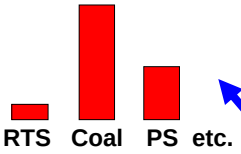

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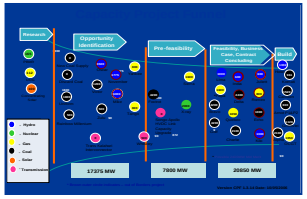

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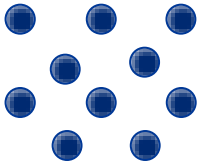
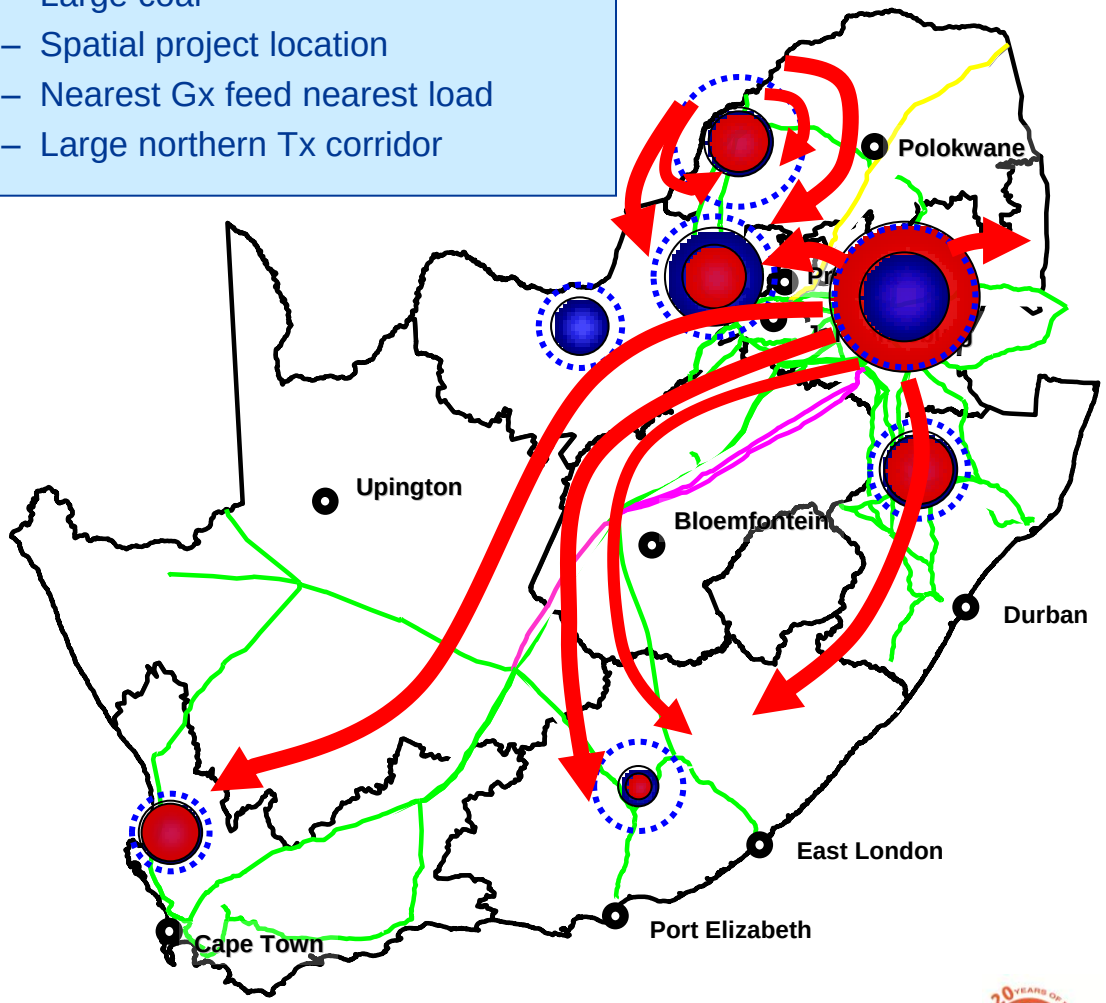


Inland Scenario

- Large coal
- Spatial project location
- Nearest Gx feed nearest load
- Large northern Tx corridor



Impact of location on corridors - Coastal Scenario

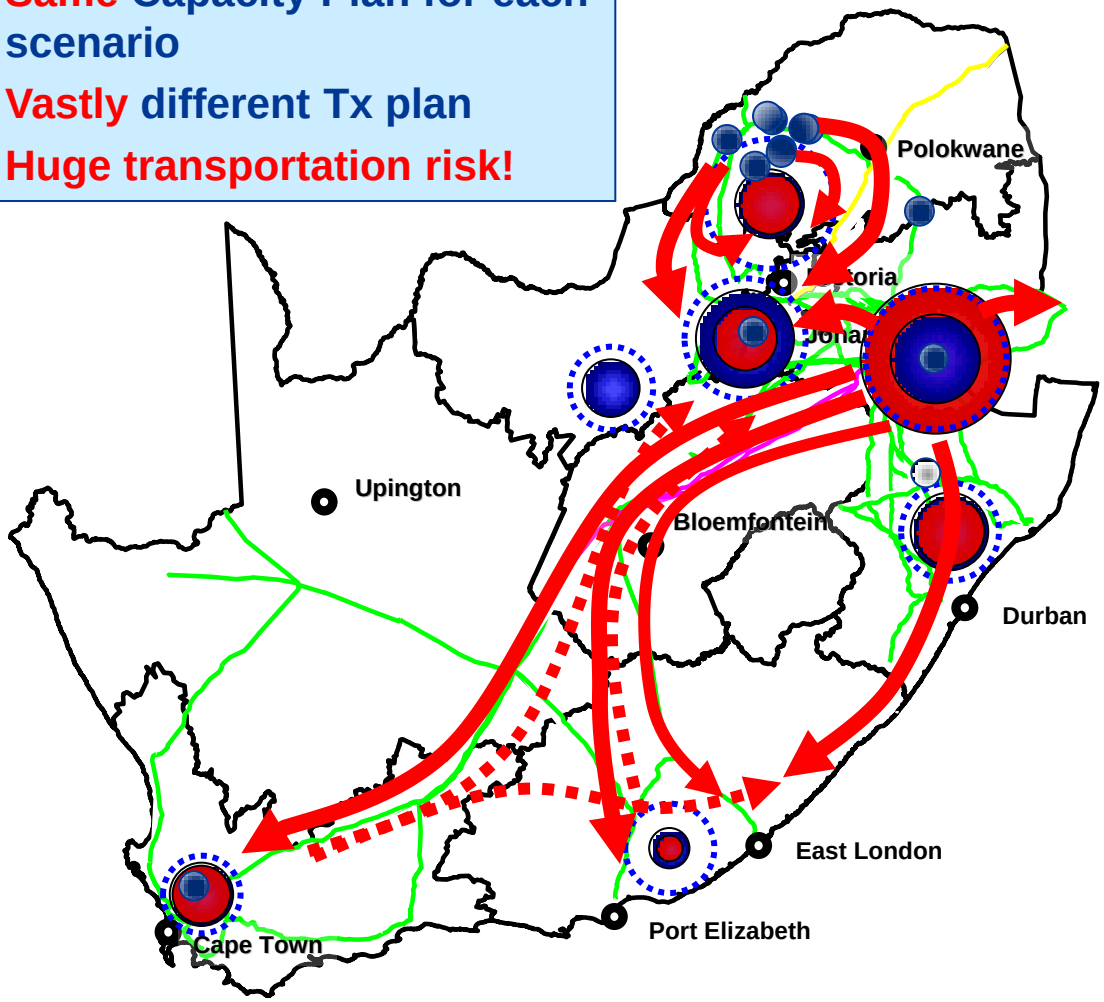
Coastal Scenario

- Large nuclear displacing generation from the north to the coast
- Reduced northern corridors
- Reversing flow & increased corridor size

Same Capacity Plan for each scenario

Vastly different Tx plan

Huge transportation risk!



Issues to Consider

Servitude and EIA restrictions

Lead times:

- **Long Tx lines 6 - 8 years**

Use all appropriate proven technology available

- HVDC, EHV AC, HVDC conversions of existing AC lines

Transmission technology choice must be compatible with strategic power system development plan

Purpose of the 2040 Network Study

- To **adapt to the uncertainty of future** load and generation
- To identify the **critical power corridors** and constraints on the transmission network
- Unlock and create a **flexible and robust grid** to be able to respond to the changing future needs of the country

The 2040 Transmission Network Study was undertaken to determine the development requirements of the future transmission grid to accommodate the expected load demand needs and the potential impact of future generation scenarios using the 2010 Integrated Resource Plan (IRP) as a baseline.

Organisations already engaged

Within ESKOM:

- Generation
- Primary Energy department
- Gas & Liquid Fuel department
- Group Capital
- Project Development department
- Distribution
- Nuclear Department
- Strategy & Risk Management
- Transmission
- Southern African Energy

Outside ESKOM:

- SAWEA
- SASTELA
- SAPVIA
- CEF
- Solar Park Project
- Stellenbosch University
- Govt. Departments
  - DPE
  - DOE
  - DEA
  - DWAF
  - DAFF
  - DPW

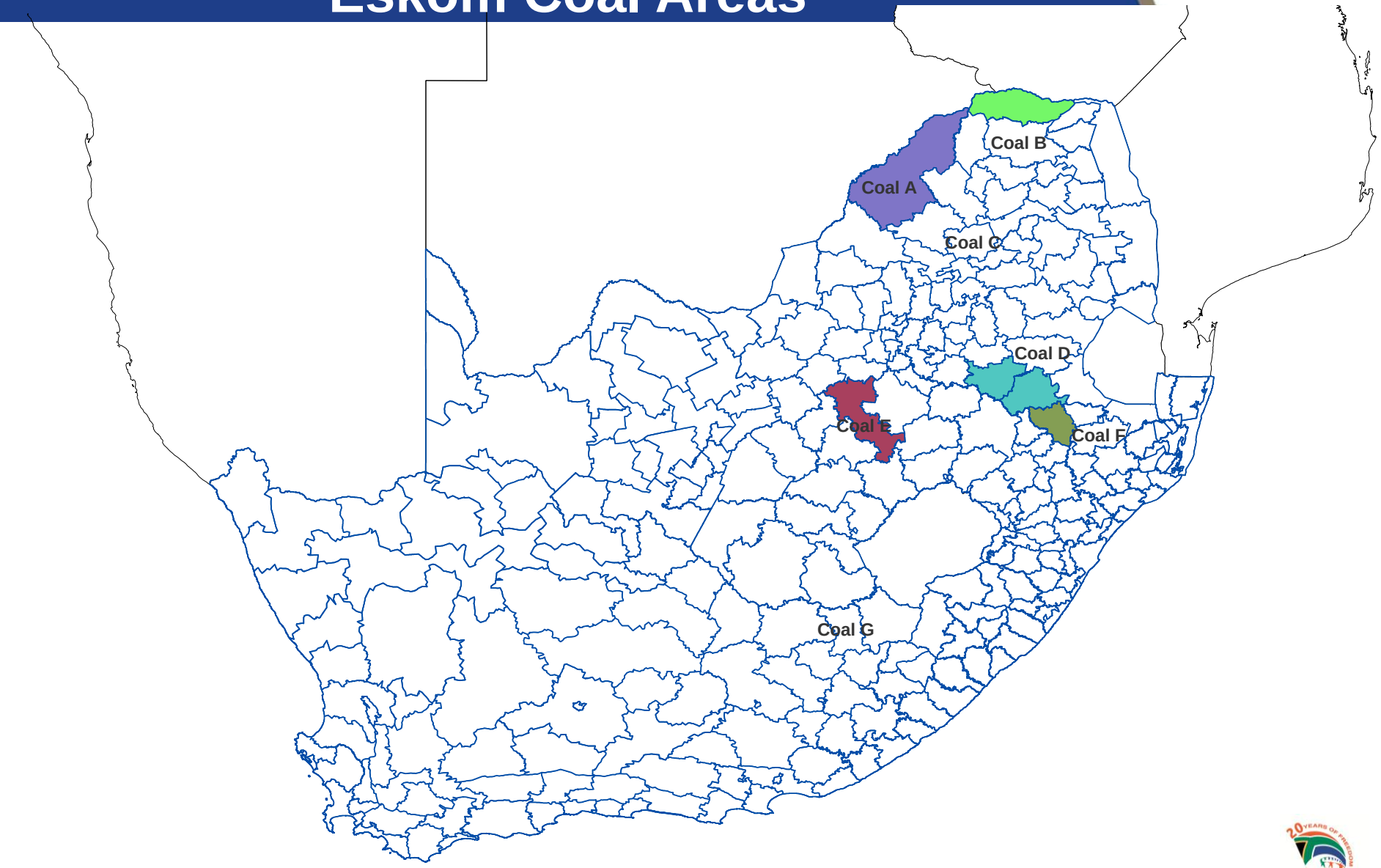
The Three Generation Scenarios

- **The IRP 2010 base Scenario (BASE IRP)**
  - 2010 IRP extended to 2040
  - Coal fixed at 2030 level
  - Balance in similar ratio to 2030 mix
- **Increased Renewables Scenario (GREEN)**
  - Replaced nuclear component with RE base generation equivalent
  - CSP (with storage)/ Wind with CCV of 30% / Natural Gas
- **Increased Imports Scenario (IMPORT)**
  - Doubled imported power by 2030
  - Reduced coal & nuclear

- *New draft IRP Update was reviewed and found that above scenarios still appropriate and 2040 Study results and findings are applicable*

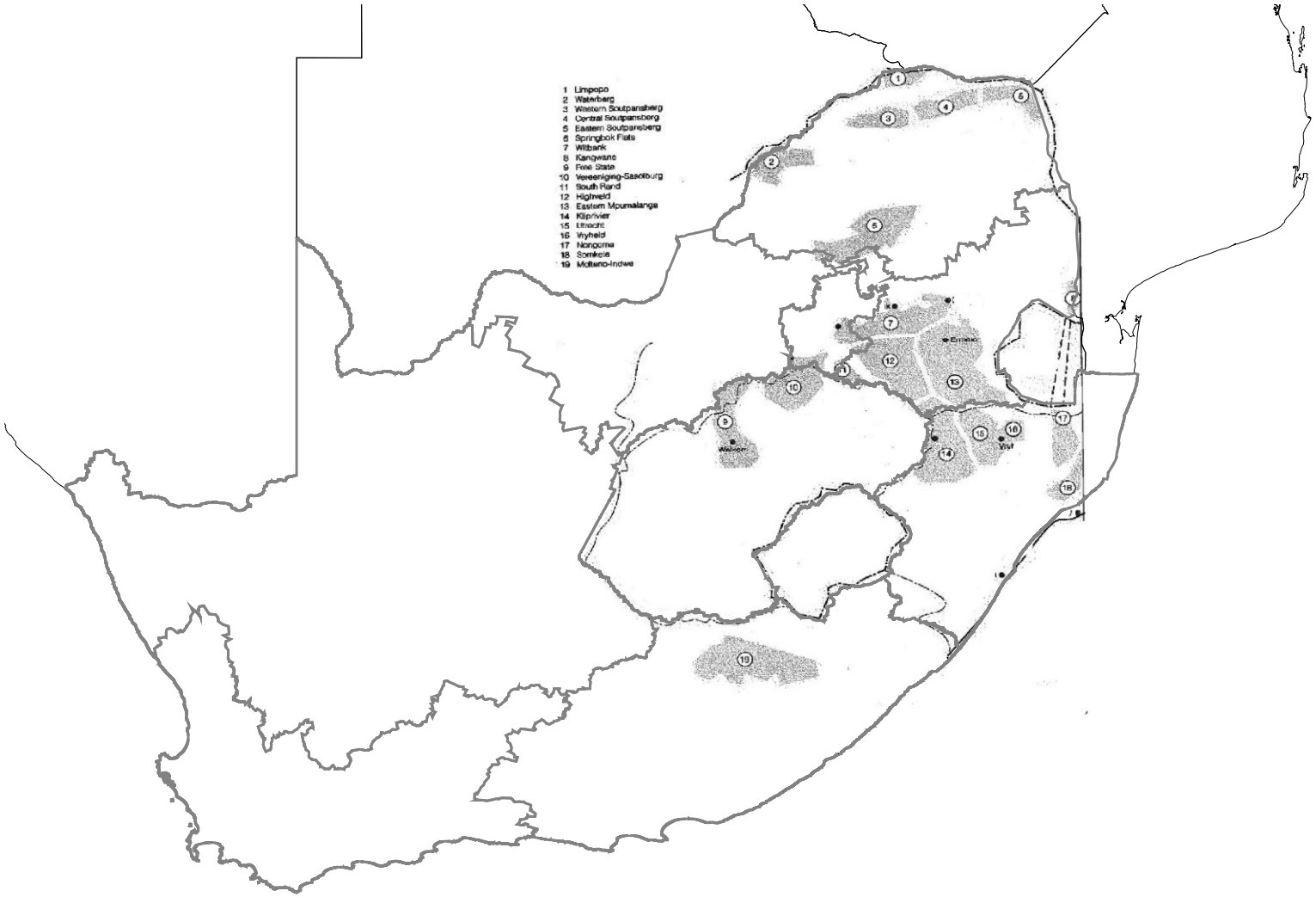
2040 Network Study – Generation Resource Map

