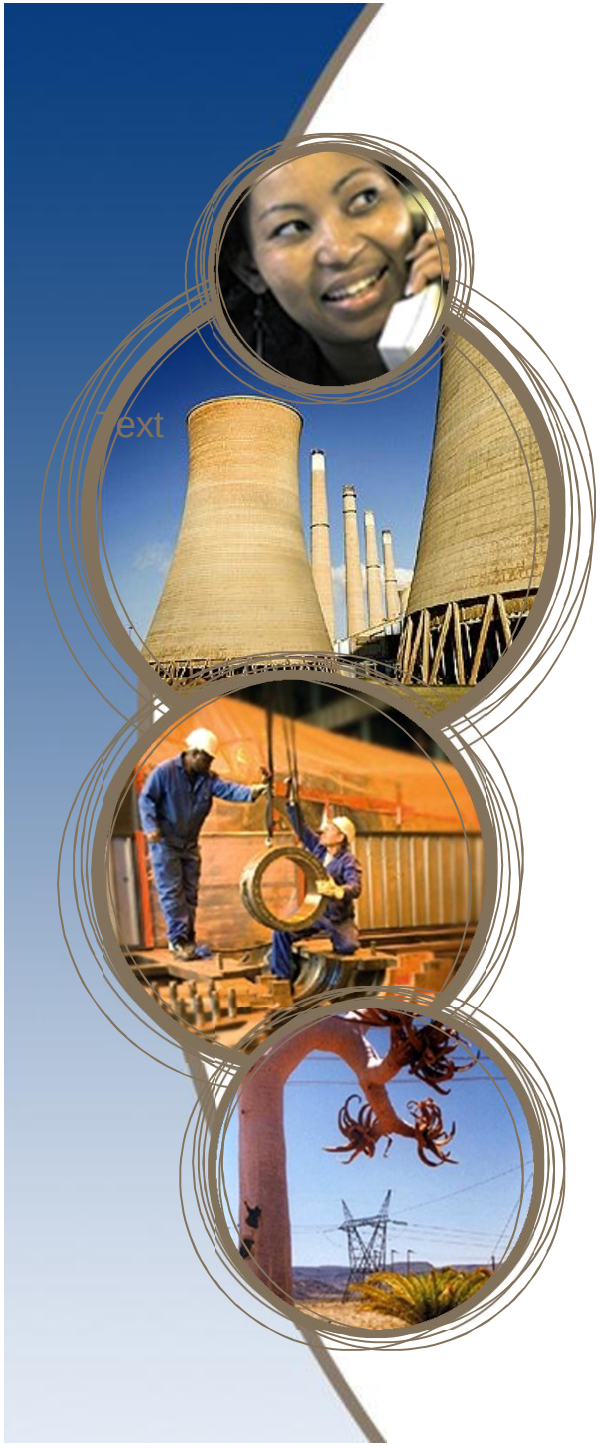


# SAIPPA

## Unlocking Grid Capacity for future Independent Power Producers (IPPs)

## Transmission Strategic Grid Planning

## GCCA

Country Club Johannesburg, Woodmead

Ronald Marais

Transmission - Grid Planning

Presentation to SAIPPA

27 August 2015

# Eskom fully supports the DOE IPP programme and has to-date taken steps to ensure the success of Transmission and Distribution network connections

## Highlights contributing to the success relating to Transmission and Distribution network connections

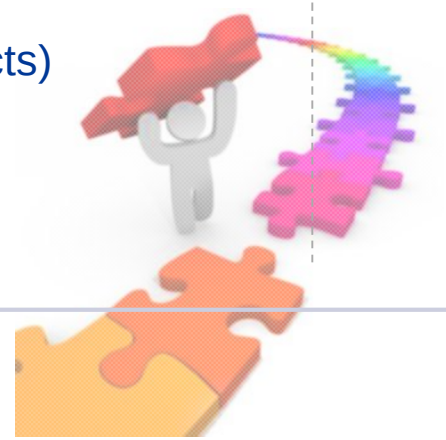
- Established the **Grid Access Unit** and the **Single Buyers Office** to facilitate the connections and buy the energy respectively.
- Published the **Grid Connection Capacity Assessment** (GCCA) document **to guide stakeholders** to areas on the system **where network capacity is available** in relation to the renewable energy resources
- **Identified strategic transmission line routes** to unlock network capacity to connect future IPPs. Currently **collaborating with Department of Environmental Affairs** to initiate Strategic Environmental Impact Assessments
- **Committed resources to work closely with the DOE IPP Office** with the intention of aligning the IPP programme to feasible network expansion plans
- **Successfully enabled the network to integrate Bid Windows 1 to 3 at a cost of R2.4 billion**
- **Introduced a Self Build Procedure document** that provides IPPs the option to ñ*self build*ò their dedicated connection infrastructure
- Beyond Bid Window 3.5 and based on the IRP2010 and interest from IPPs, we have a **good indication of network requirements and cost to integrate potential IPPs up to 2024**

# Since 2011, 42 projects (2124 MW) of RE IPPs were connected, ~88% (1865 MW) of which are in operation

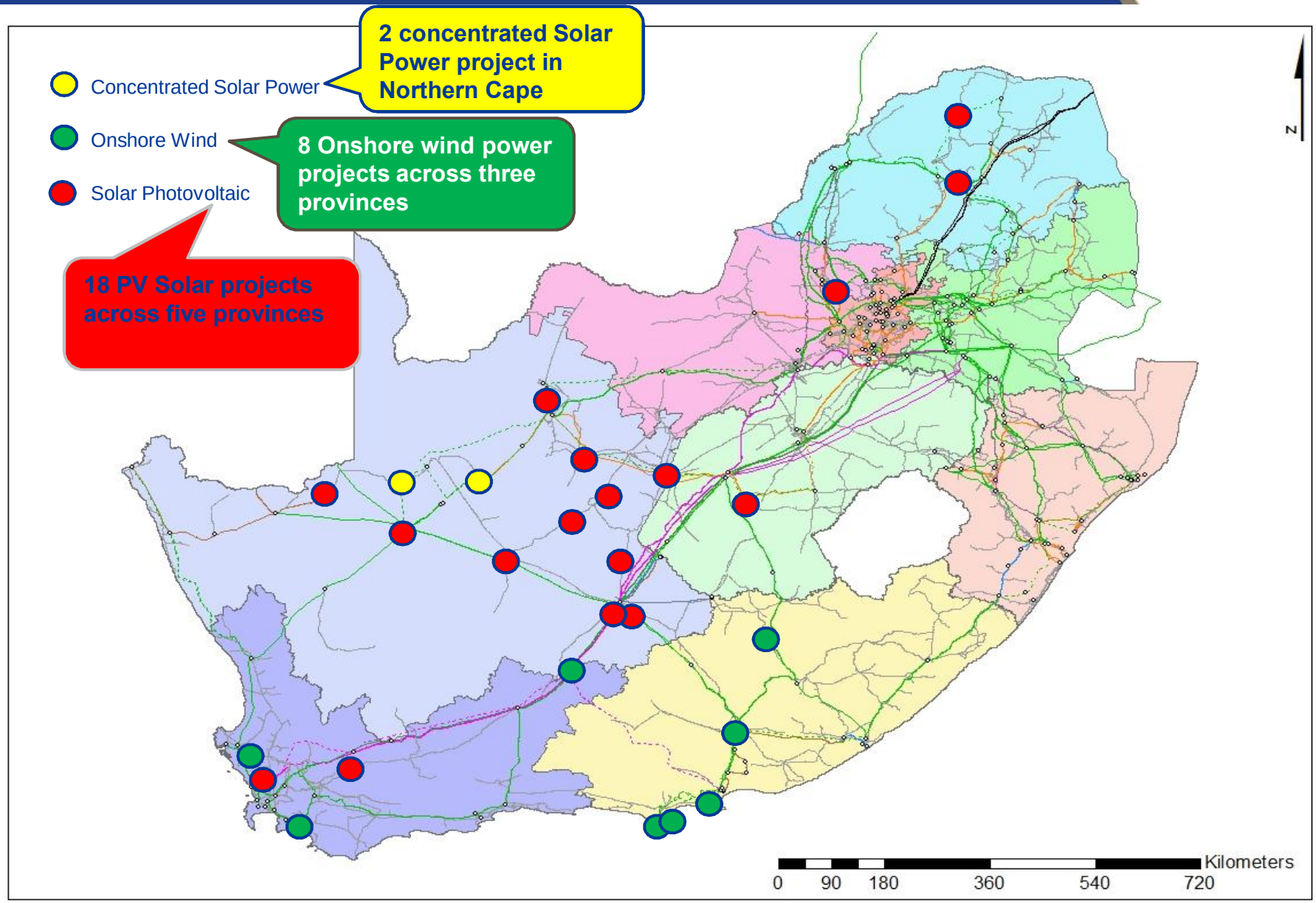
## Status of Current IPP programme

| Name of programme | MW contribution | Current status |
|---|---|---|
| Bid Window 1<br><br>(28 projects) | 1436 | All 28 projects connected. |
| Bid Window 2<br><br>(19 projects) | 1054 | 14 projects connected (706MW)<br><br>5 projects in execution |
| Bid Window 3 and 3.5<br><br>(21 projects) | 1656 | All budget quotations issued for 19 bid window 3 projects.<br><br>2 budget quotations due on 30th Aug 2015 for bid window 3.5 are in progress |

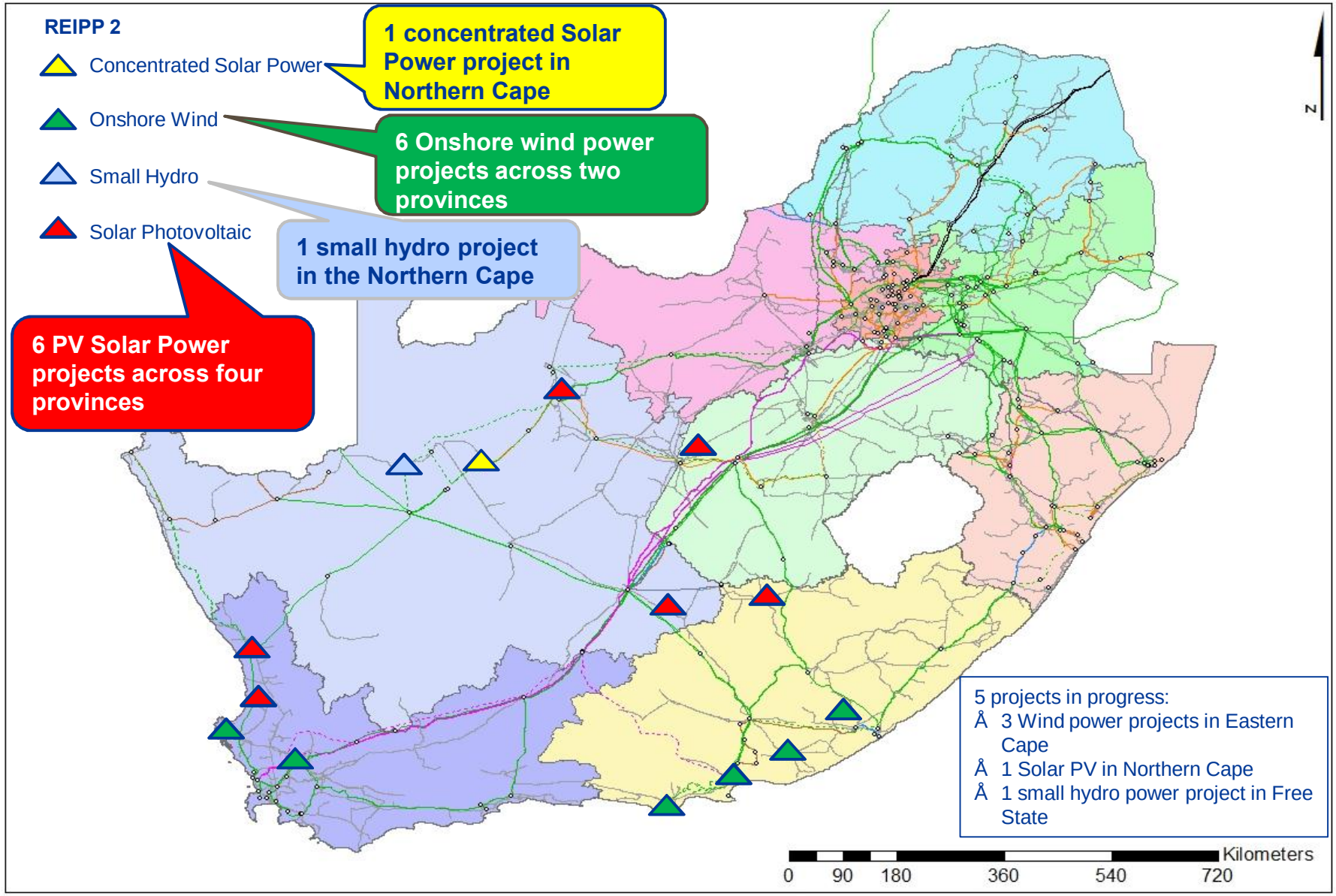
**2142 MW of RE IPPs have been connected to the grid underpinned by a R2.4 Billion Eskom investment**