Eskom Coal Areas



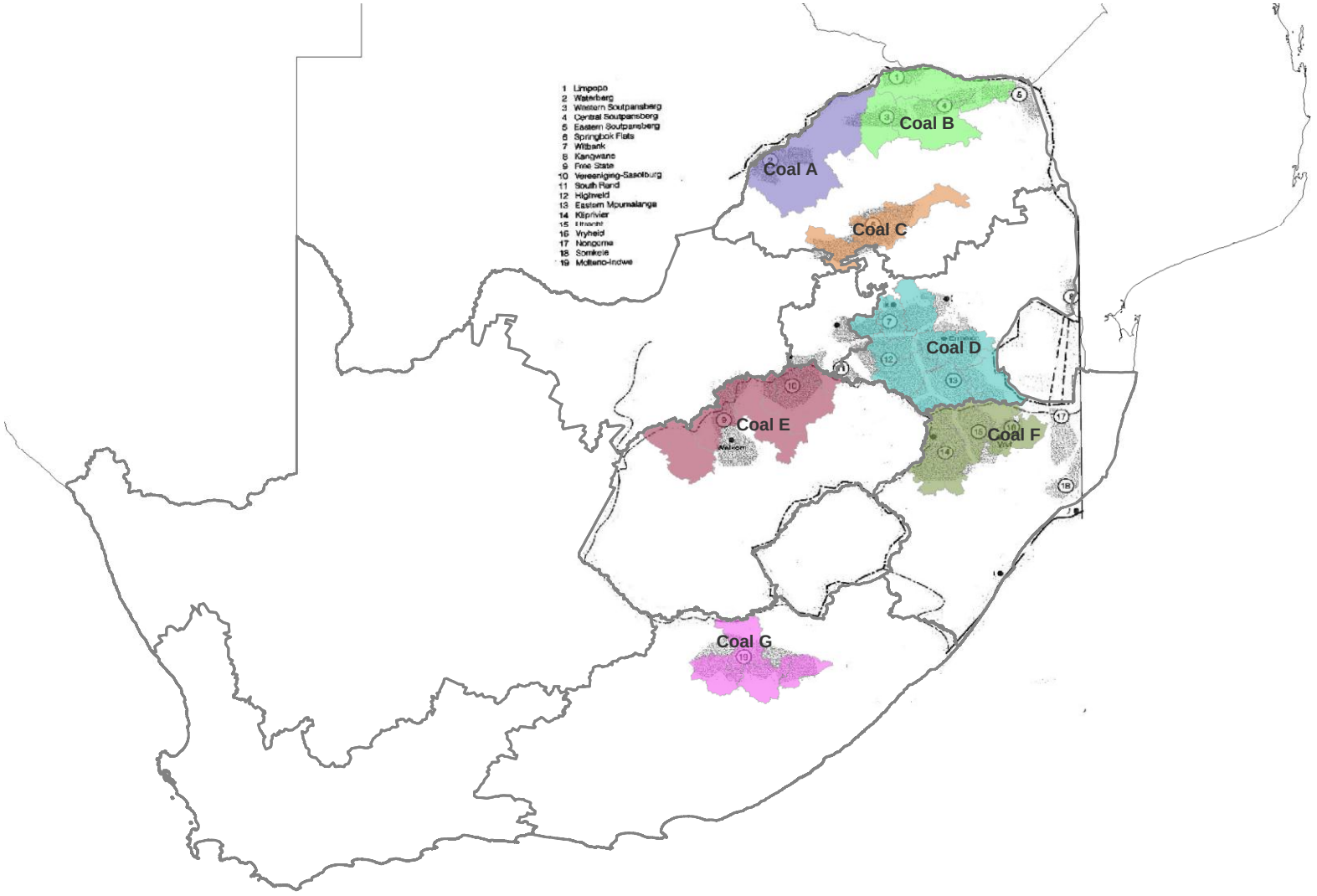
2040 Network Study – Generation Resource Map

Public Coal Map



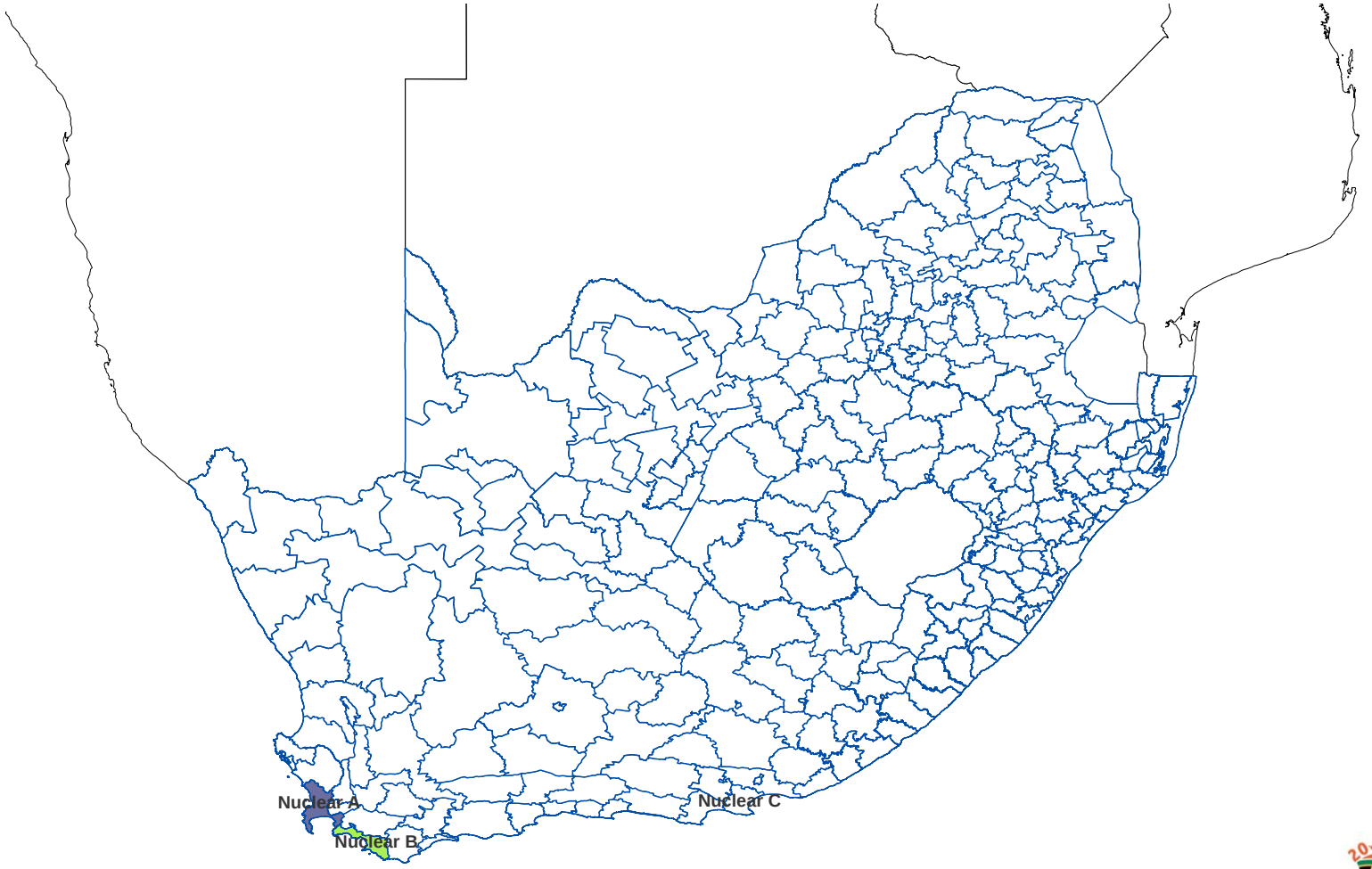
2040 Network Study – Generation Resource Map

Coal Map & Eskom Coal Areas

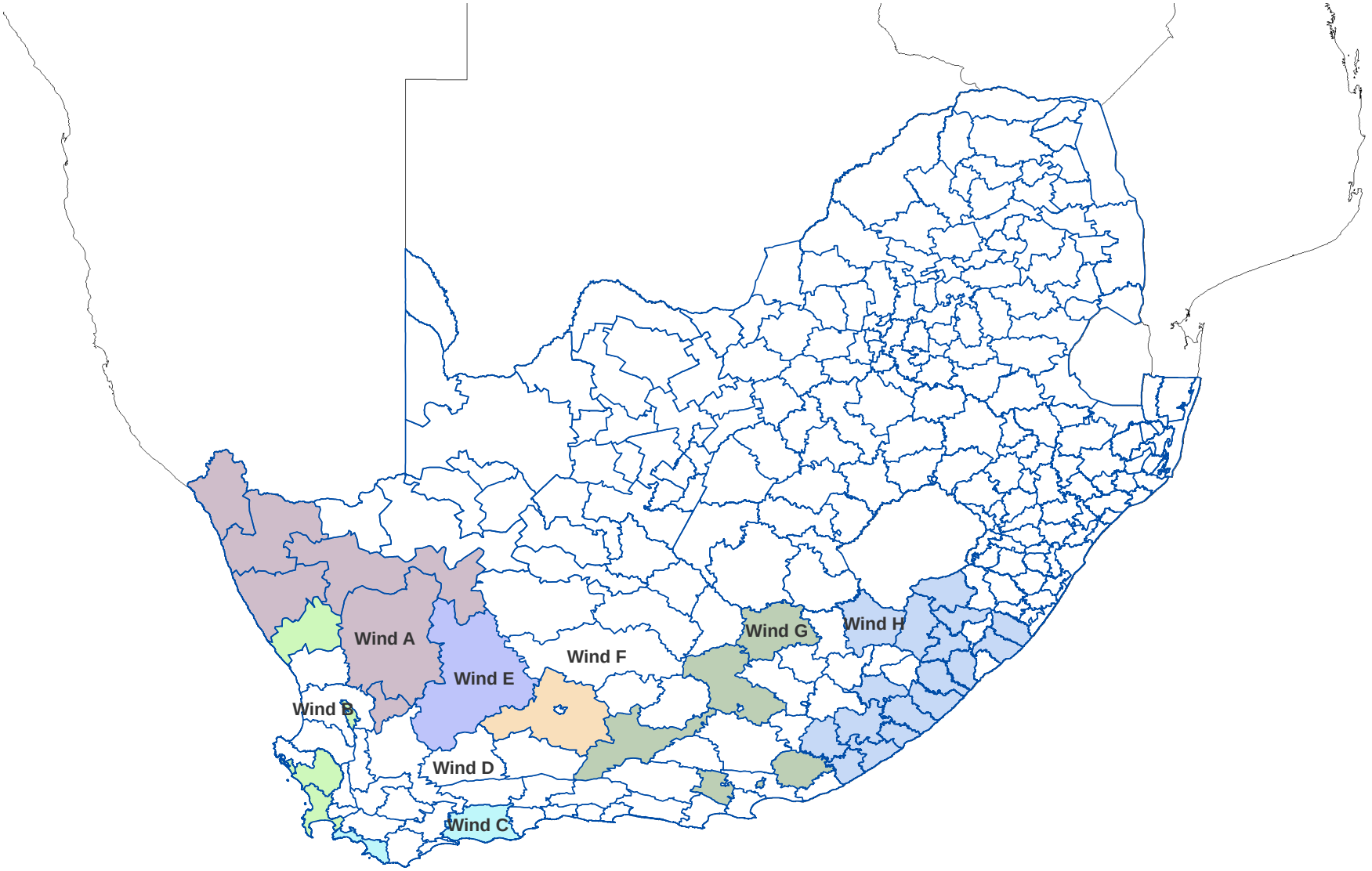


2040 Network Study – Generation Resource Map

Eskom Nuclear Areas

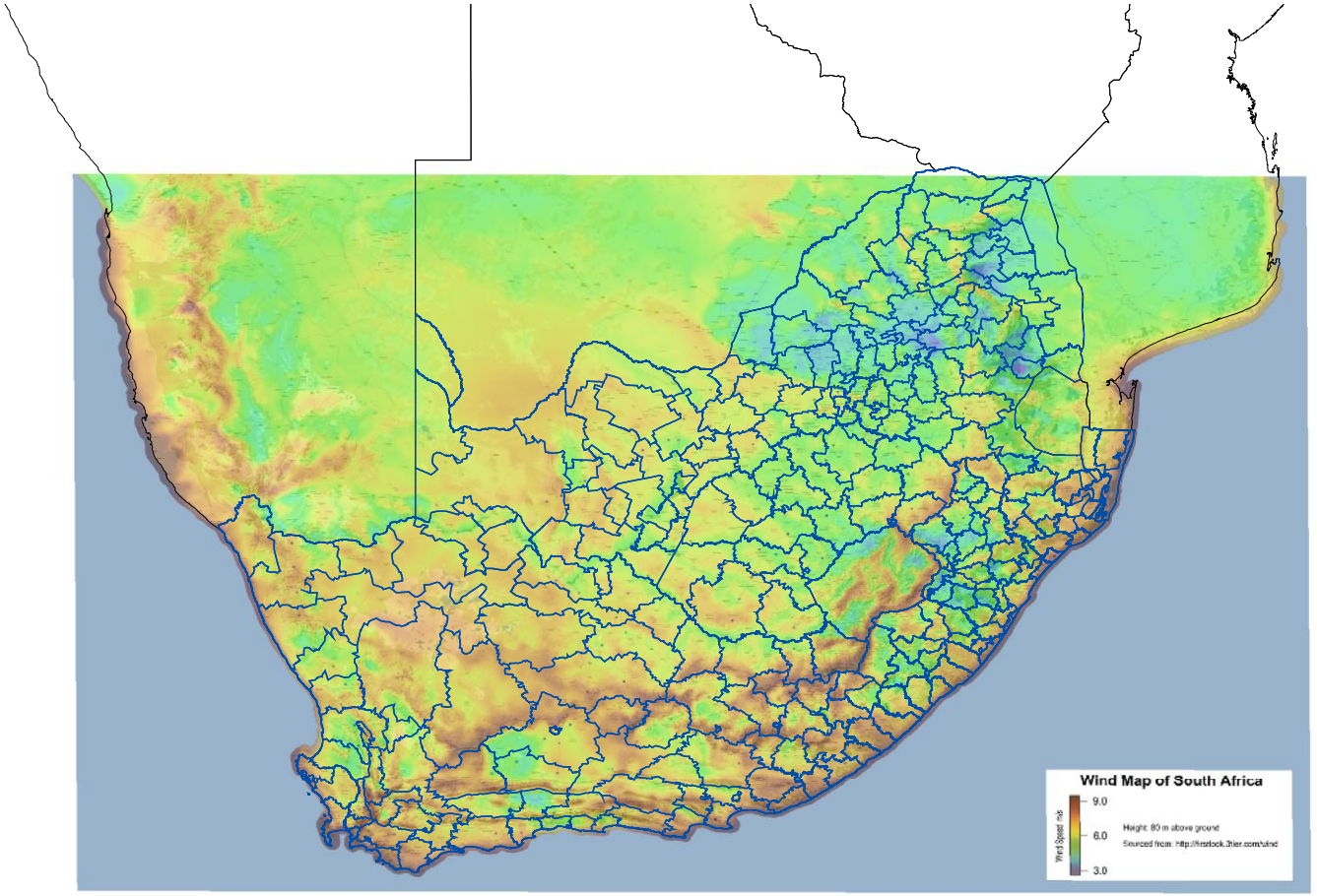


2040 Network Study – Generation Resource Map
Eskom Wind Areas



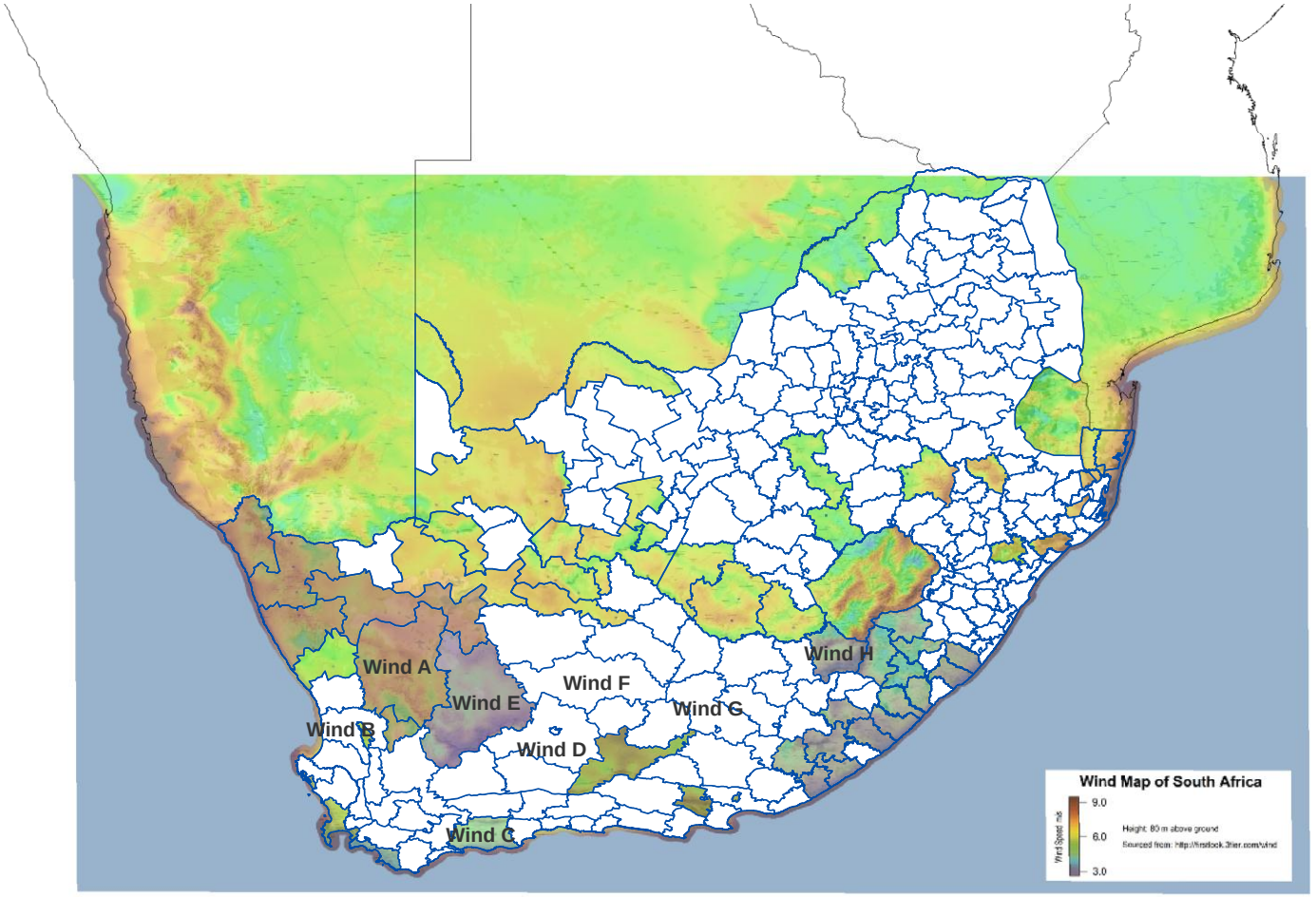
2040 Network Study – Generation Resource Map

Wind Map of South Africa

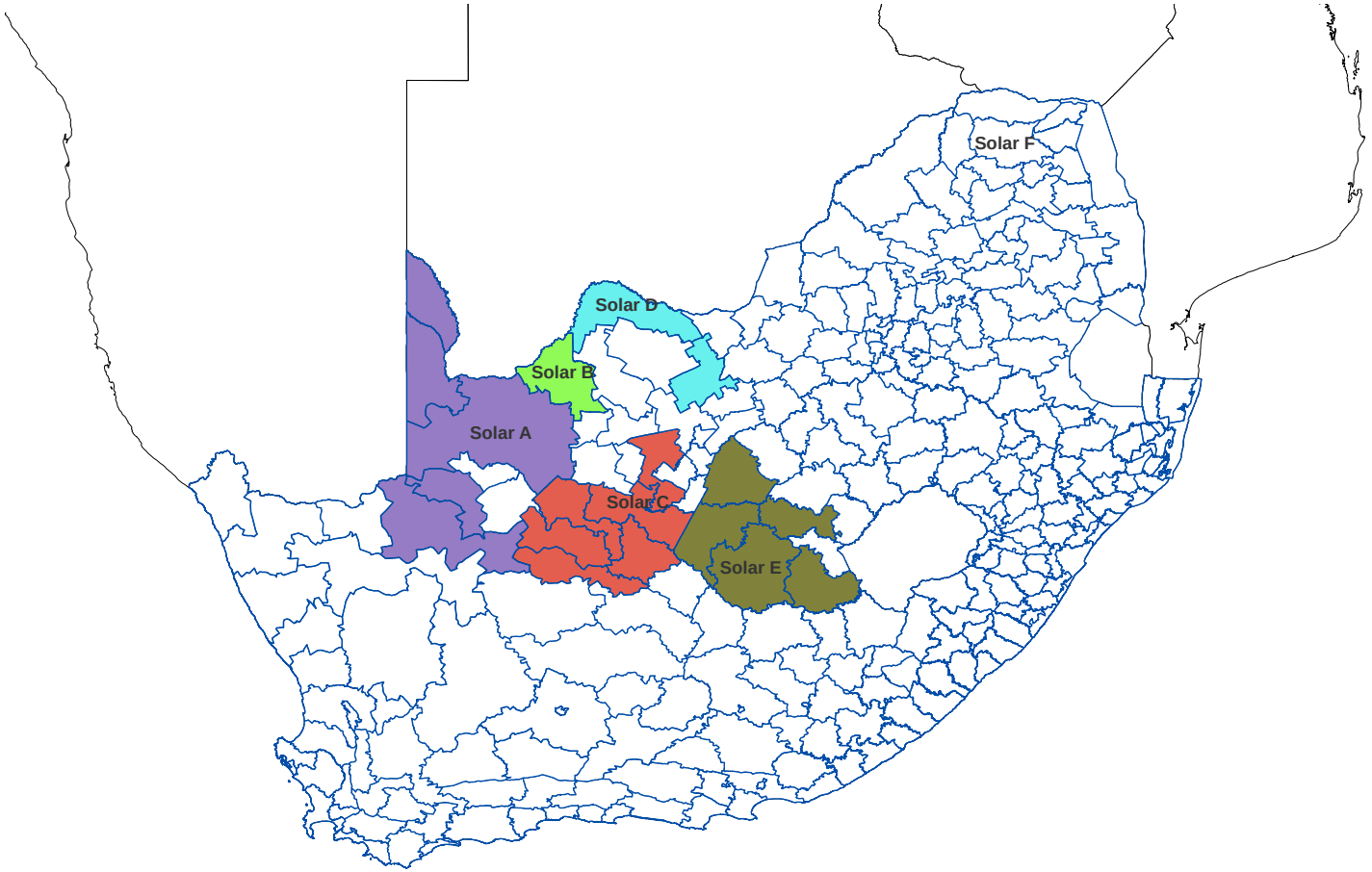


2040 Network Study – Generation Resource Map

SA Wind Map & Eskom Wind Areas

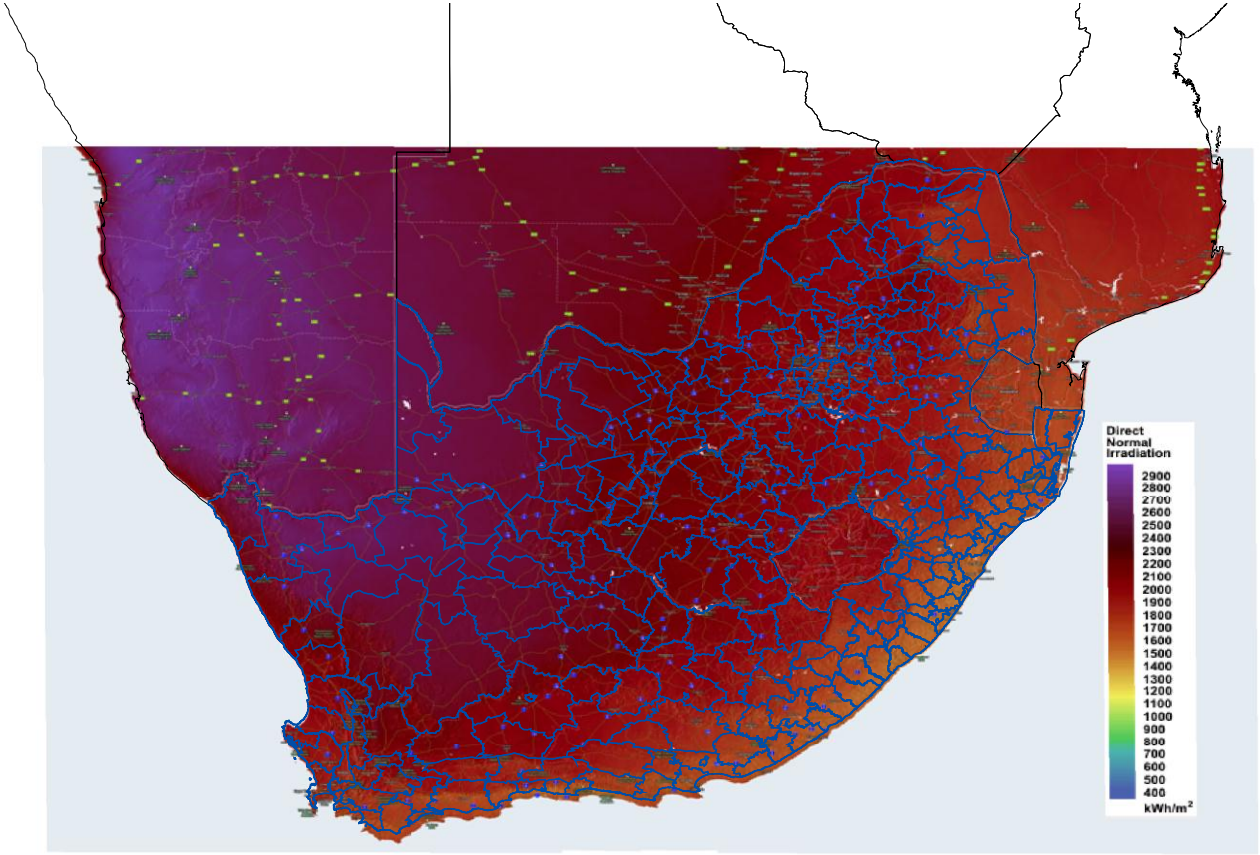


2040 Network Study – Generation Resource Map
Eskom Solar (CSP) Areas



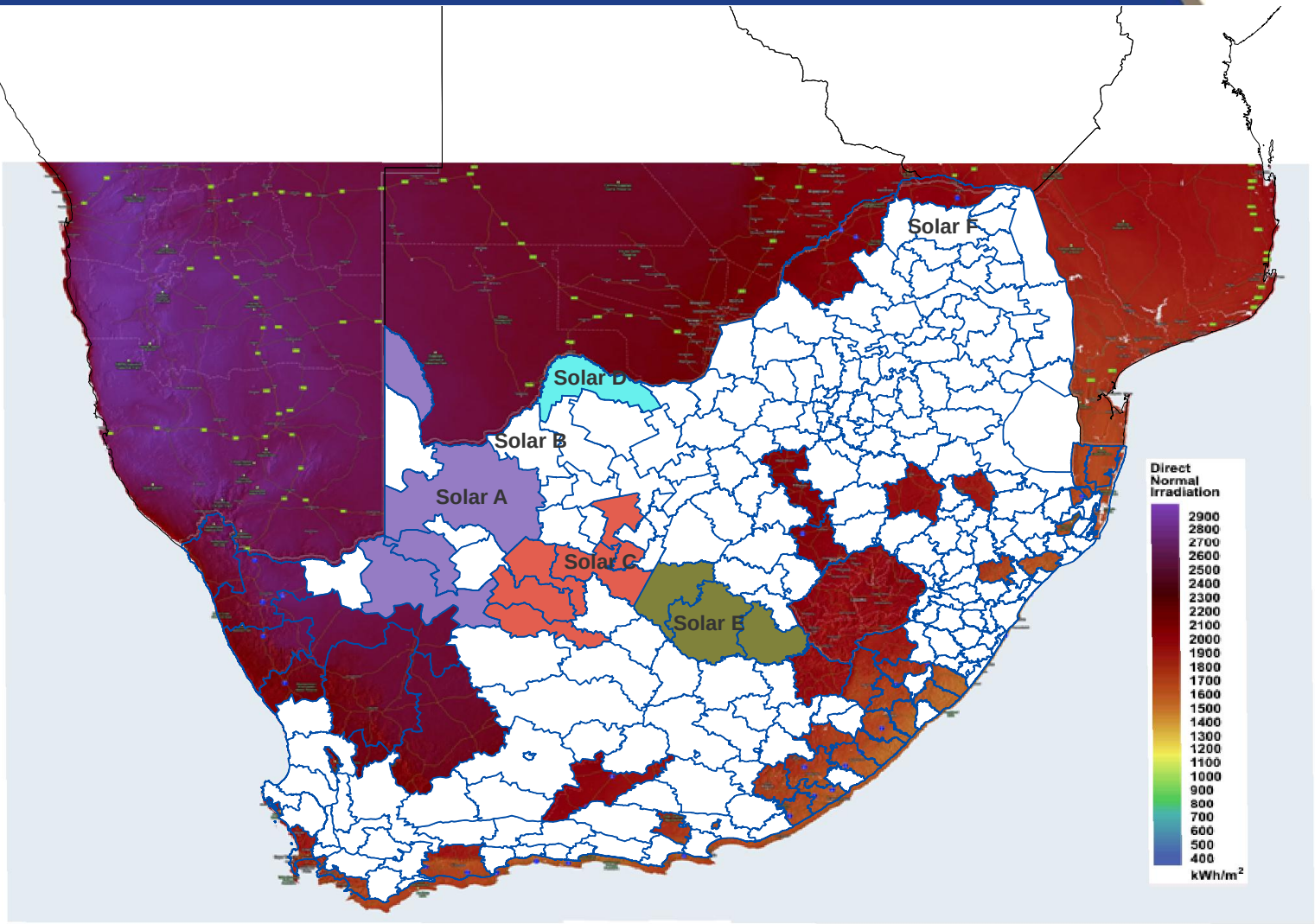
2040 Network Study – Generation Resource Map