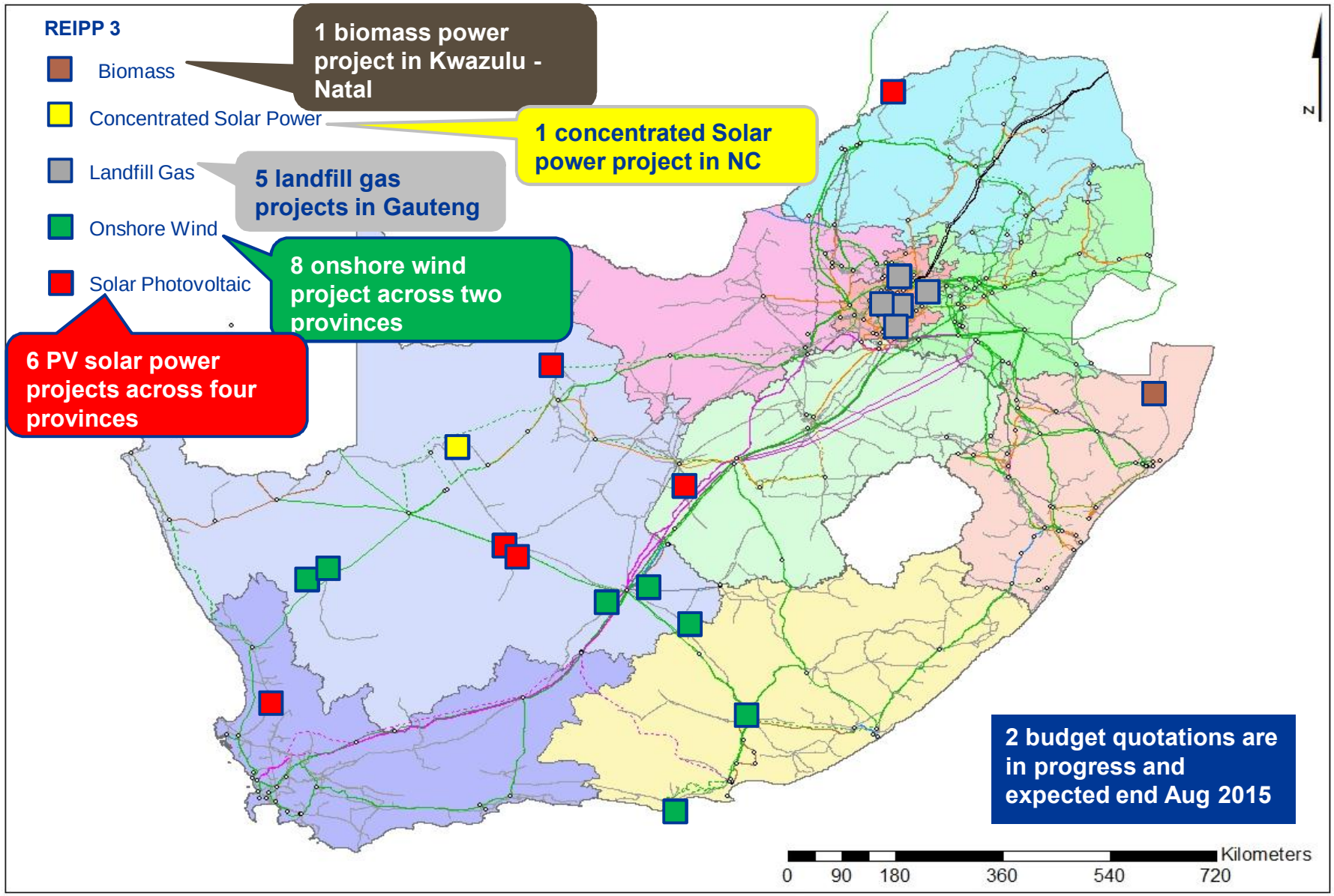
# All 28 projects from Bid Window 1 were connected, adding 1436 MW to the grid



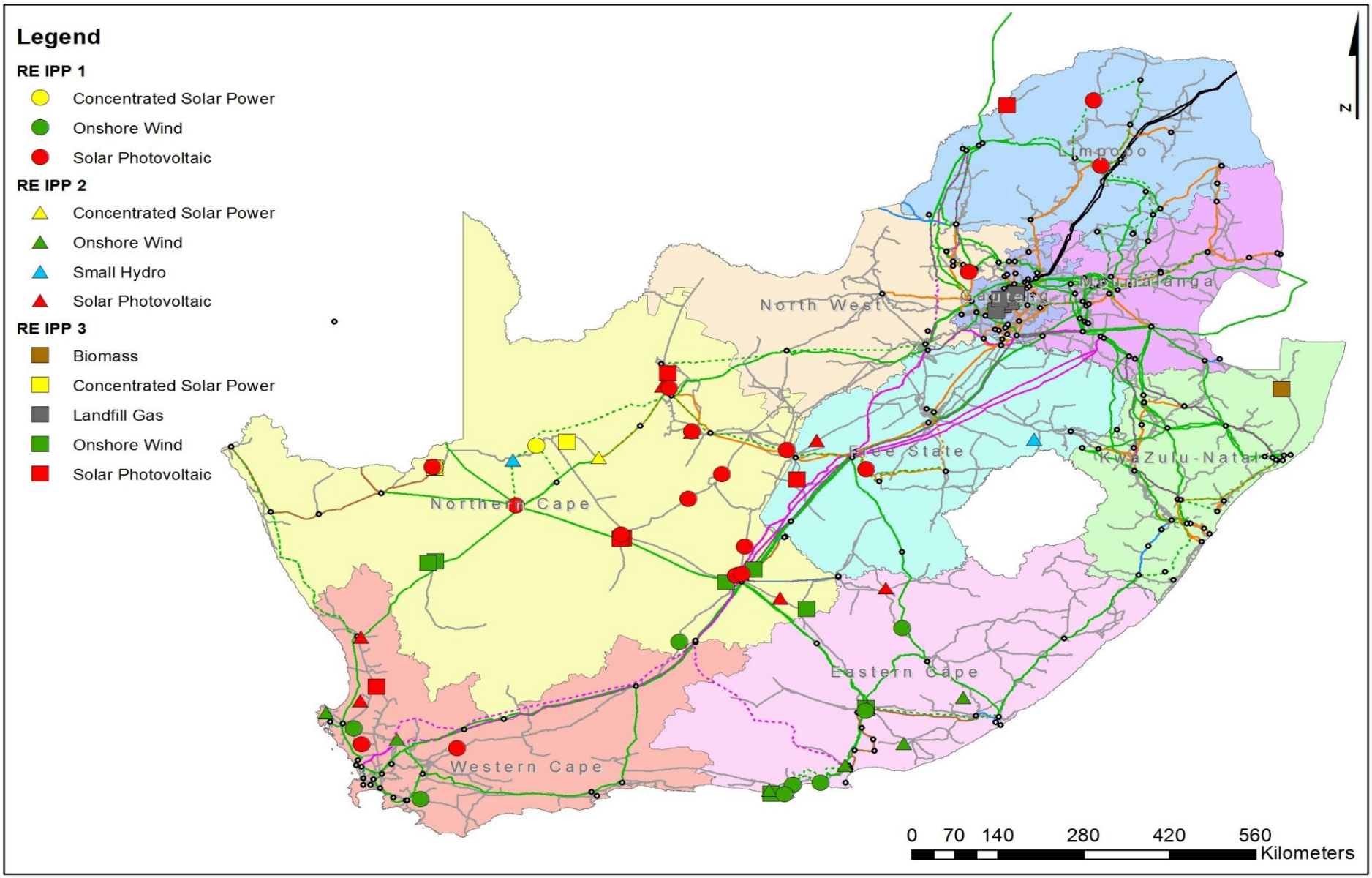
# 14 of the19 projects from Bid Window 2 have been completed, adding a total of 706 MW to the grid; with 5 of the projects in progress



# Of the 21 Bid window 3 and 3.5 projects, 19 budget quotations have been issued



# 42 projects (2124 MW) of RE IPPs have been connected, between bid window 1 and 3.5, at a cost of R2.4 Billion (excluding energy cost)



# Transmission

# Strategic Grid Planning

# What have we done

Eskom

**Determining the Future Grid**

- Conducted Transmission 2030 Study
- Conducted Transmission 2040 Study

**Expanding the Grid**

- Publish Annual Transmission Development Plan

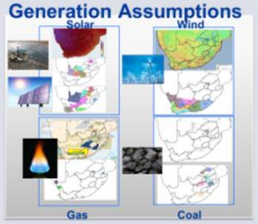

**On Time Grid Access**

- Prepared Generation Connection Capacity Assessment (GCCA)
- Created Generation Connection Application Procedure
- Developed a Tx Self -Build Policy
- Developed Streamlined Application Process

- Identify Future Corridors
- Flexibility to move to Different Scenarios
- Reduce Implementation time to meet generation & demand development
- Impact of Intermittence
- Grid Capacity
- Provide information on spatial network capacity available to connect Generation
- Enable faster implementation to ensure success of REIPP

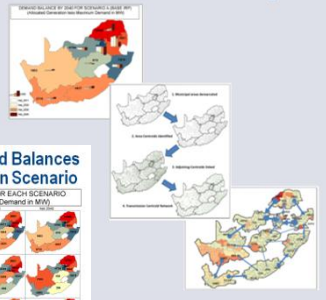
**Outputs and Studies Completed**

Generation Assumptions

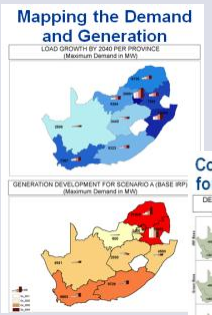



Engagement
Within ESKOM
Outside ESKOM

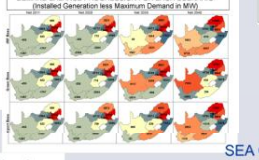

Scenario Corridor Analysis



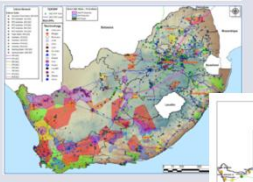
Mapping the Demand and Generation



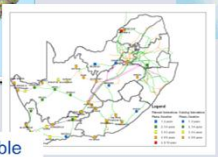
Comparing Demand Balances for each Generation Scenario