Public Solar Irradiation Map

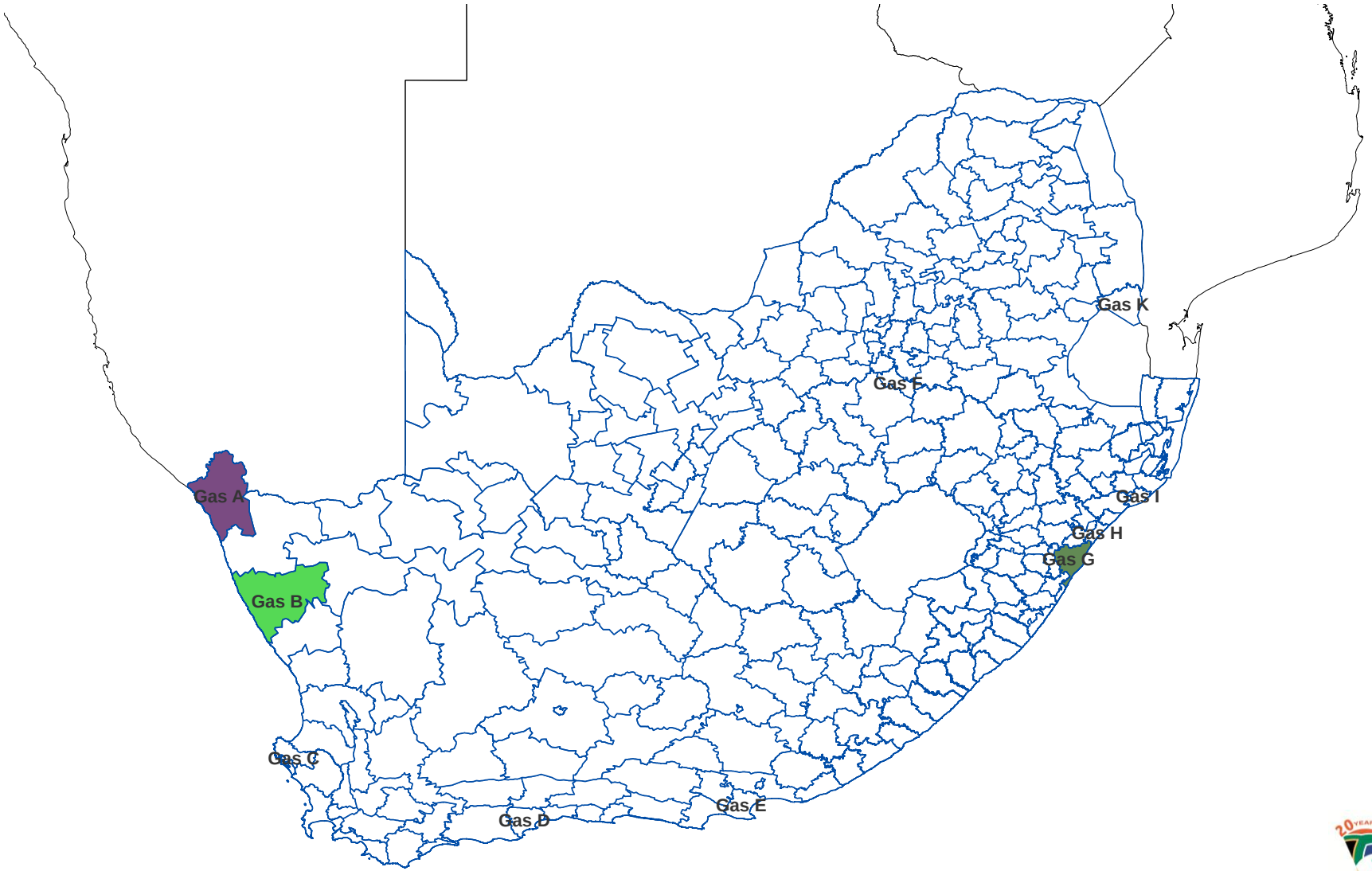


2040 Network Study – Generation Resource Map

Irradiation Map & Eskom Solar Areas

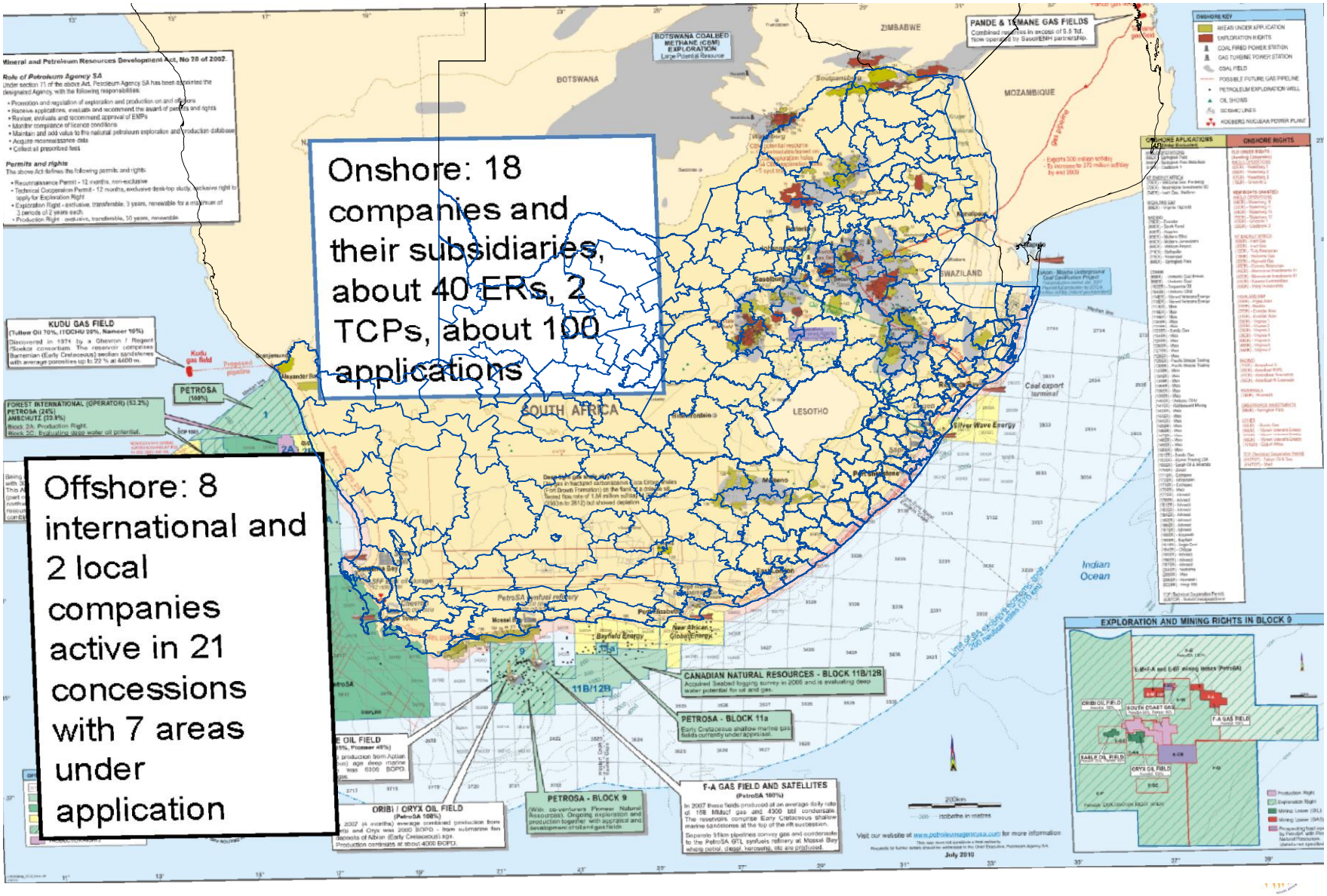


2040 Network Study – Generation Resource Map
Eskom OCGT & CCGT Areas



2040 Network Study – Generation Resource Map

Public Gas Potential Map

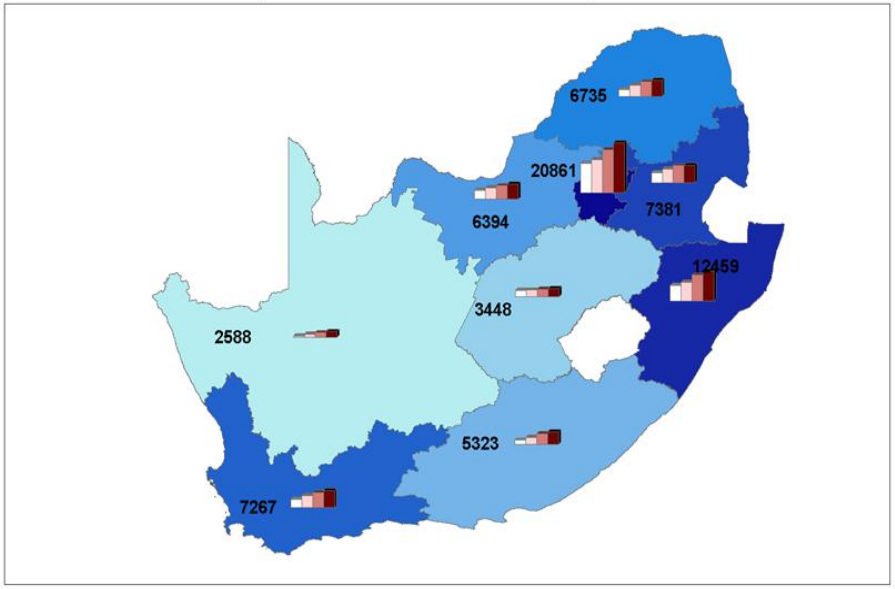


Mapping the Demand and Generation

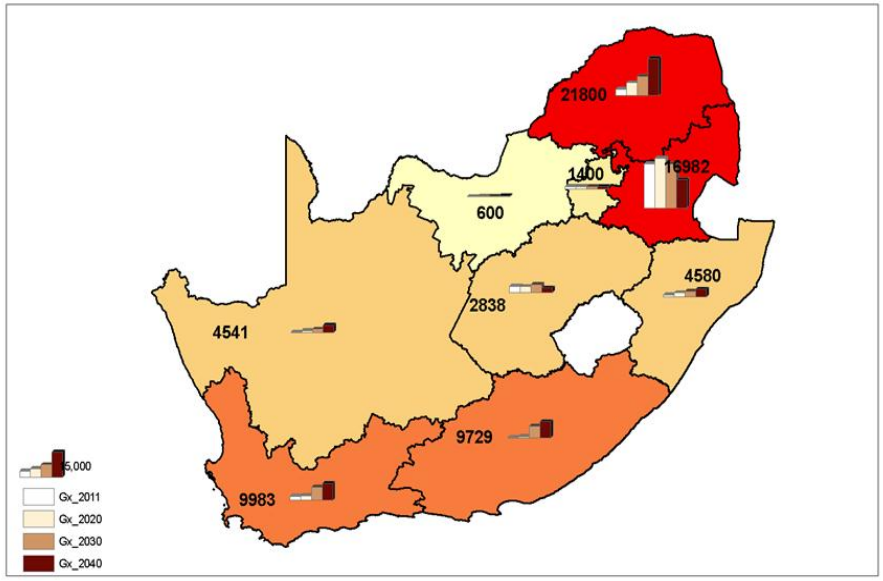
- Demand was allocated to each Municipal Area and then summated by province to get the total Load Demand for each province
- The Bars represent the relative Demand for 2011, 2020, 2030 and 2040 with the 2040 figure shown

- Generation was allocated to each Municipal Area and then summated by province to get the total Generation for each province for each Generation Scenario
- The Bars represent the relative Generation for 2011, 2020, 2030 and 2040 with the 2040 figure

LOAD GROWTH BY 2040 PER PROVINCE
(Maximum Demand in MW)

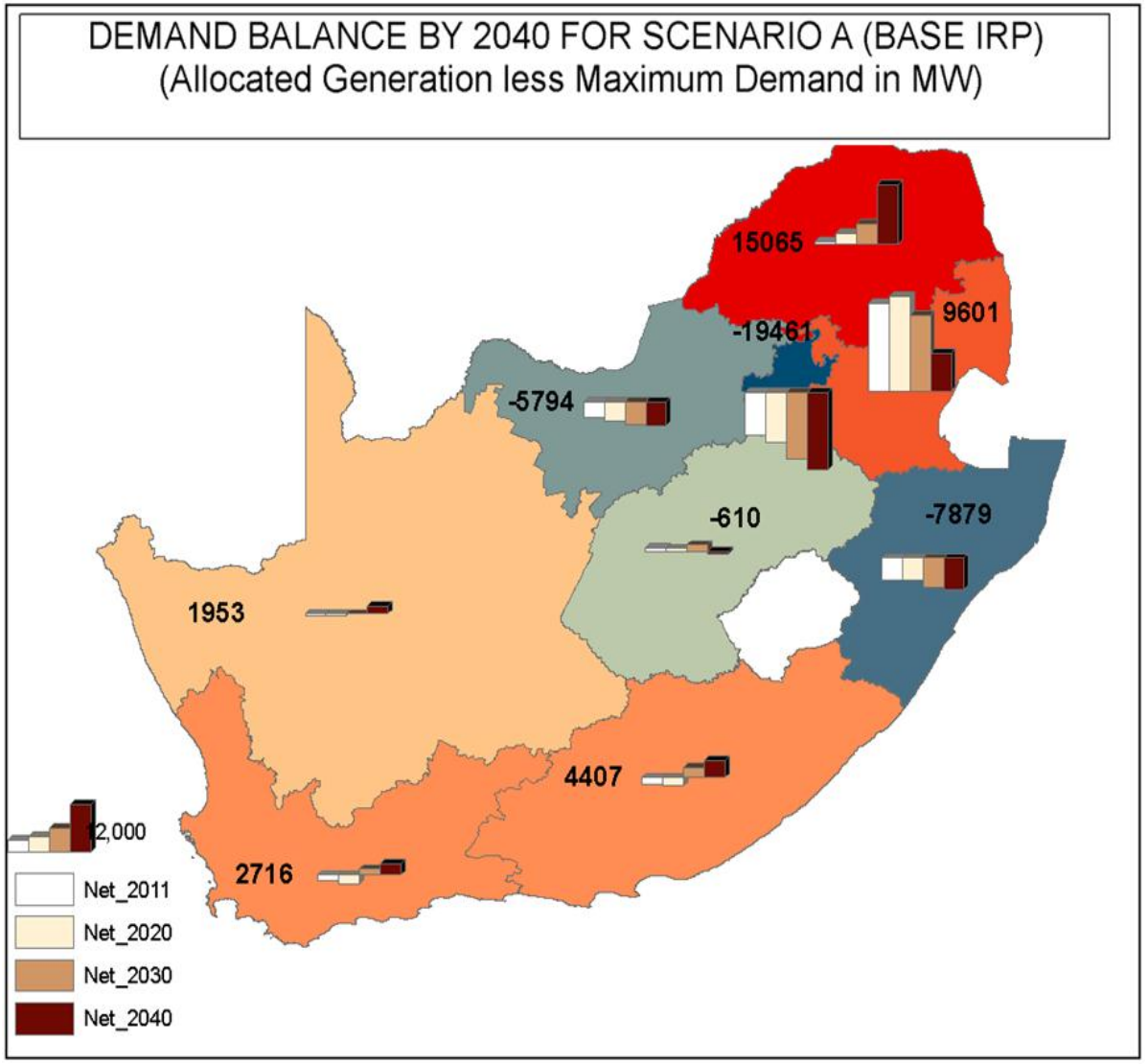


GENERATION DEVELOPMENT FOR SCENARIO A (BASE IRP)
(Maximum Demand in MW)