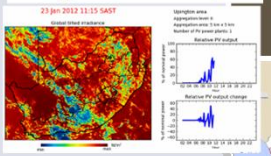
Renewable Energy Application Integration Analysis Cluster Area Study



SEA Corridors for SIP 10 project



Intermittency - Renewable Energy Cloud Cover Impact



Final SIP 10 Corridors

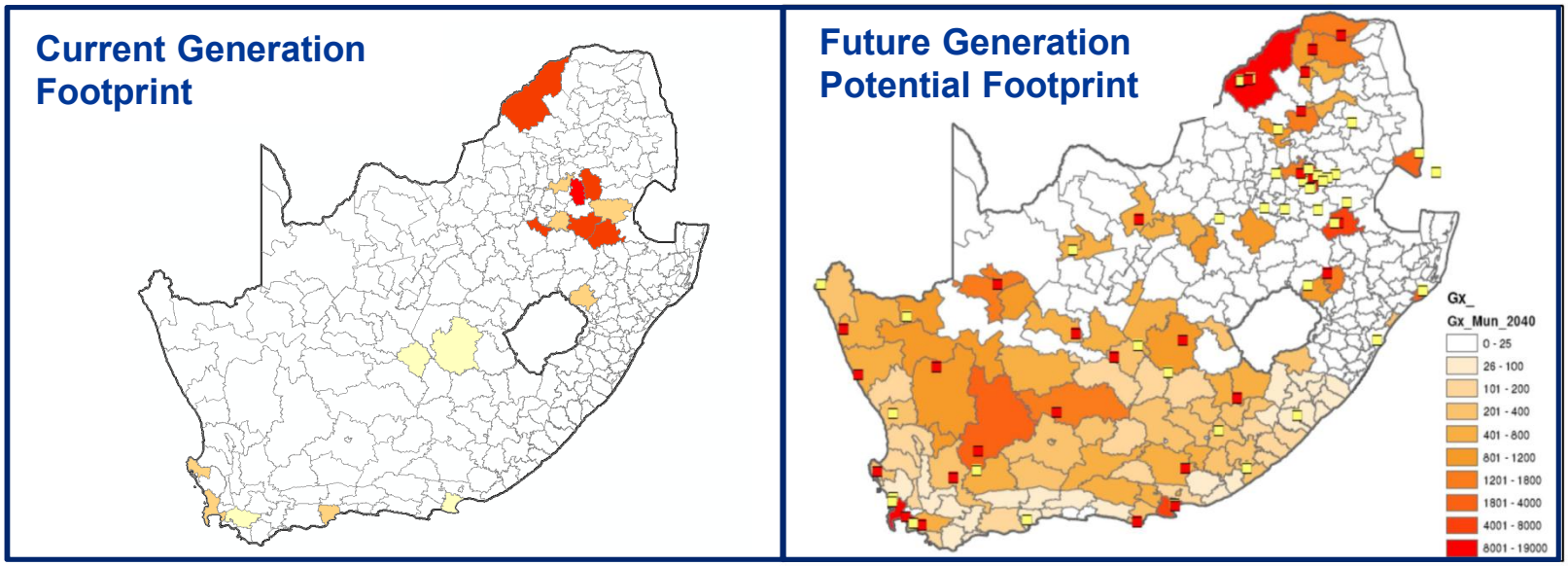
# Purpose of the 2040 Network Study

- 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.*

# Why do we need Alignment

## Change in Generation Spatial Footprint




**Irrespective of generation scenario**

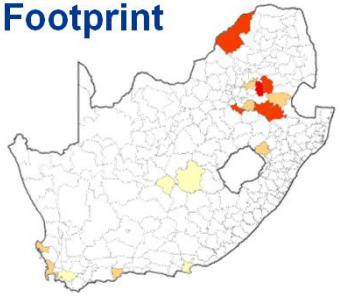
# Tx Strategy to increase Grid Access to meet future needs of the IRP and customers

## Change in generation diversity has major impact on future Tx Grid

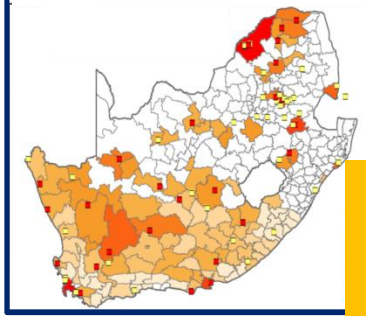
- Grid Access ï Increased connection capacity needed in new areas (delivery time > 8yr)
- On Time Connection ï Smaller IPP generation plant can be constructed faster (delivery time <5yr)
- Unknown locations - Multiple unspecified IPP sites require market access for best price

### Change in Location - Spatial Footprint

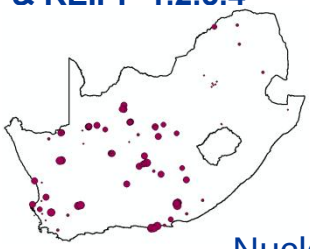
**Current Generation Footprint**



**Future Generation Potential Footprint**



**Current Eskom Wind, Solar & REIPP 1.2.3.4**



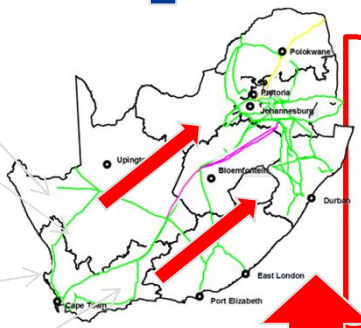
### Change in Construction 3yr - 5yr Speed of IPP plant rollout

Solar

Wind

Gas

Nuclear




***Beyond 2020 Demand Balance significantly changed by dispersed generation in South***

***Significantly More Transmission Corridors and Grid Access required***

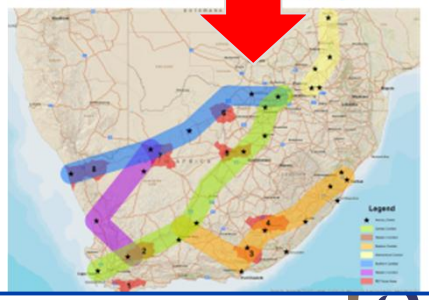
### Strategic EIAs & Servitudes can enable faster grid development

**Transmission Line Project Timeline**


**1. Strategic Investment in the EIAs & Land acquisition is critical to meet future IRP connection timeframes**

**2. Reducing Tx investment today compounds future Tx Grid roll out leading to high risk of Gx capacity delays**

SEA Corridors



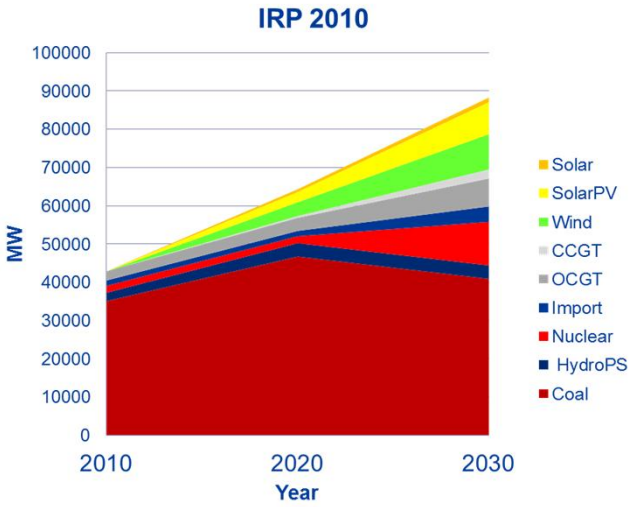
**Change of Spatial Footprint into areas with limited Demand requires additional Transmission Capacity**

**Need to reduce the time to increase grid access by investing in strategic access and corridors servitudes**

# 2040 Tx Study – Generation Spatial Allocation

Eskom

Transmission to enable IRP requires Spatial Information

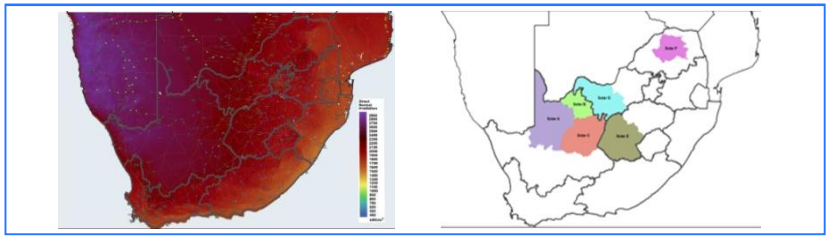



**However there is uncertainty in**

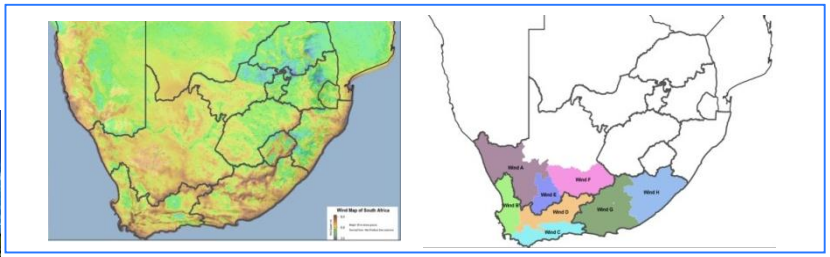
- Where is the location?
- What is the size?
- What is the type?