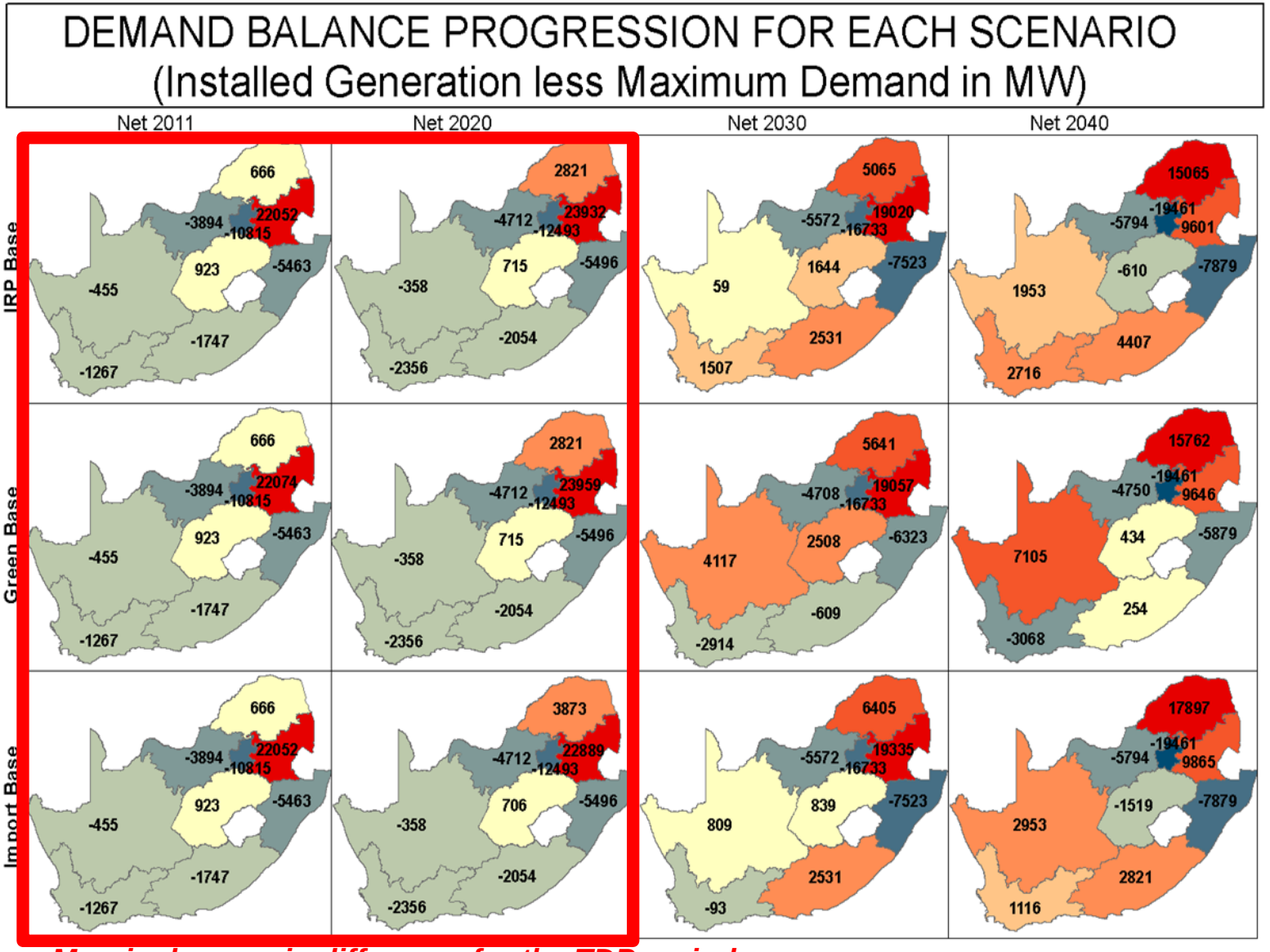


Mapping the Demand Balance up to 2040

- The Supply and Demand Balance value was calculated for each Generation Scenario for each year to 2040 to determine the change over this period
- The 2011, 2020, 2030 and 2040 scenarios are presented in the report to illustrate the change over each decade
- The Bars represent the relative Demand Balance for 2011, 2020, 2030 and 2040 with the 2040 figure shown for Scenario A in this case
- All three Generation Scenarios can be mapped and compared to show the differences between the scenarios over time

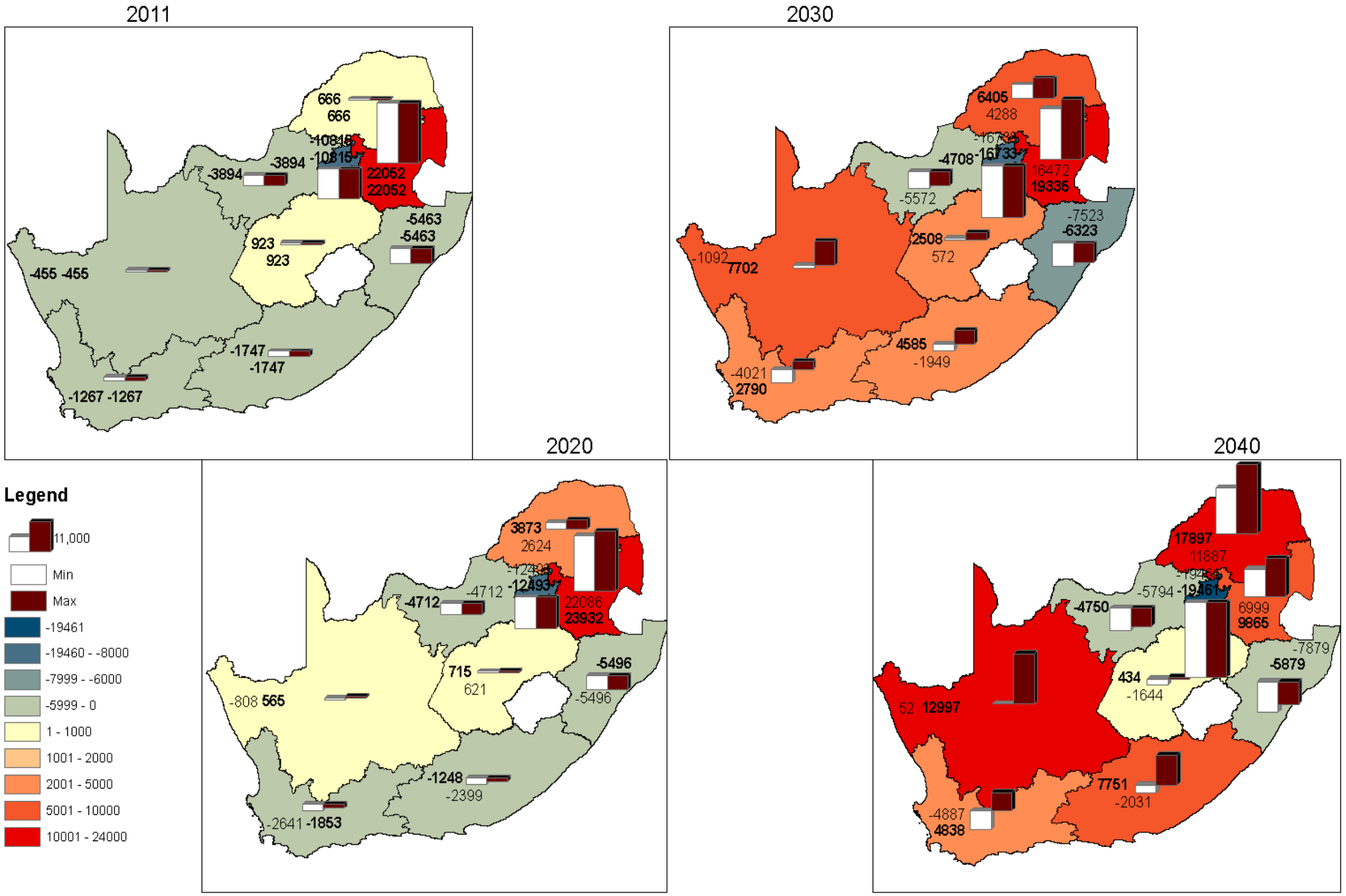


Comparing Demand Balances for each Generation Scenario

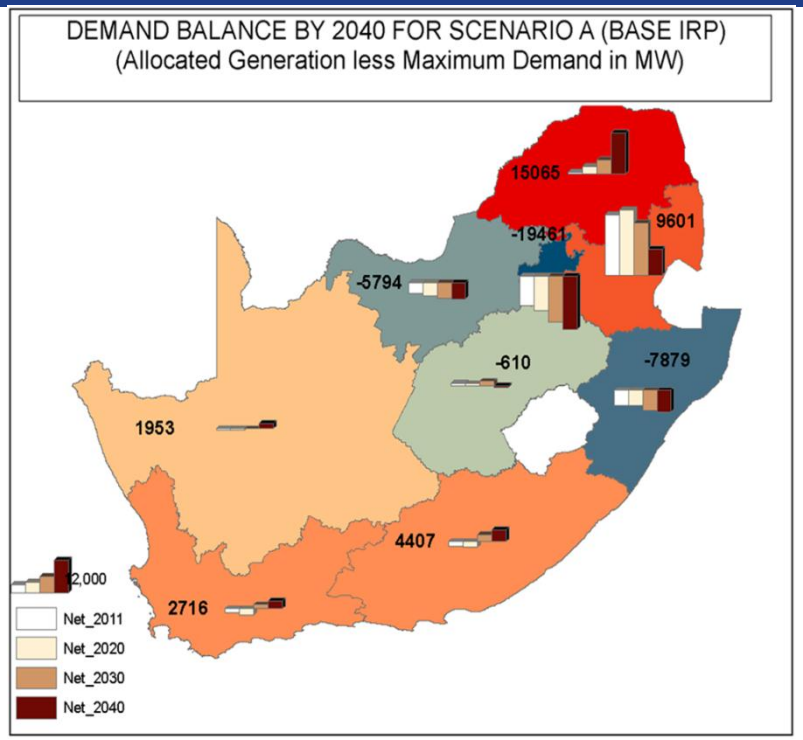


Marginal scenario difference for the TDP period

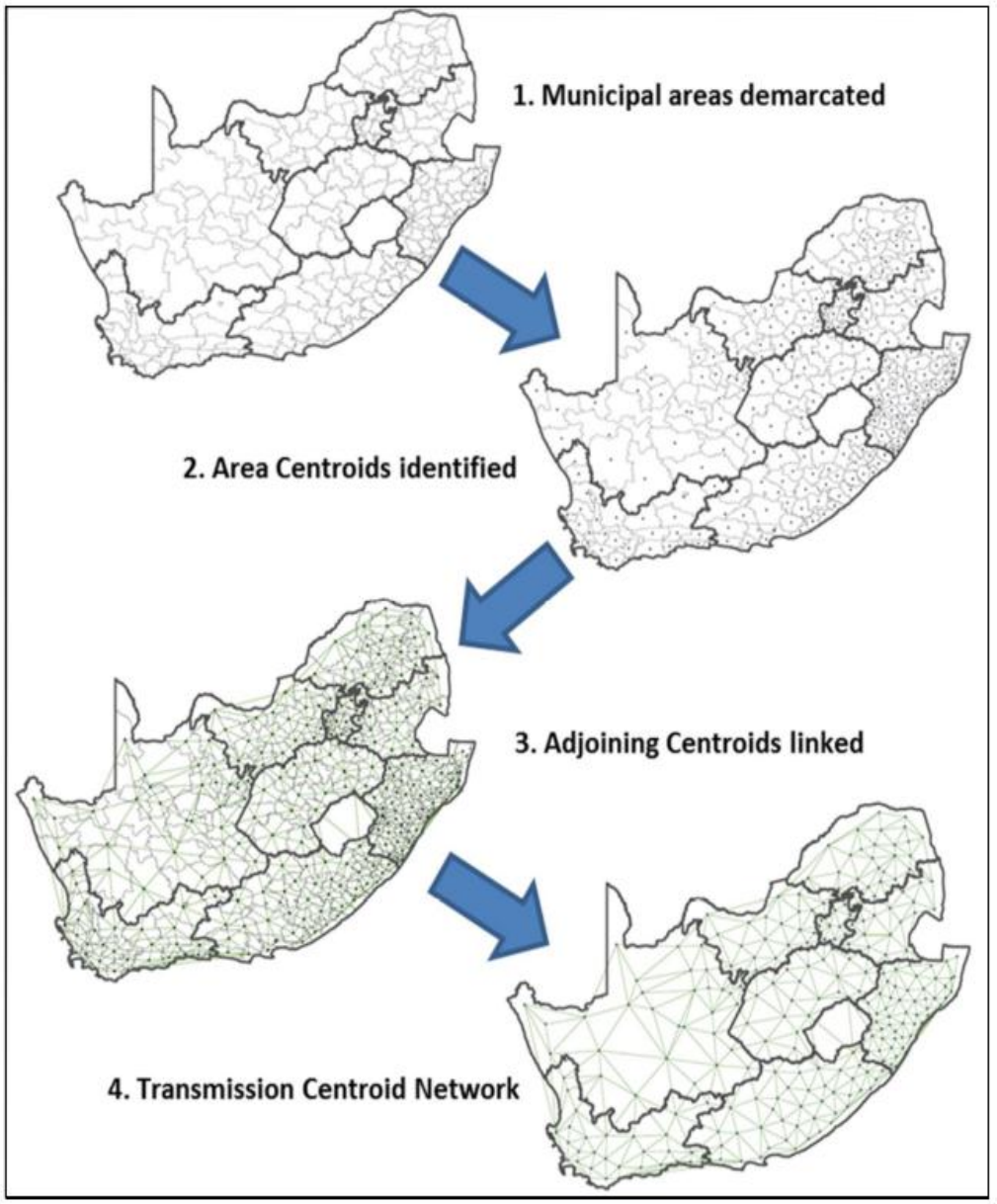
MAX & MIN DEMAND BALANCE PROGRESSION CONSIDERING ALL SCENARIOS
(Allocated Generation less Maximum Demand in MW)



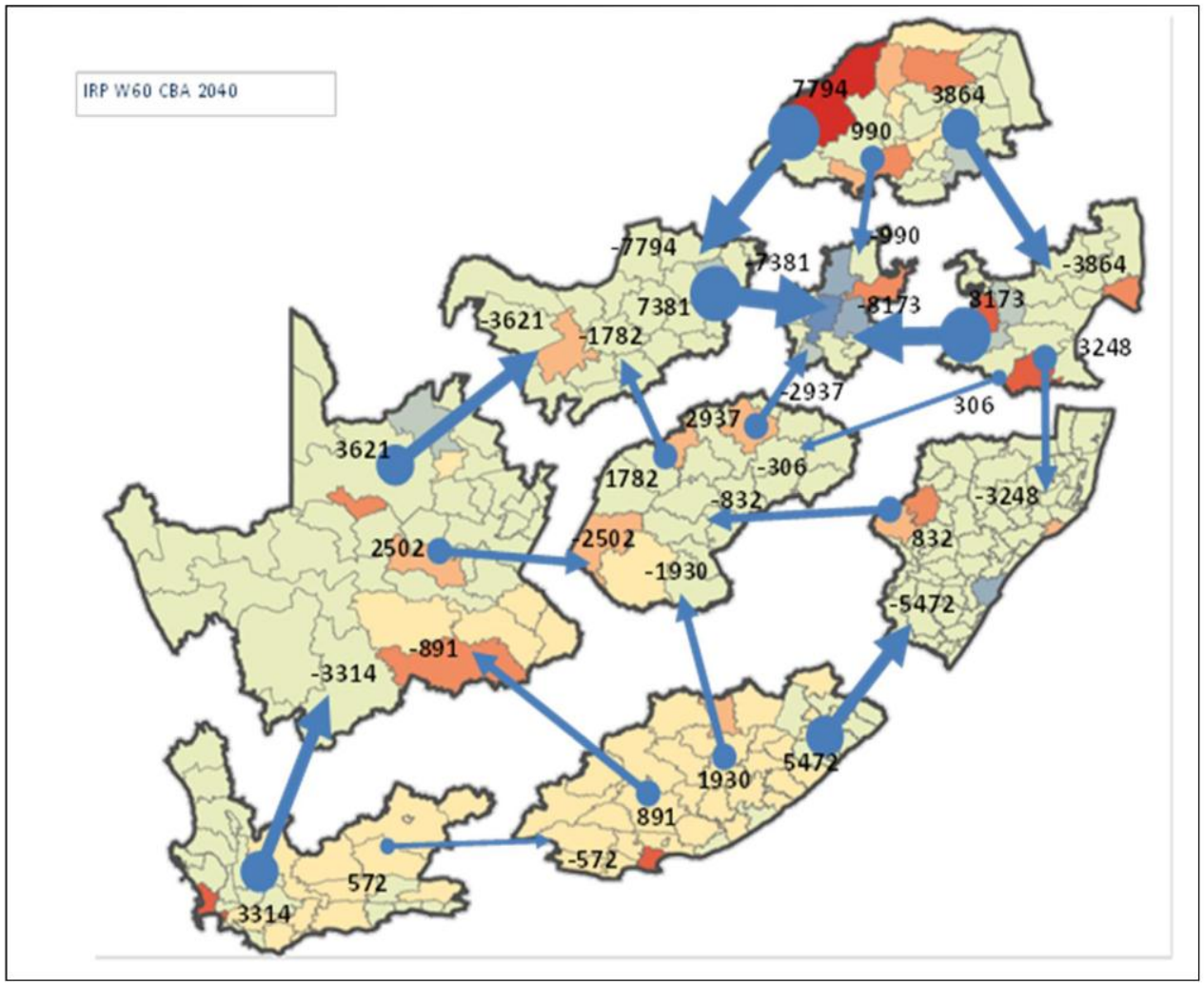
Transmission Centroid Network



- Unconstrained spatial Tx network model developed
- "Relative" electrical impedance between each adjoining centroids was calculated considering physical terrain
- Preferred power transfers for each generation scenario were determined