Generation
Energy Resources for Electricity

Solar

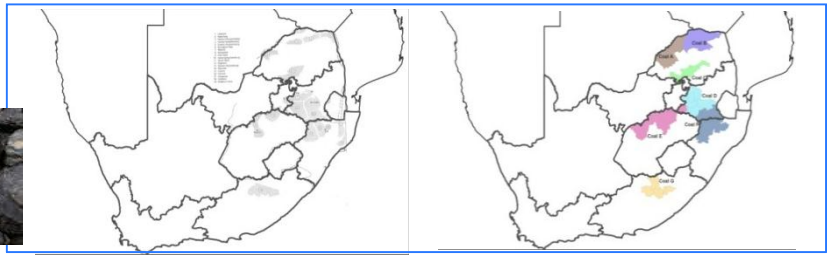


Wind



Gas

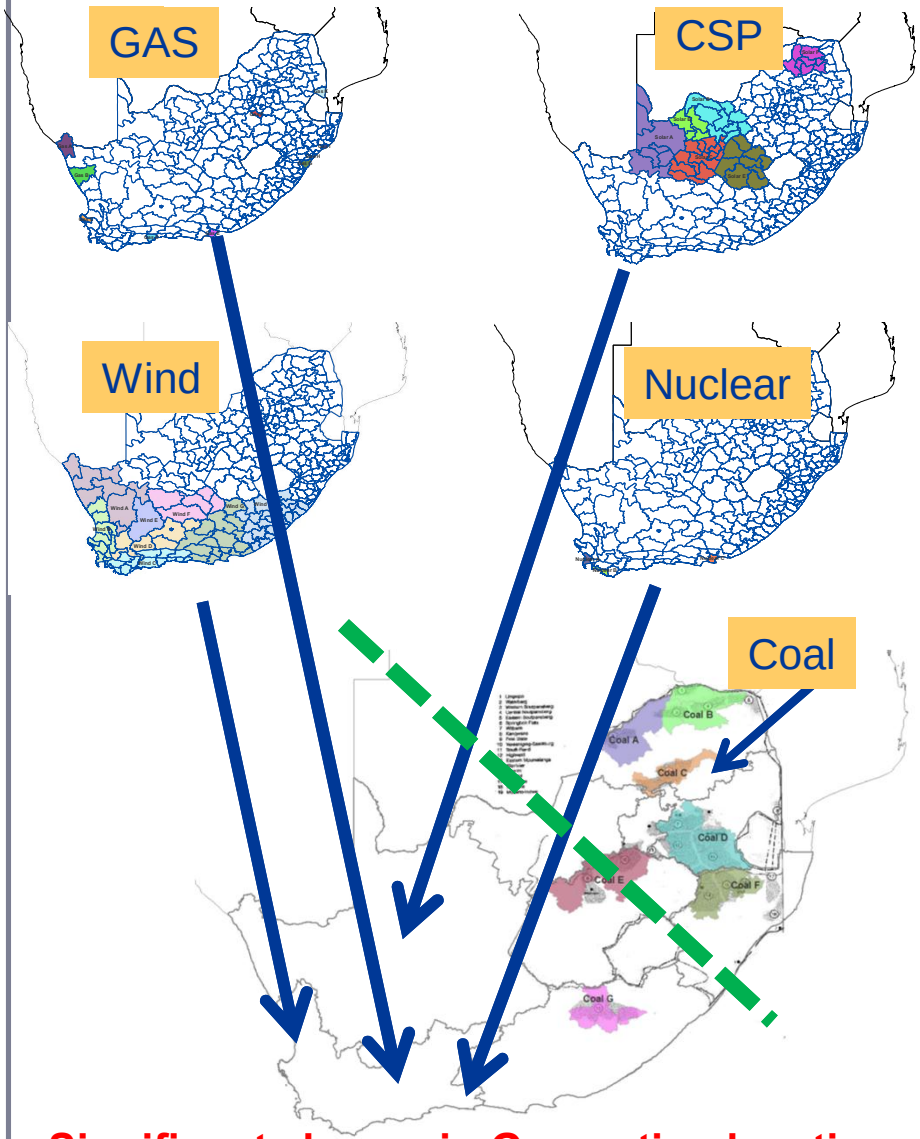
Coal



# 2040 Tx Study – New Generation Allocation

## Generation

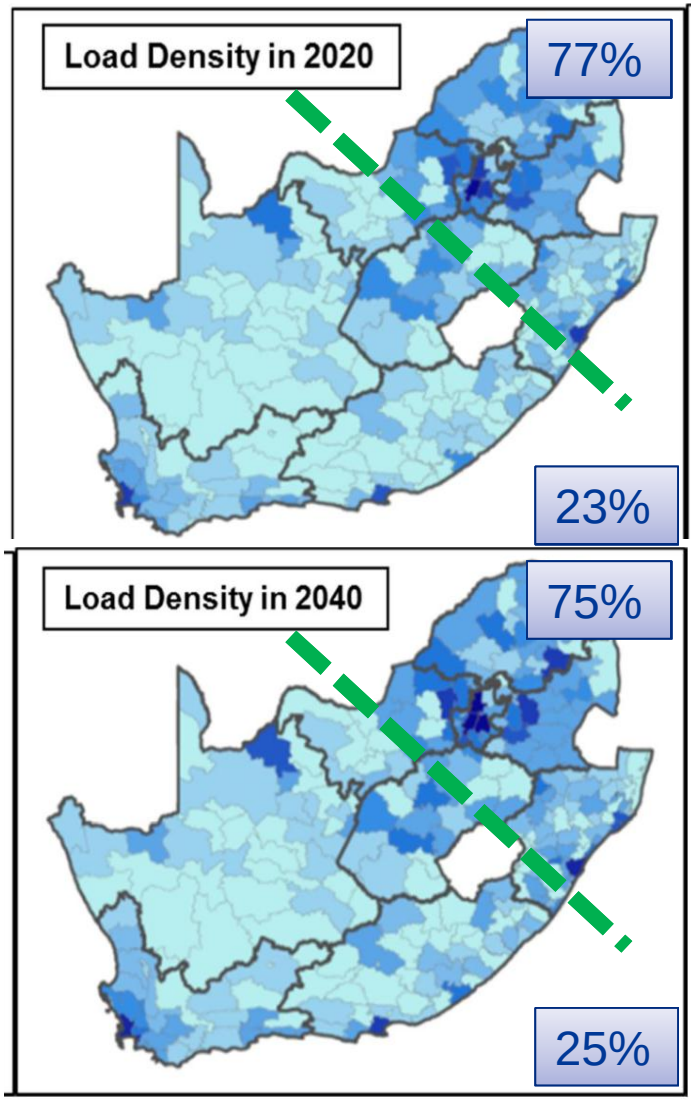
Energy resources for electricity




**Significant change in Generation location**

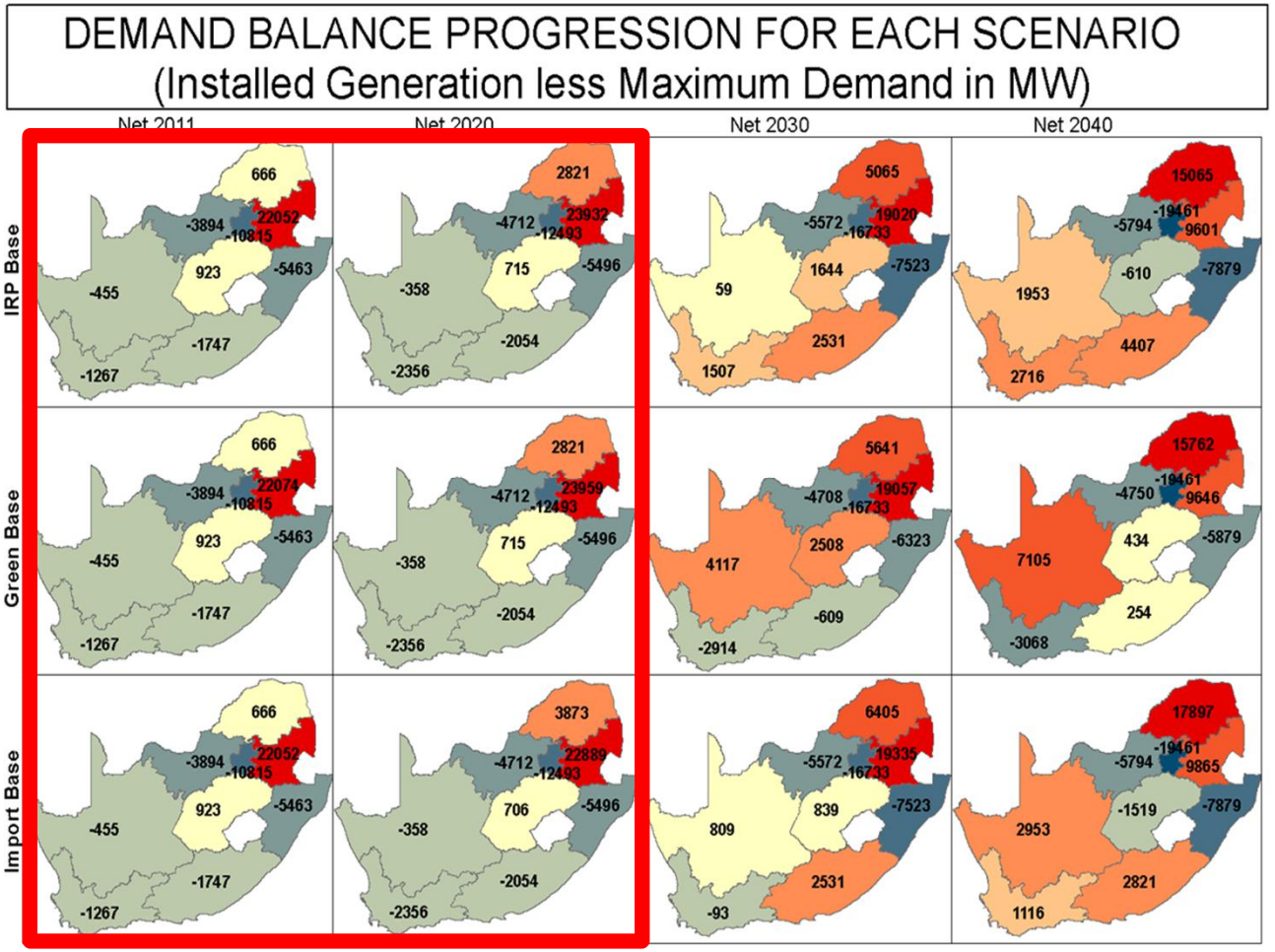
## Demand

Load Demand for each area for 2020 & 2040




**No significant change in load location**

# Comparing Demand Balances for each Generation Scenario




Generation Excess

Demand Excess


***Significantly More Transmission Corridors and access required***

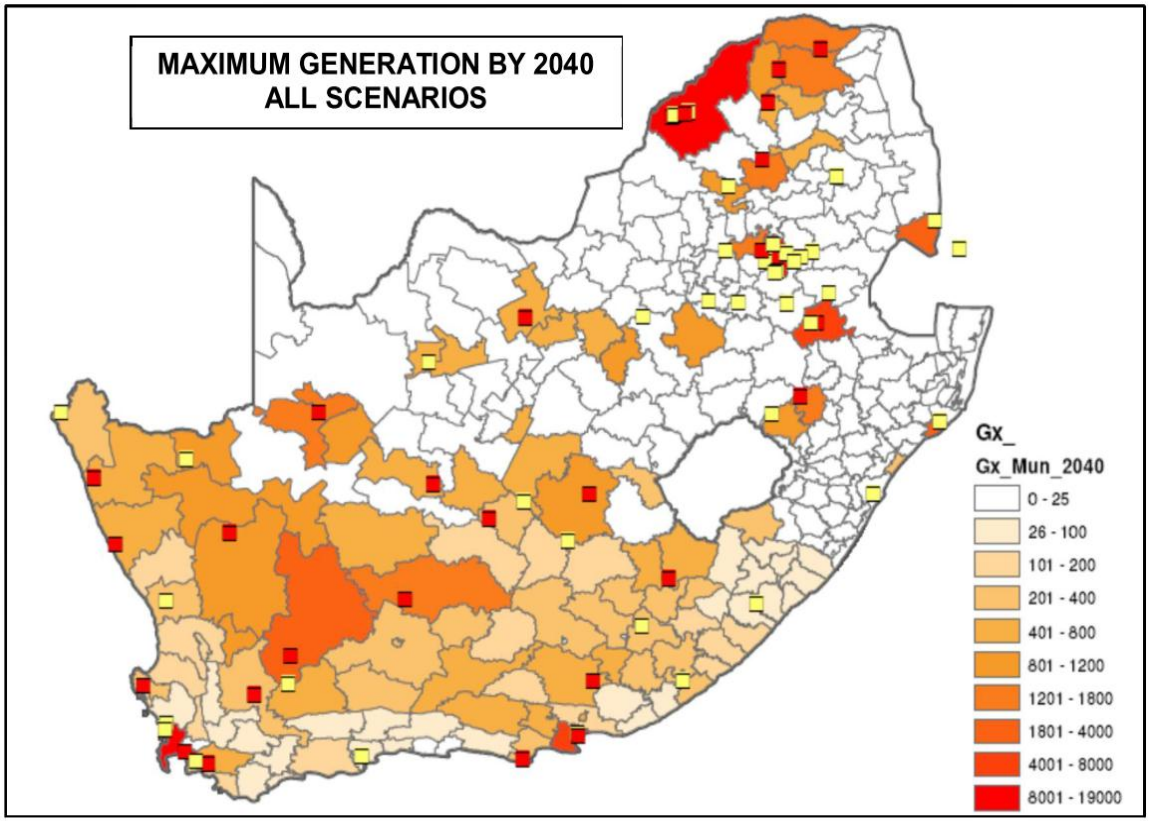
***Up to 2020 Demand Balance still dominated by Centralised generation in North***

***Beyond 2020 Demand Balance now significantly changed by dispersed generation in South***

# Allocation of Generation Injection Points

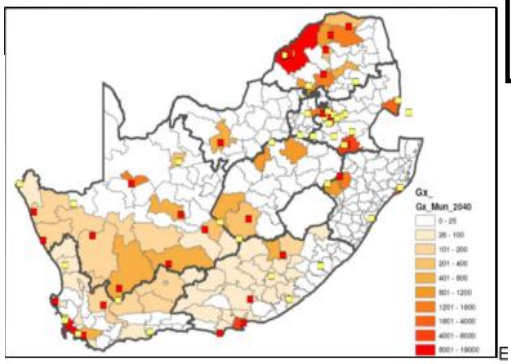
Eskom

**Location of potential generation sites for all scenarios**

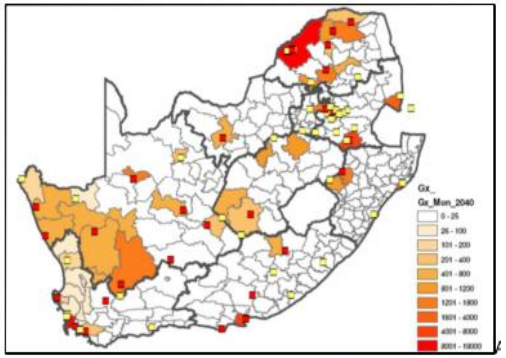



**Renewable generation intermittency will still result in large spatial variation within a single scenario.**

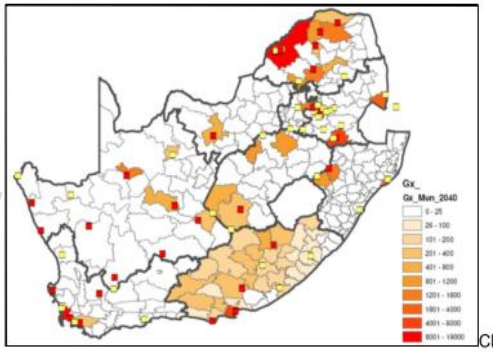
**Base IRP Scenario**



**Even Spread of Wind**



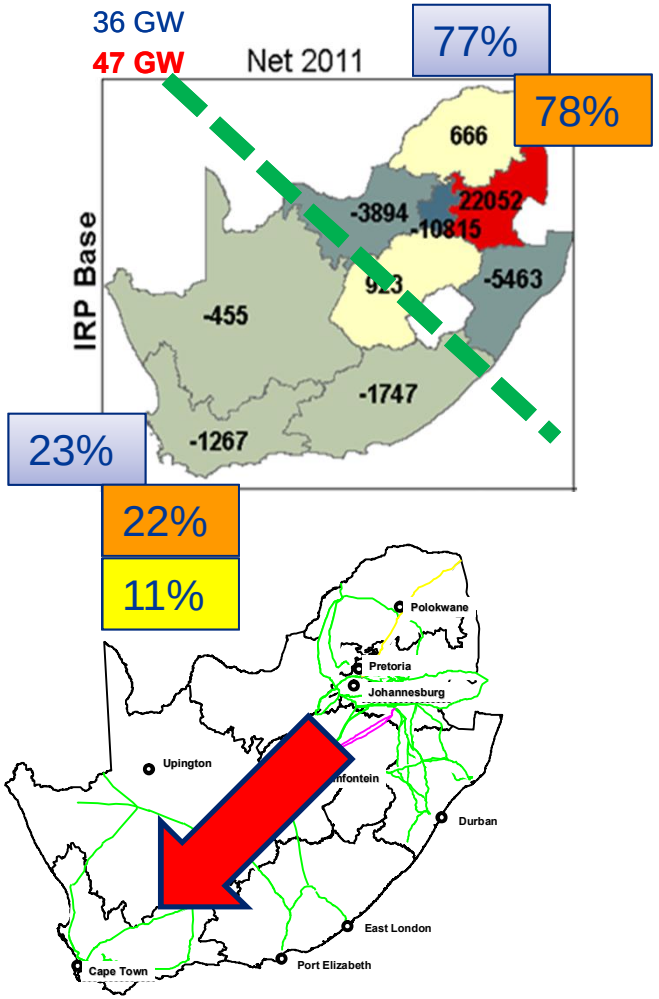
**West to East Pattern of Wind**



**East to West Pattern of Wind**

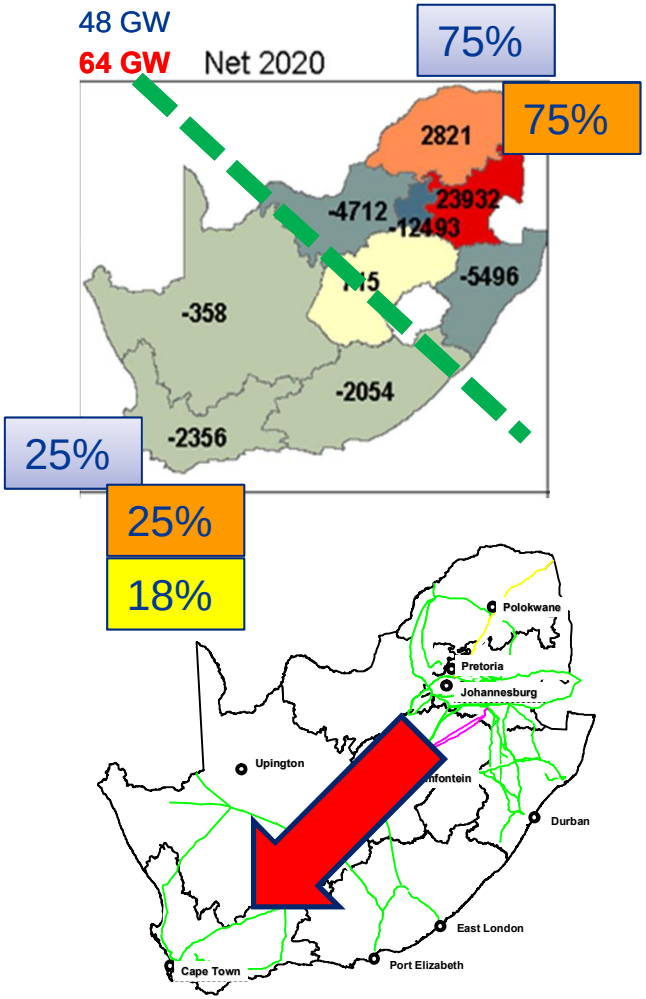
# Comparing Demand Balances for each Generation Scenario