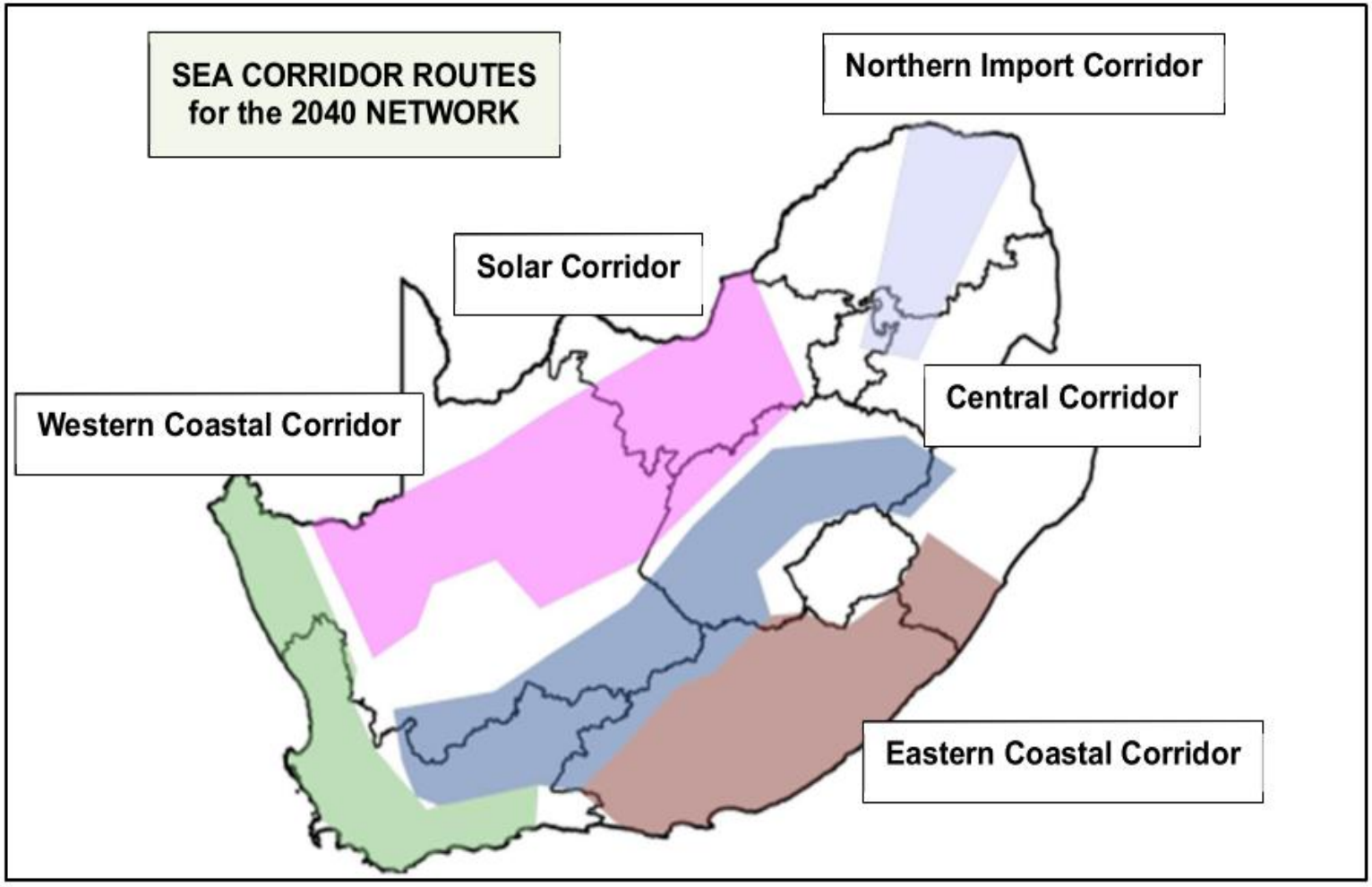


Inter-Province Power Transfers for the IRP W60 CBA 2040 scenario



- Power transfers with direction of flow can be plotted between each province for the four Max Scenarios.
- Arrows indicate relative size of transfer in MW
- This case is for the IRP BASE scenario with 60% Wind generation in an east-to-west (CBA) distribution pattern
- Area shading indicates within province where generation excess (red) or high load demand (blue) is physically located

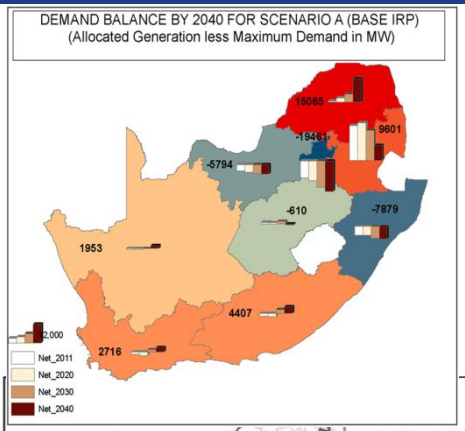
The identified 2040 SEA Corridors

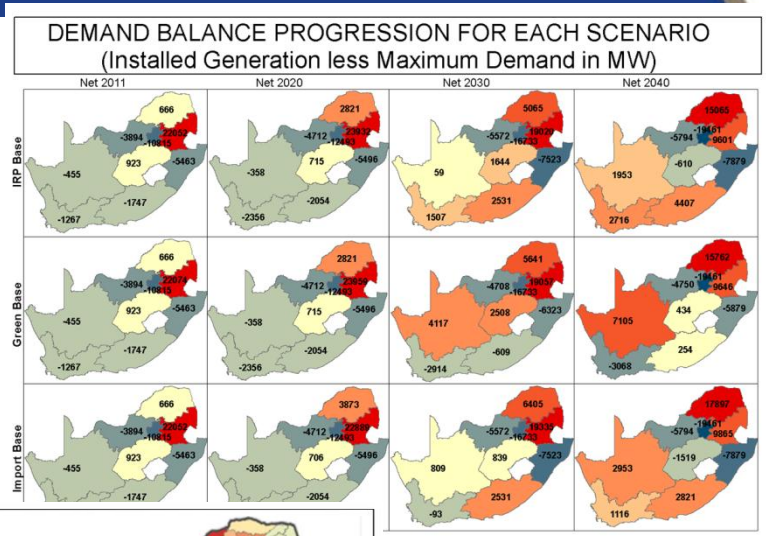


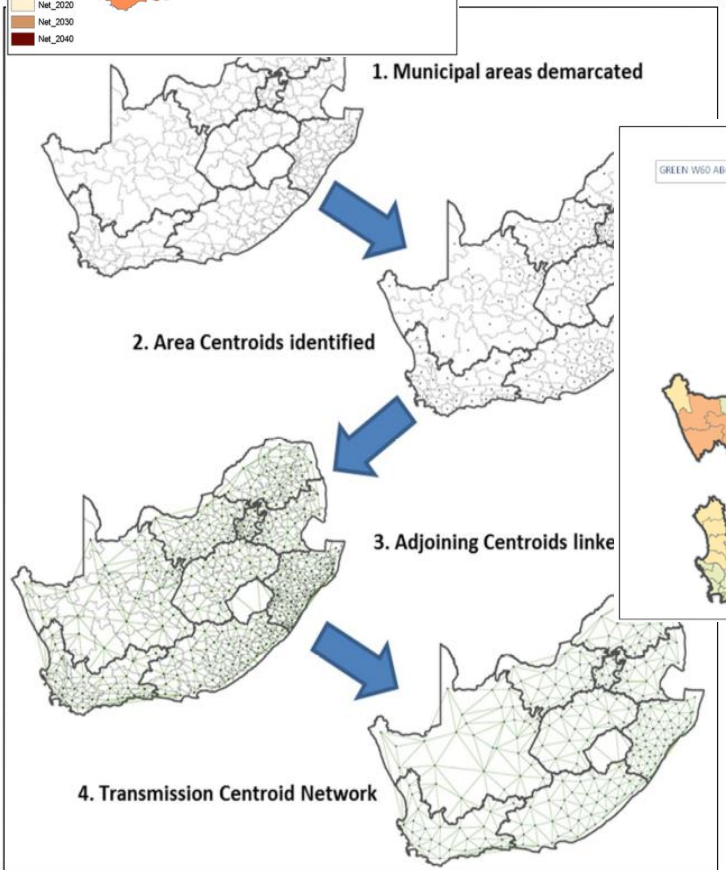
Analysis of the inter-province power flows across the generation scenarios and loading conditions start to indicate where the power flows concentrates under all scenarios.

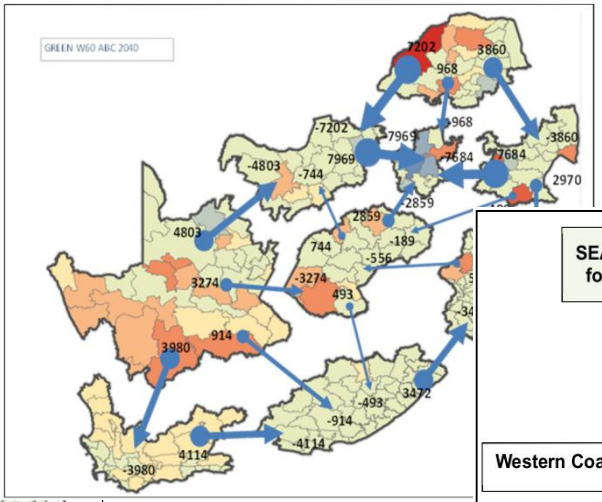
Five major corridors were identified for the future strategic development of the Tx Grid

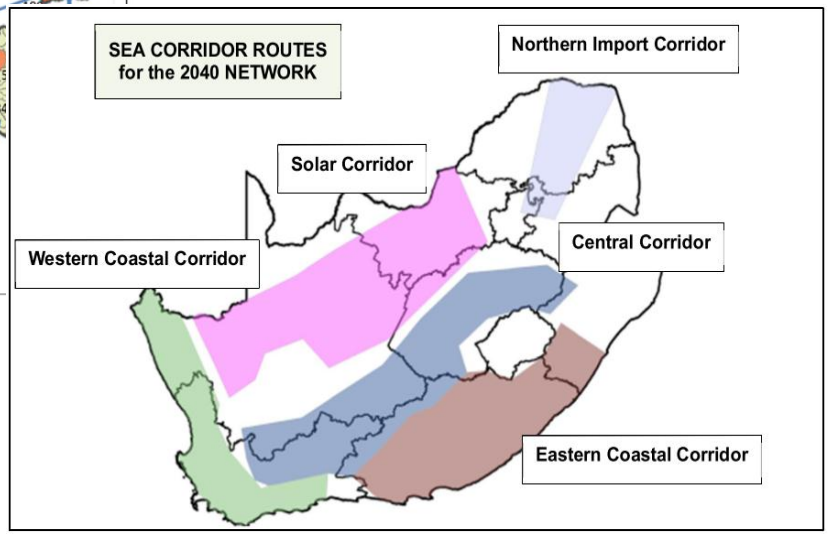
Strategic Grid Plan







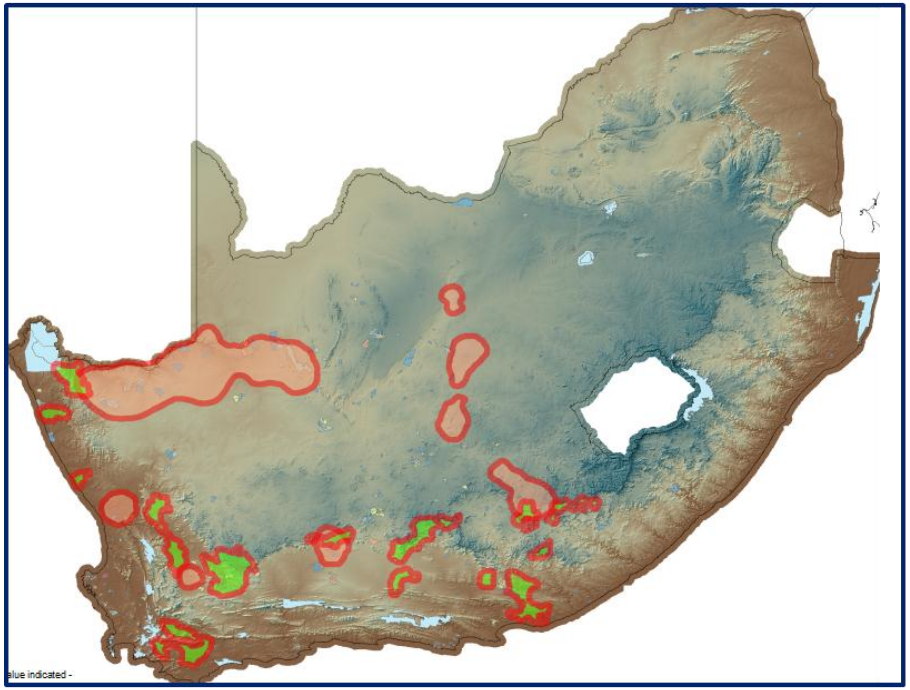




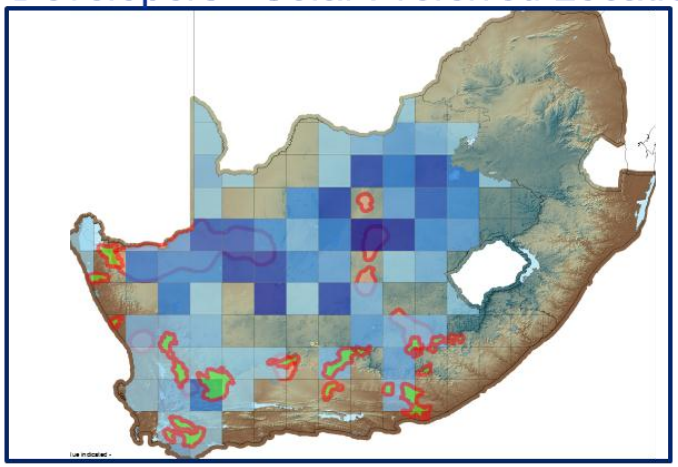
DEA \ CSIR Renewable Zones Study for SIP 8 (increase Renewable Energy)

Eskom

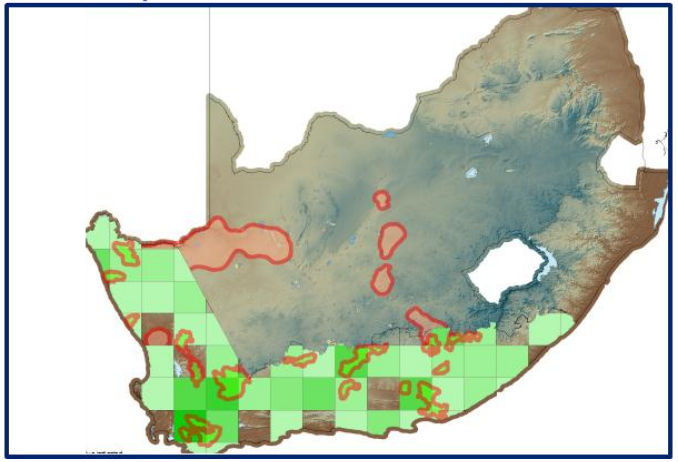
SEA - Wind and Solar Preferred Location



Developers - Solar Preferred Location



Developers – Wind Preferred Location

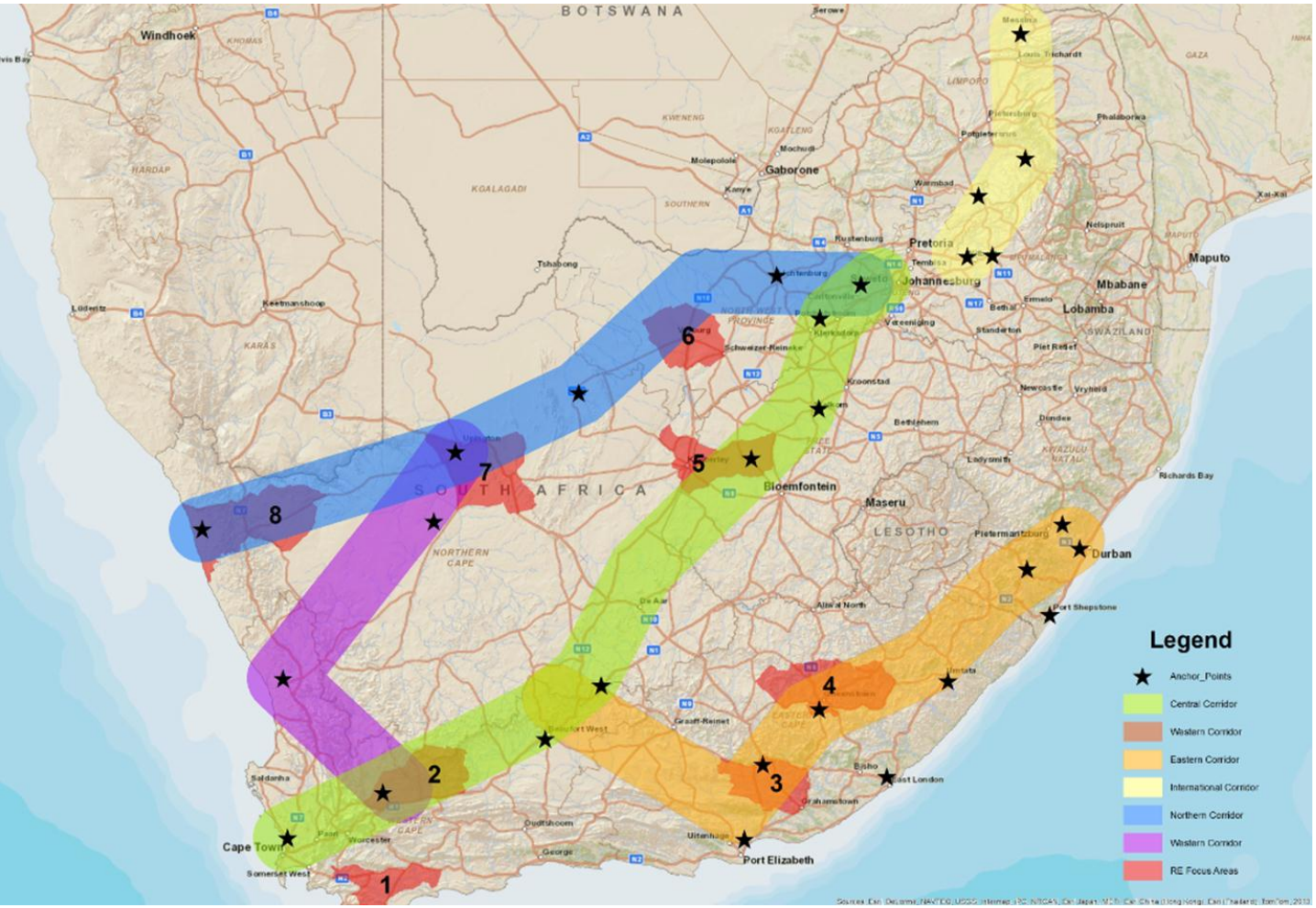


The CSIR were appointed by DEA to undertake a study to identify suitable corridors and zones for the efficient and effective rollout of wind and solar PV energy.

The selection criteria included amongst others the environmental suitability of the land, the resource potential as well as exclusion areas.

https://redzs.csir.co.za/

Final SEA Corridors for SIP 10 project

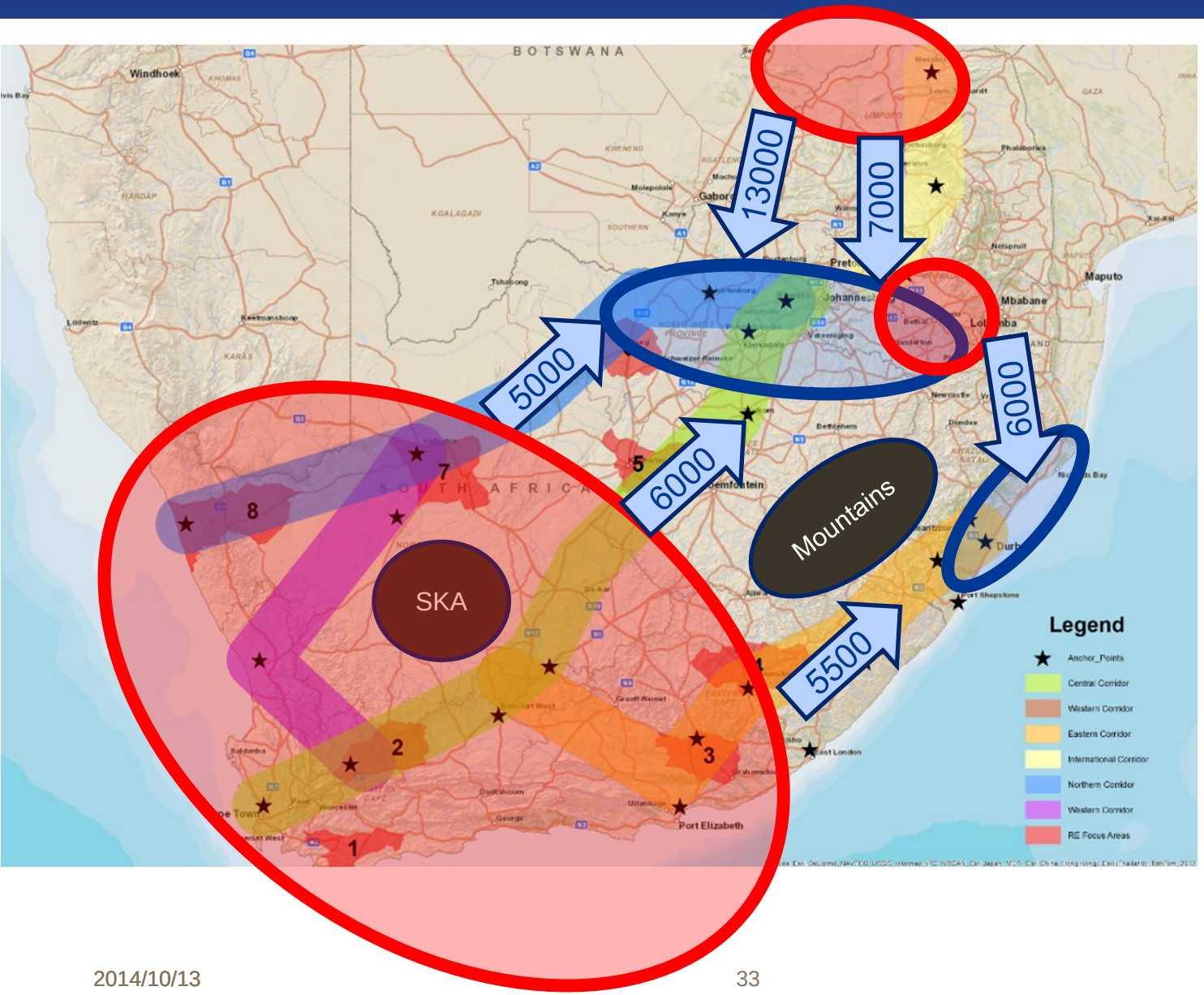


The “National” power corridors were then further refined and consolidated into five Major Transmission power Corridors.

These were then used as the basis for a national SEA study project by the DEA. This forms part of the SIP 10 project of the Govt. NDP.

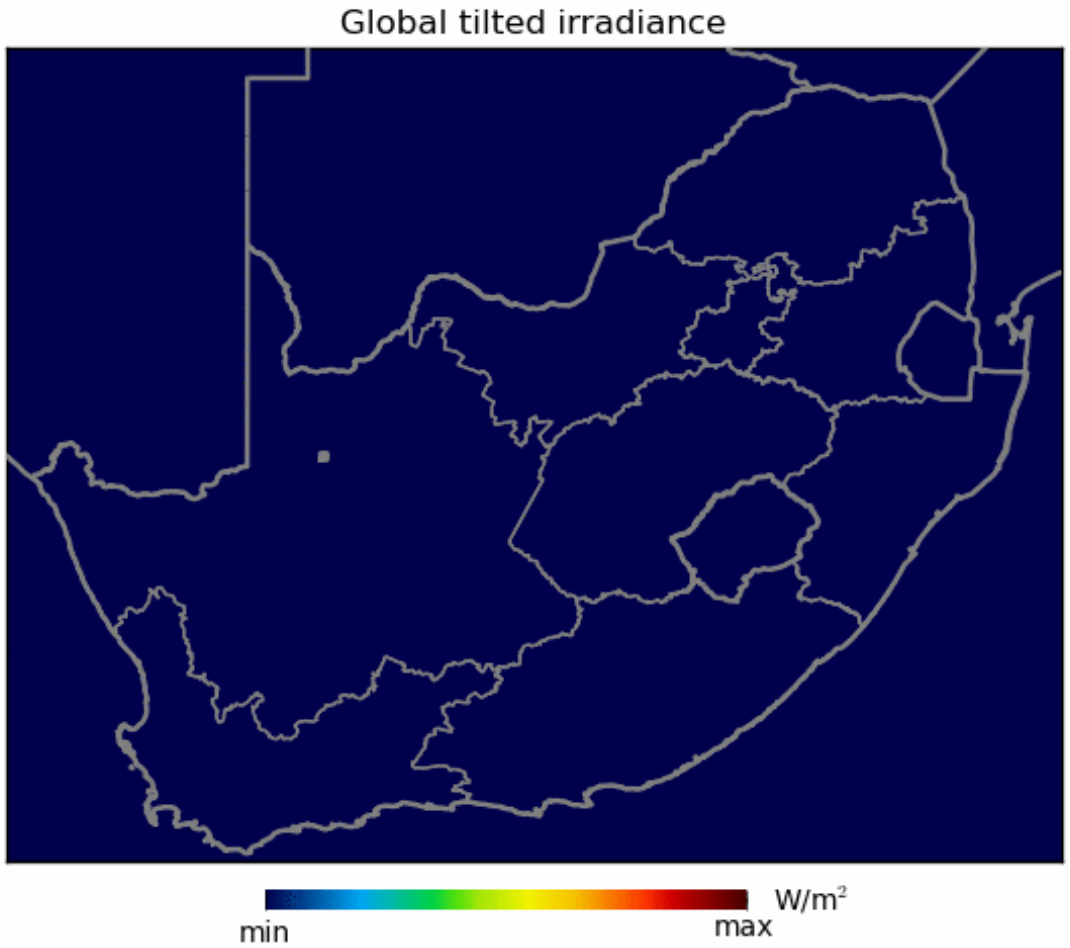
The objective is to secure all the needed environmental approvals for Tx lines within the corridors which will be valid in perpetuity.

SGP Tx 2040 Study Corridor Overview



Cloud impact on PV power generation

23 Jan 2012 04:15 SAST

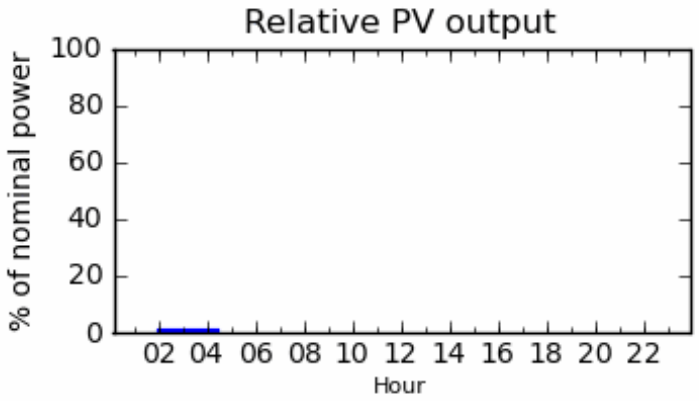


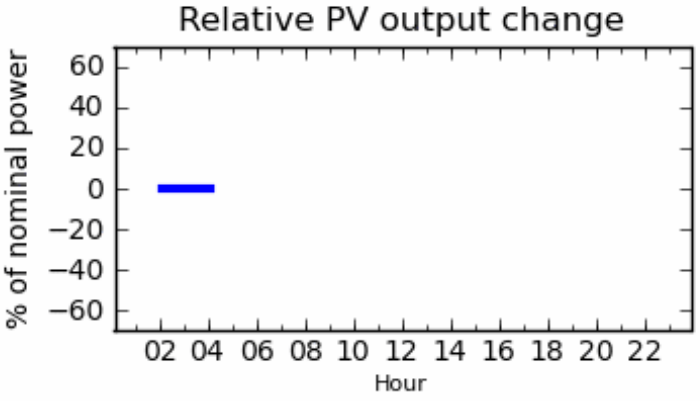
Upington area

Aggregation level: 0

Aggregation area: 5 km x 5 km

Number of PV power plants: 1





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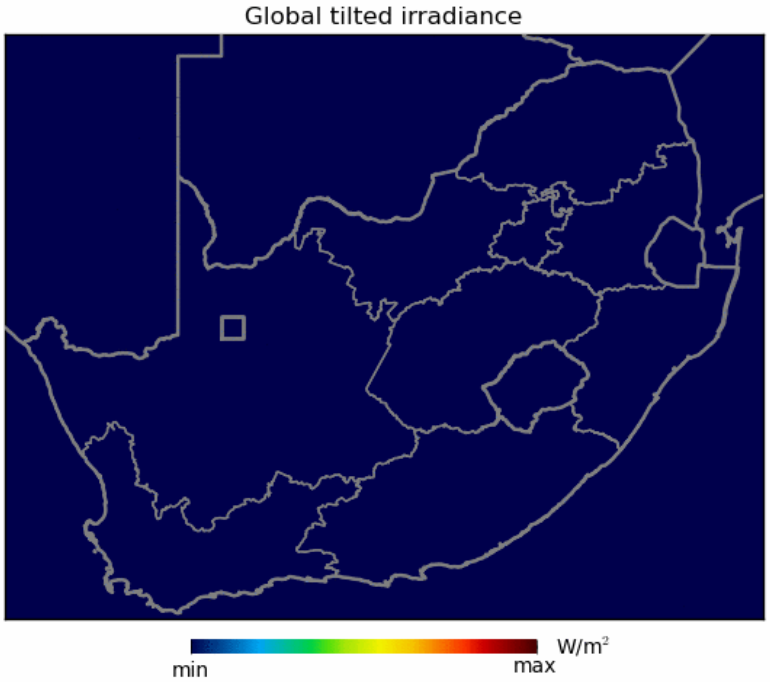
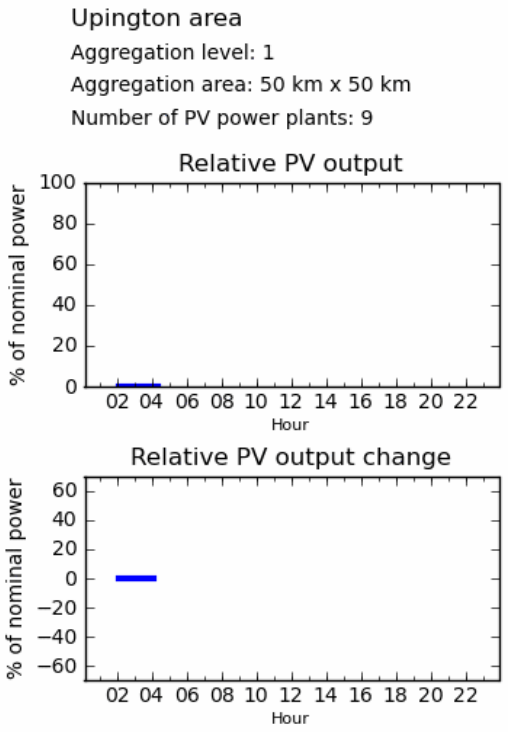
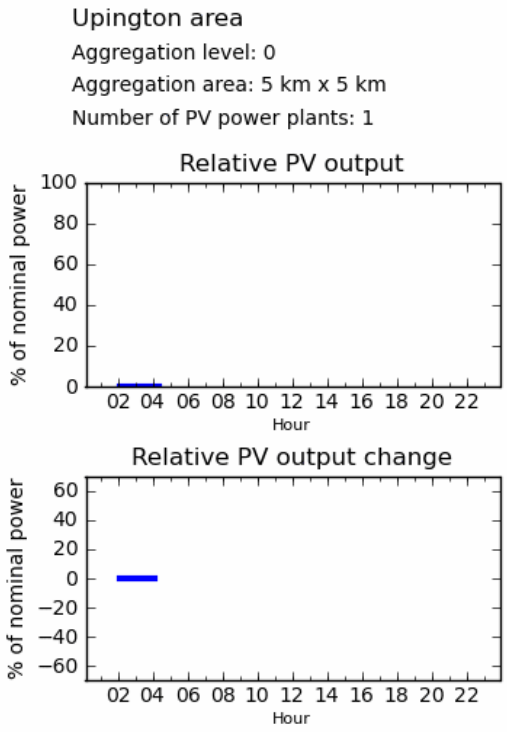
GeoModel SOLAR