## Current Network Transfer

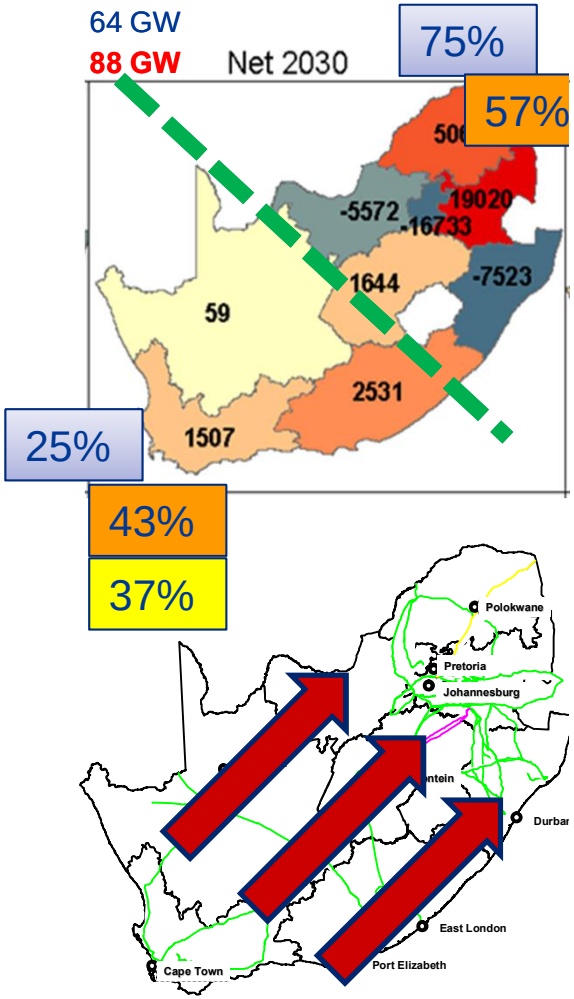



+/- 4 GW

## Future Network Transfer

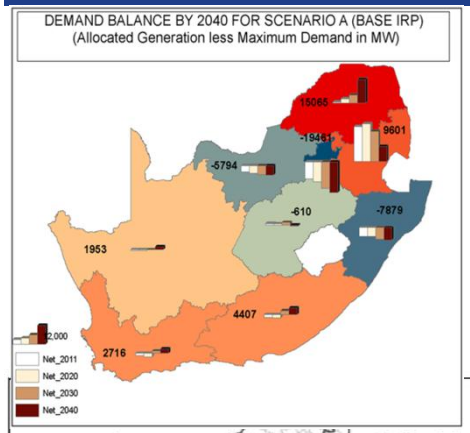


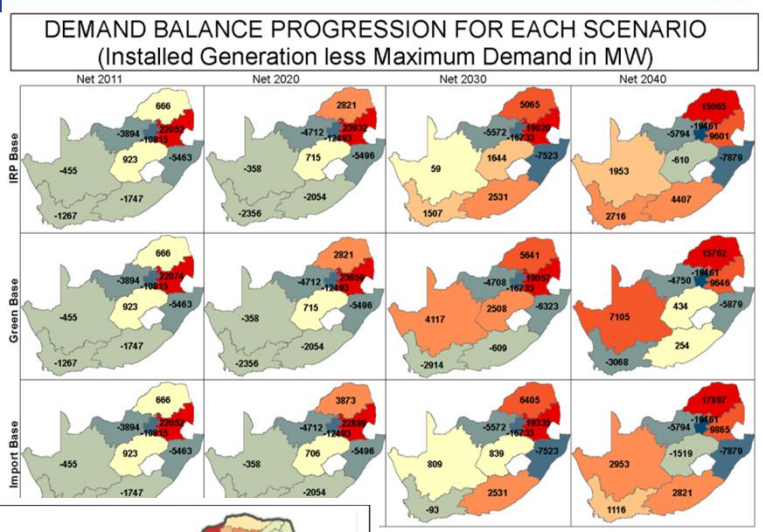

+/- 4.5 GW

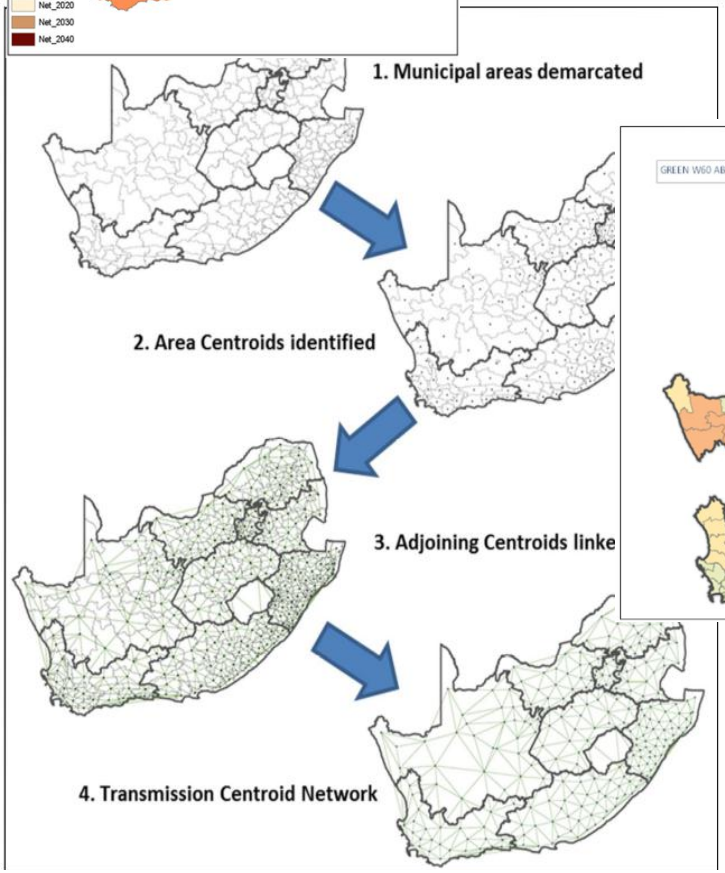


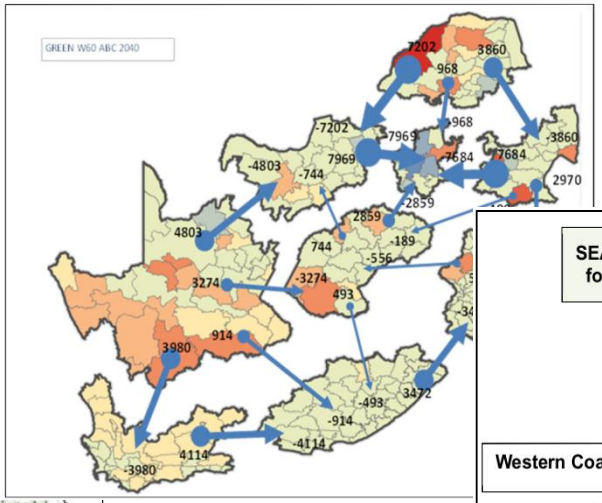

> 8 GW

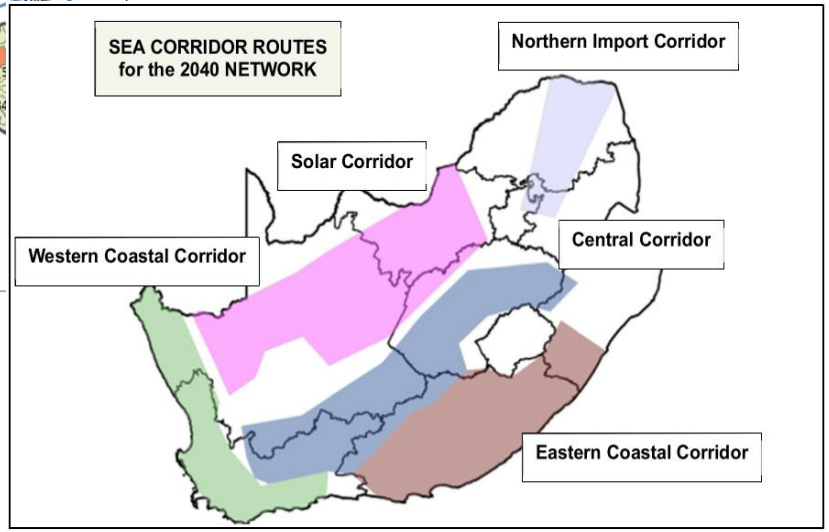
# Summary of Strategic Grid Study



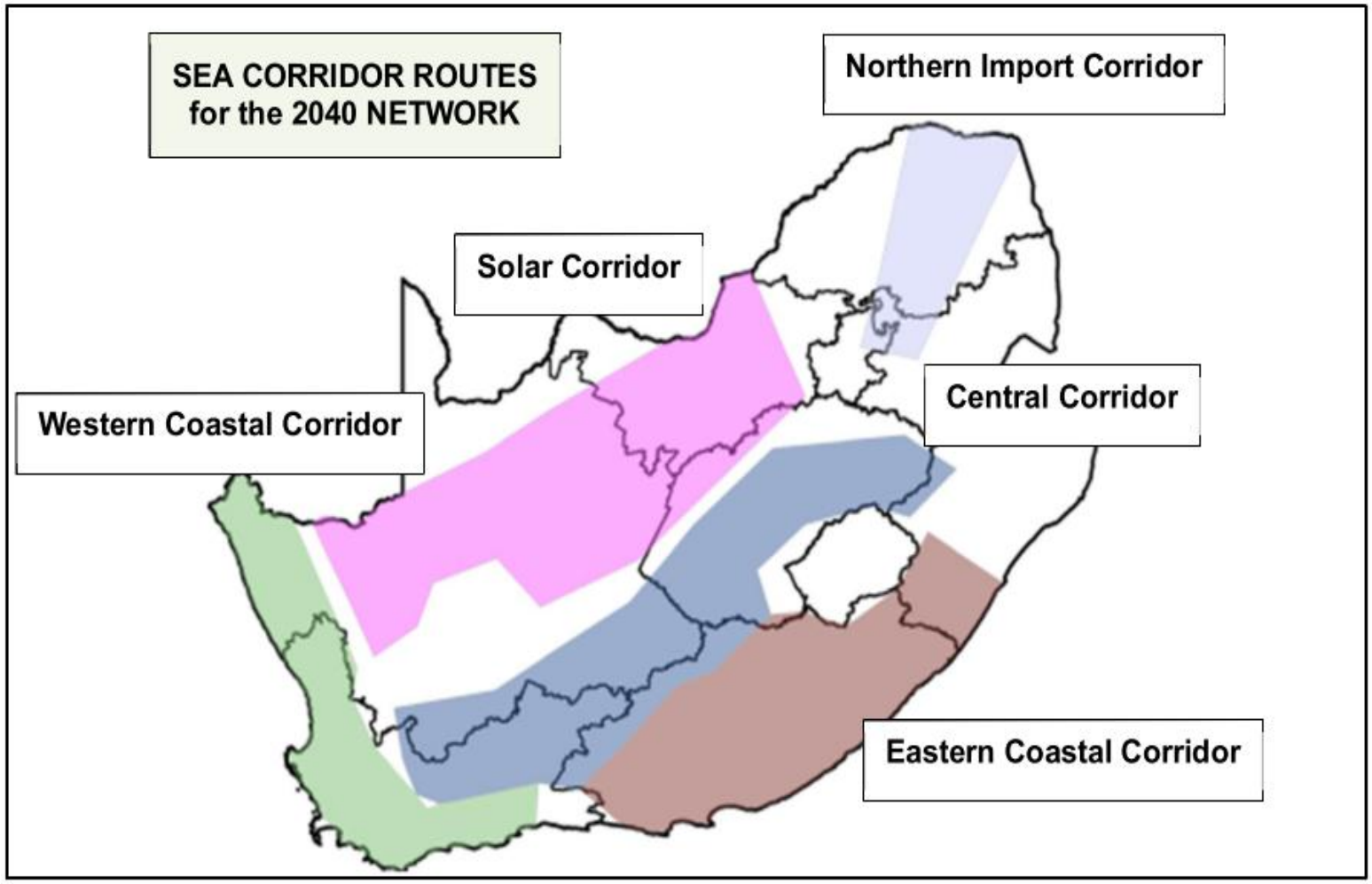



# The identified 2040 Power Corridors for SEA




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

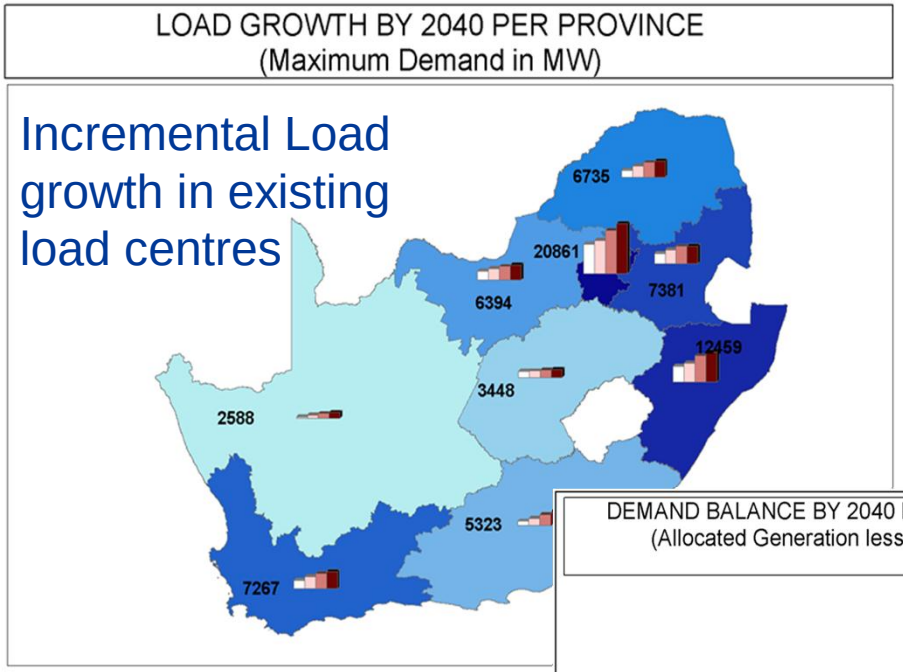
***Five major corridors*** were identified for the future strategic development of the Tx Grid

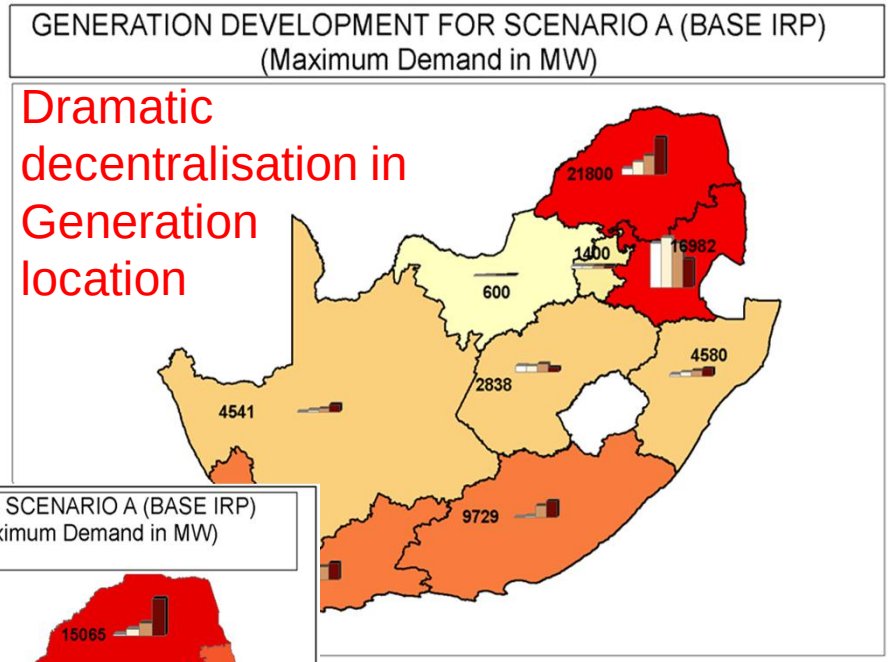
SEA studies proposed for these routes

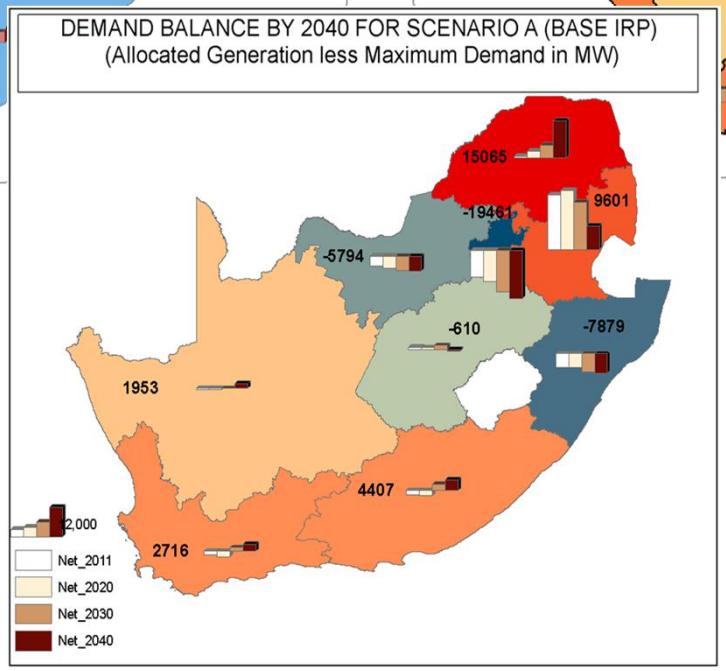
# Mapping the Demand and Generation

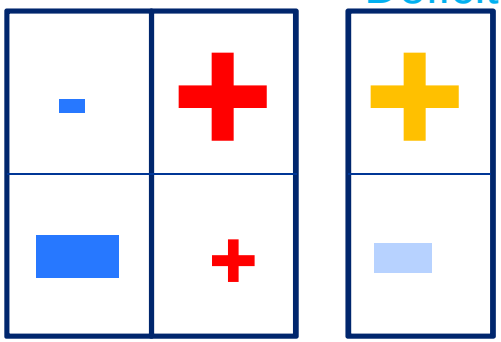
Å Spatial Location of Load

Å Spatial location Generation



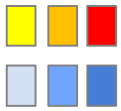







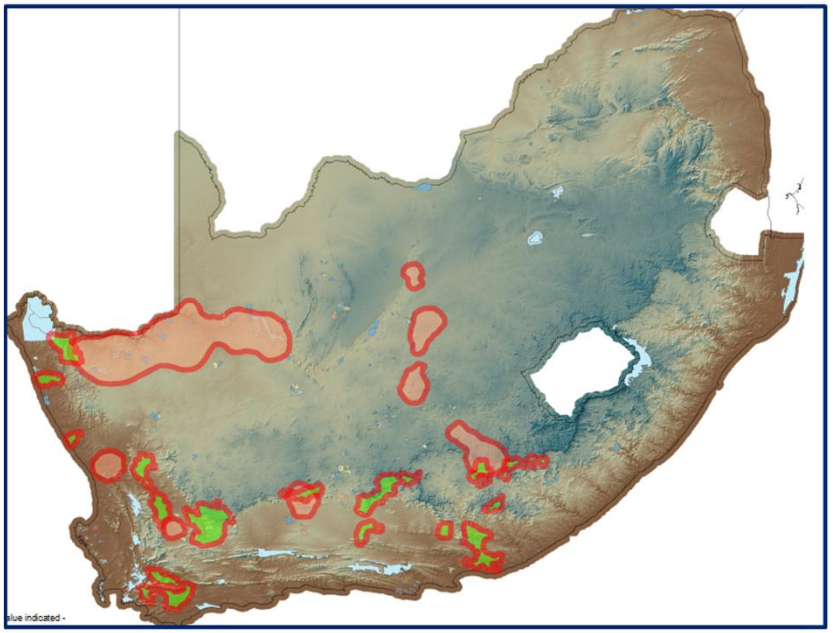


Generation Excess

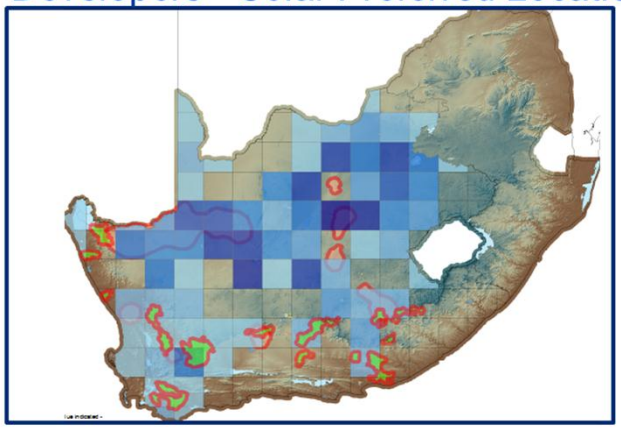
Demand Excess

# CSIR Renewable Zones Study under SIP 8

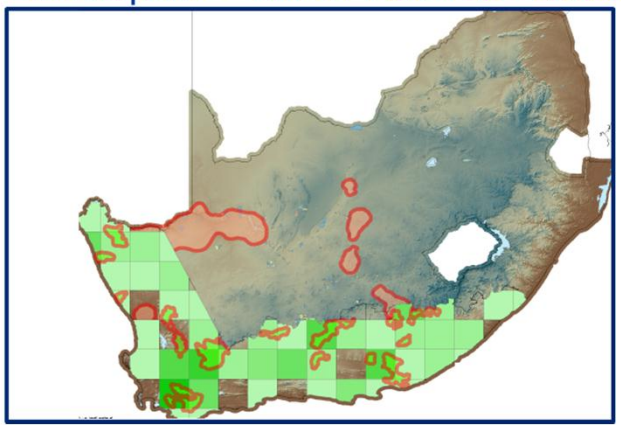
SEA - Wind and Solar Preferred Location



Developers - Solar Preferred Location

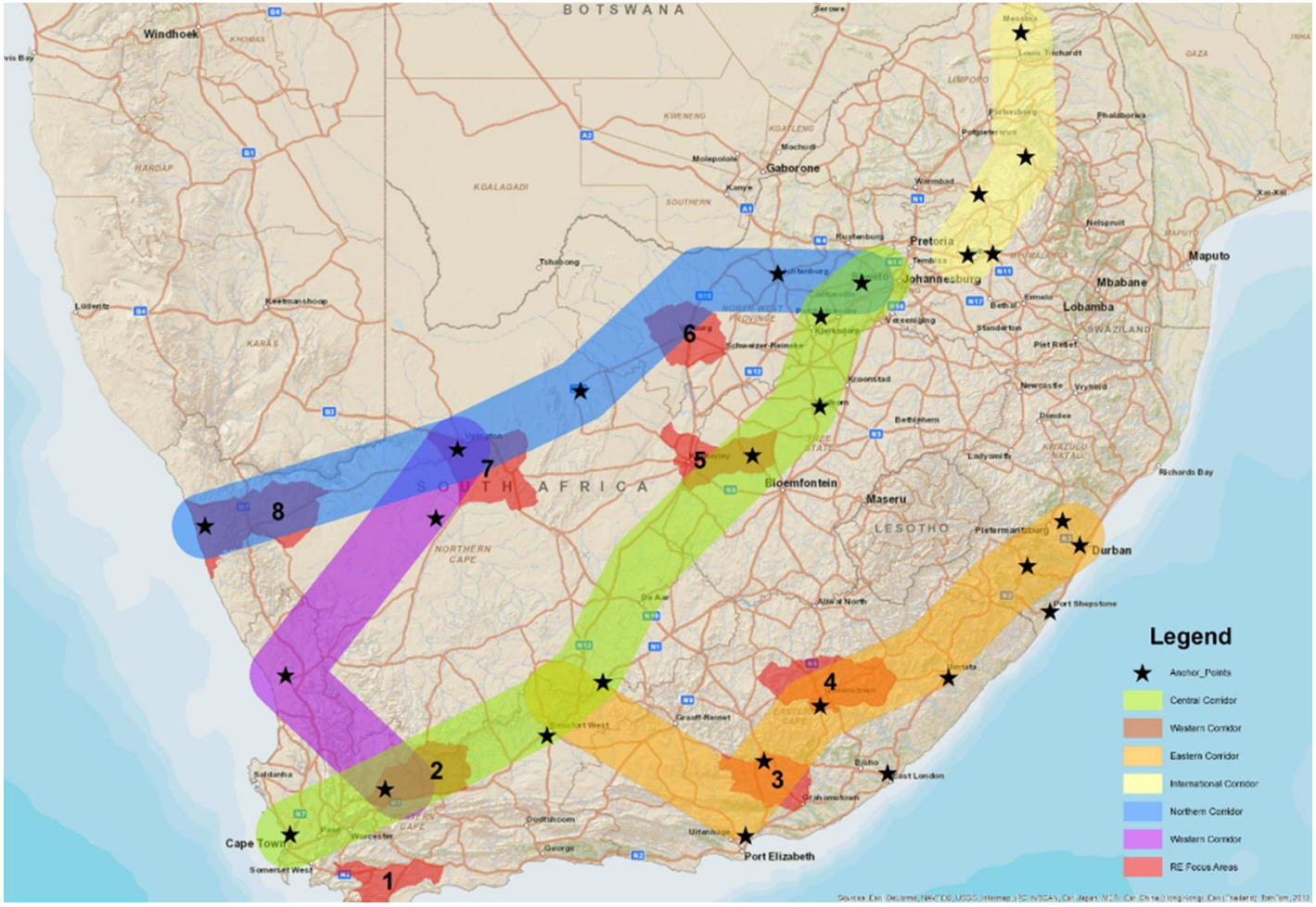


Developers – Wind Preferred Location



The CSIR were appointed to undertake a study to identify suitable corridors and zones for the efficient and effective rollout of wind and solar PV energy as part of NDP - SIP 8.
The selection criteria included amongst others the environmental suitability of the land, the resource potential as well as exclusion areas.