Cloud impact on PV power generation

23 Jan 2012 04:15 SAST







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GeoModel SOLAR

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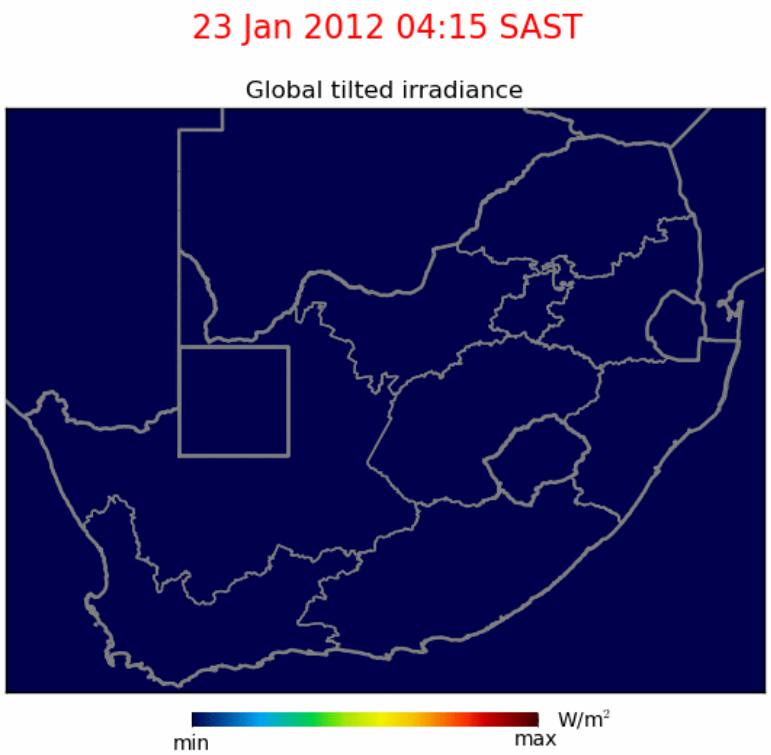
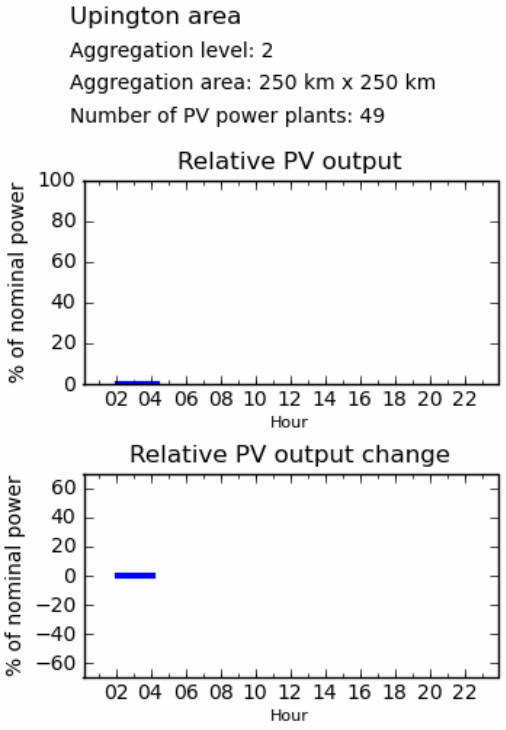
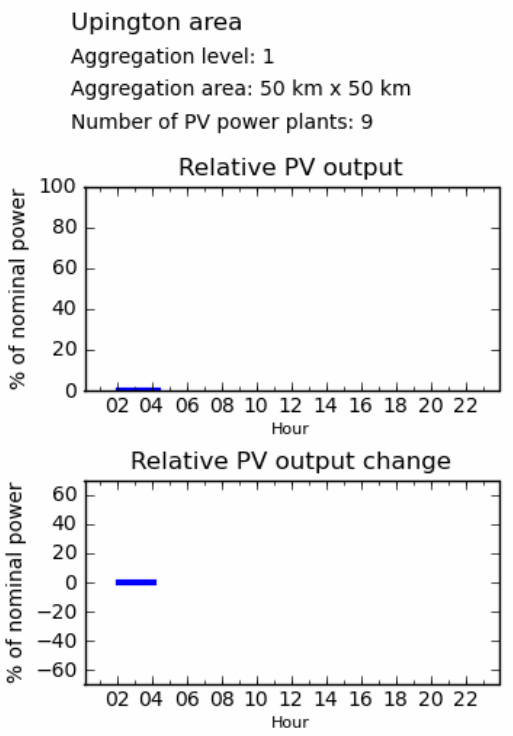
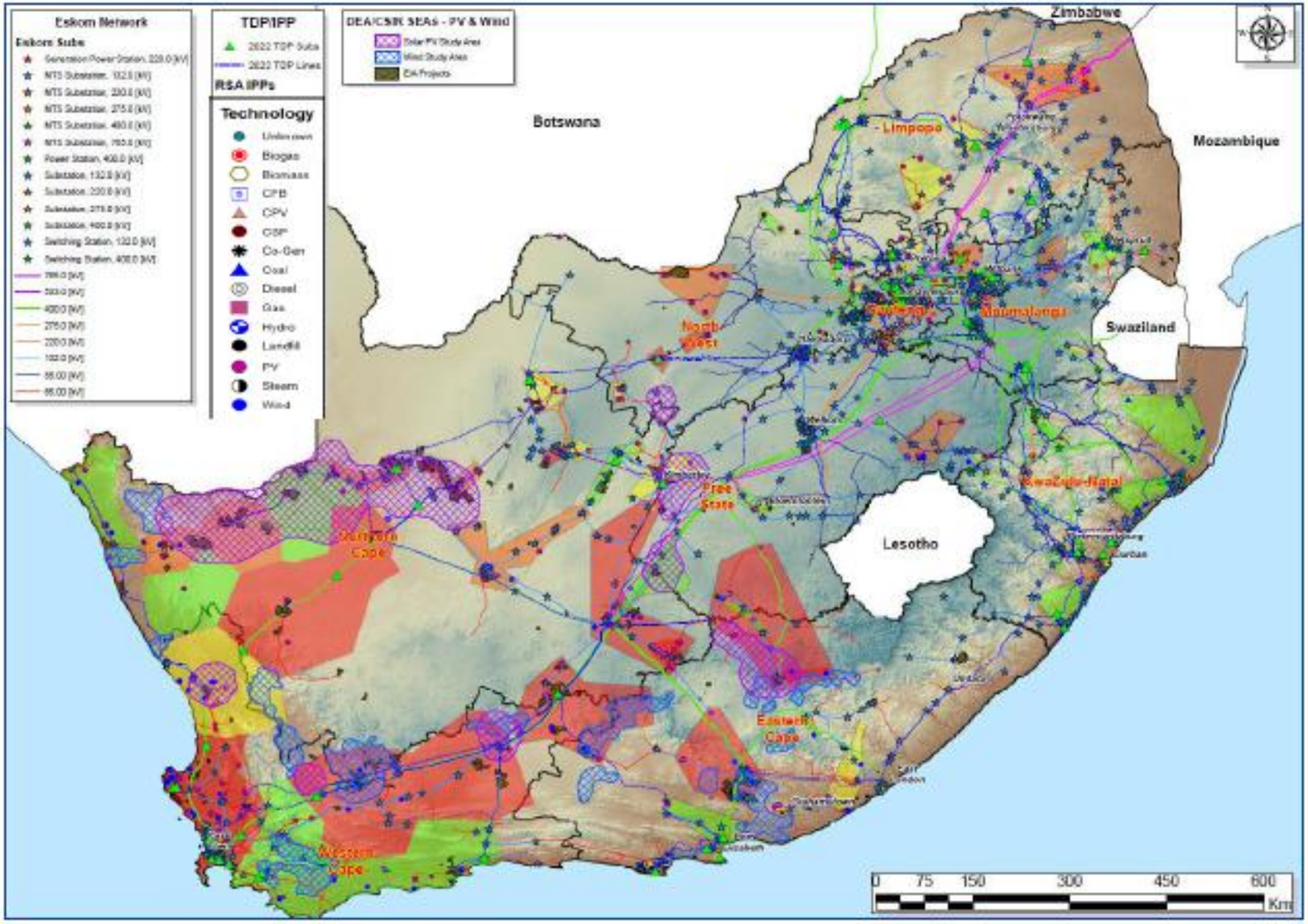
Cloud impact on PV power generation





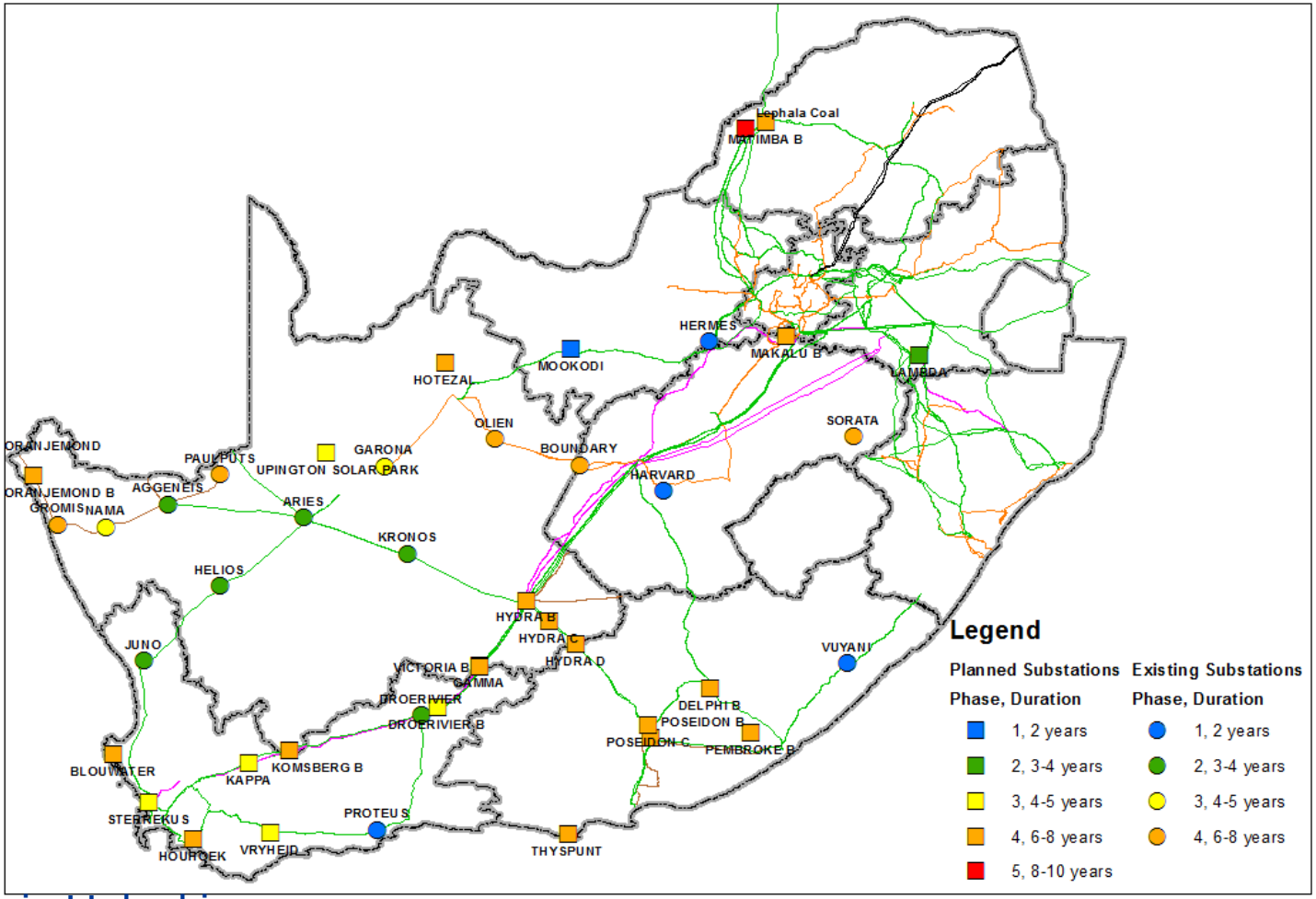


RE Project Cluster Areas Study

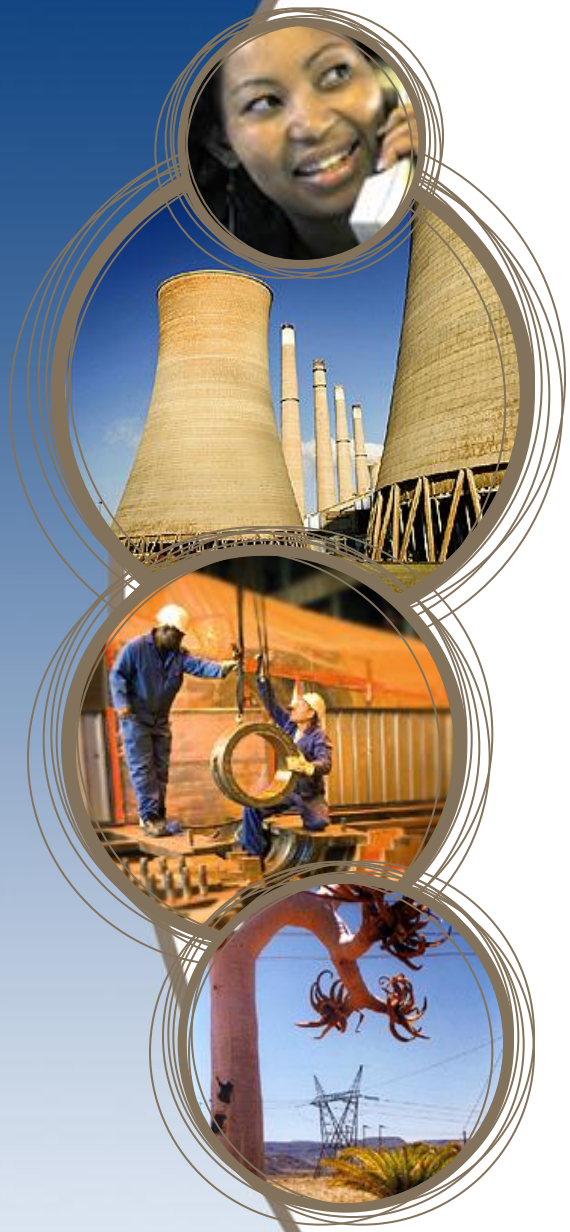


- Identified cluster areas of potential RE projects
- Green is low number of projects
- Red is high number of projects
- Aligned with identified local and national corridor routes.

Strategic Unlocking of Renewable Access



Strategic Unlocking
Implementation Time



Thank you