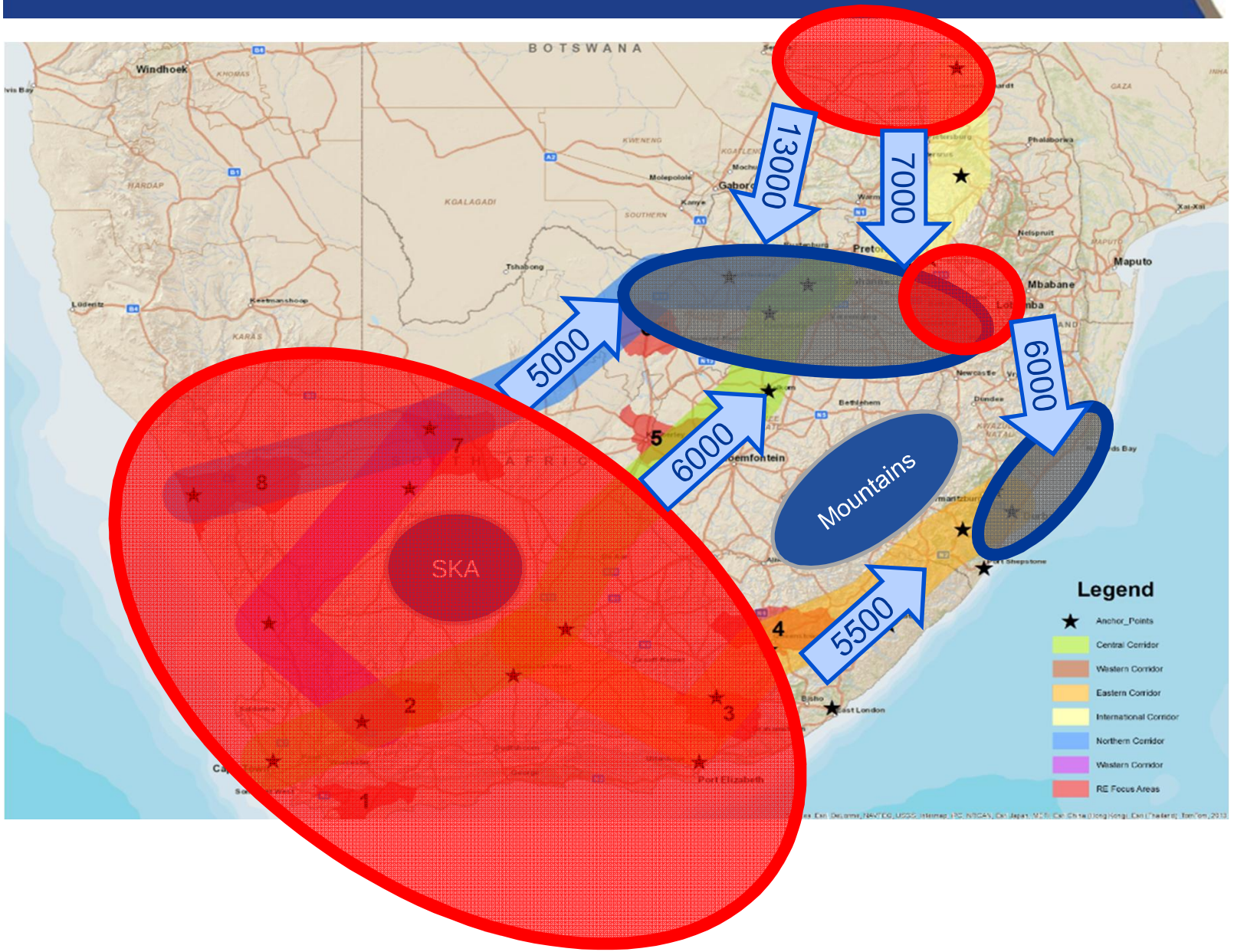
# Final Corridors for SEA project under SIP 10




- Combining all the available info and results from the supporting studies with the 2040 Network Study findings enabled the five power corridors to be further refined.
- DEA proposes to use SIP 10 SEA studies to undertake all the Environmental. Scoping studies which will be valid for longer period.
- Relatively simple process can be followed to secure the final environmental authorisation.

The SIP 10 SEA Project is currently underway and completion including government gazetting is targeted for December 2015

# SGP Tx 2040 Study Corridor Overview




**PHYSICAL REALITY**

e.g. SKA & Mtn Range

**LOAD CENTRES**

Central & KZN areas

**POWER POOLS**

2 Concentrated areas in the North

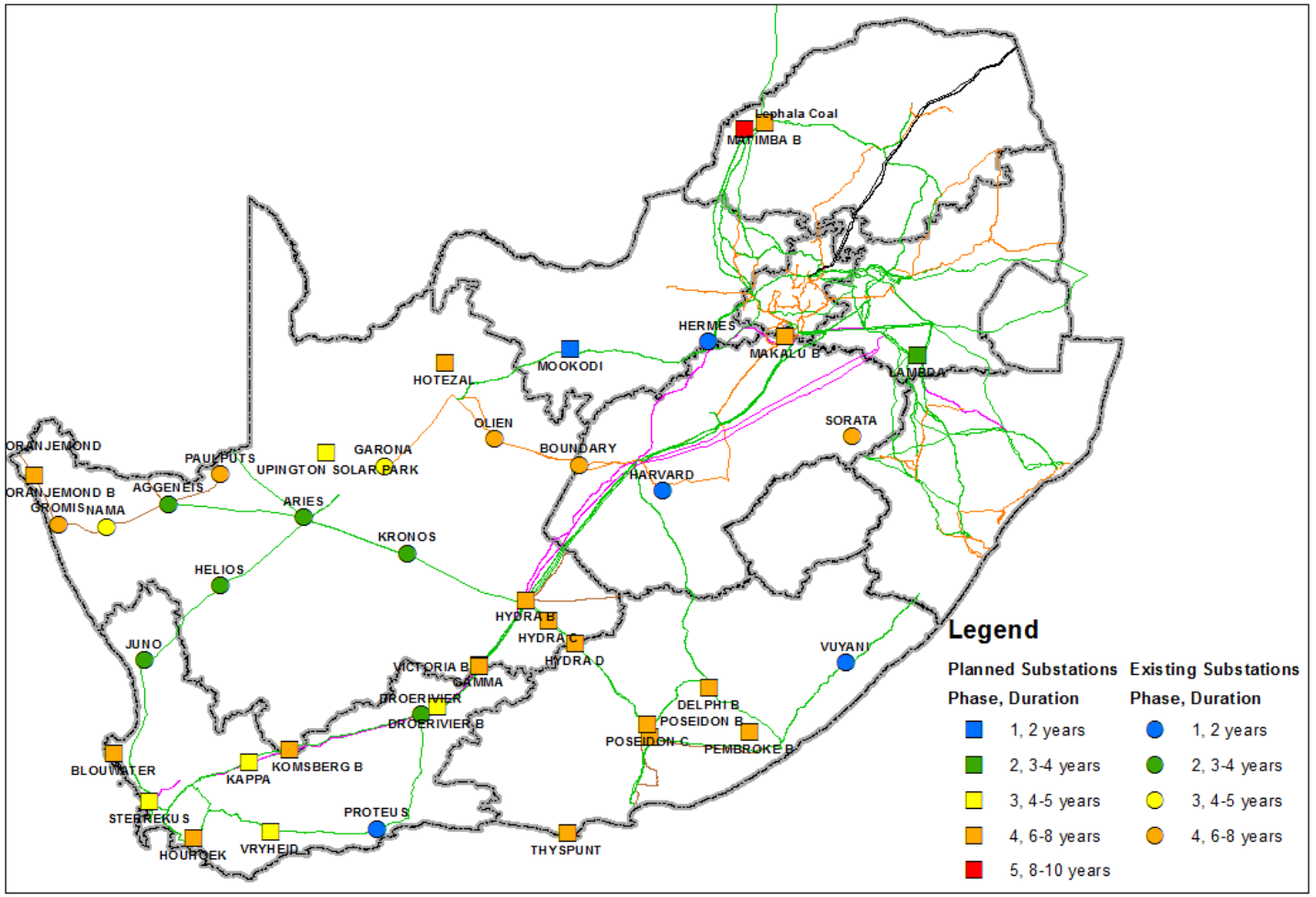
1 large Dispersed area in the South

**POWER CORRIDORS**

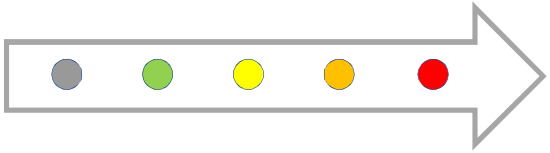
3 from the North ï two already secured

3 from the South ï only one partially secured

# Strategic Potential to Unlock more Grid Access for on-time connection of DOE programmes




Strategic Unlocking
Implementation Time



# Strategic Unlocking of Renewable Access

**Phased Substation and Transmission Infrastructure**

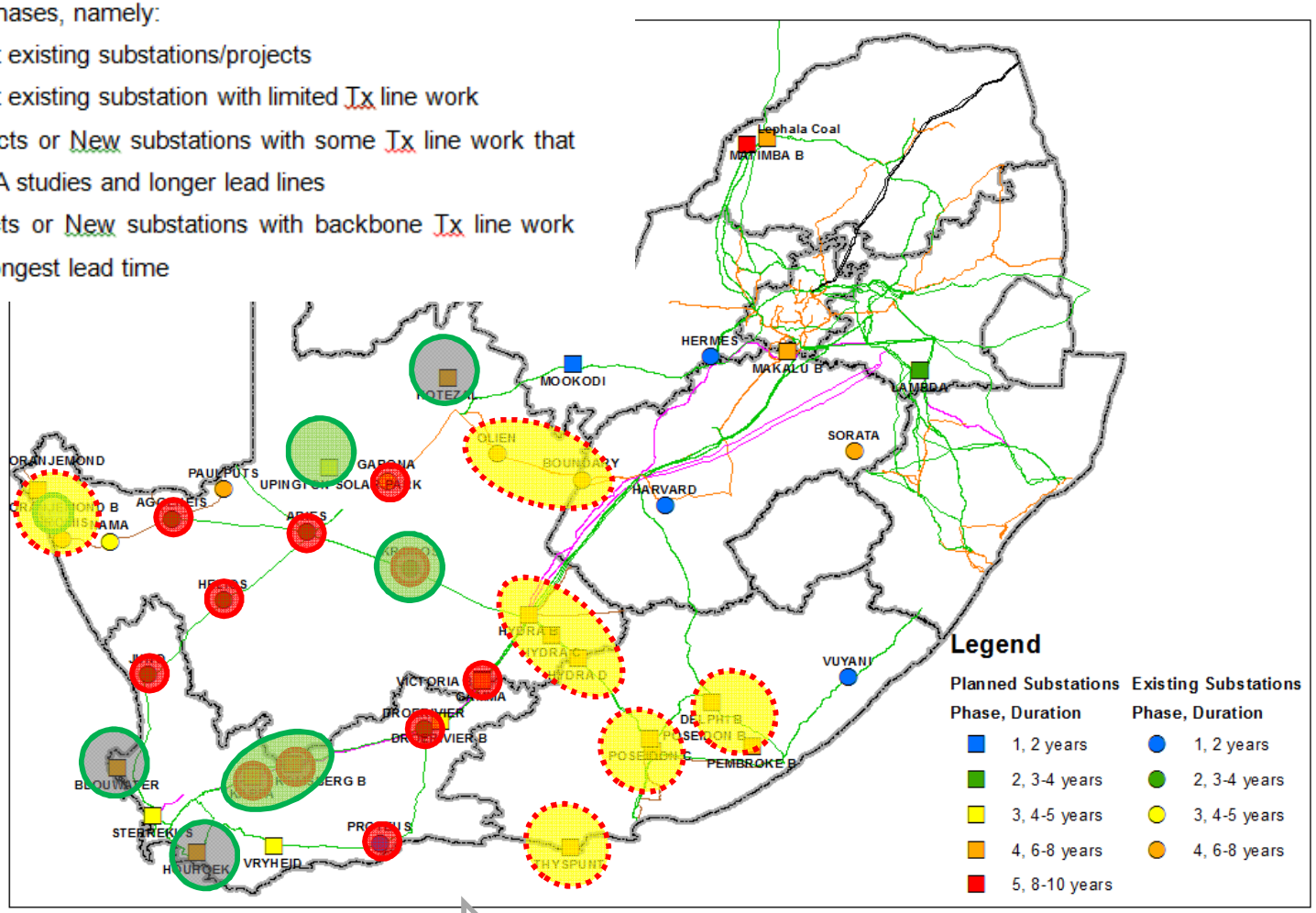
The additional transmission infrastructure required to create new connection capacity can be grouped into four main phases, namely:

Phase 1: Limited work at existing substations/projects

Phase 2: Limited work at existing substation with limited Tx line work

Phase 3: Existing projects or New substations with some Tx line work that requires full EIA studies and longer lead lines

Phase 4: Existing projects or New substations with backbone Tx line work required with longest lead time




Strategic Unlocking Implementation Time

# Transmission

# Generation Connection Capacity Assessment (GCCA)

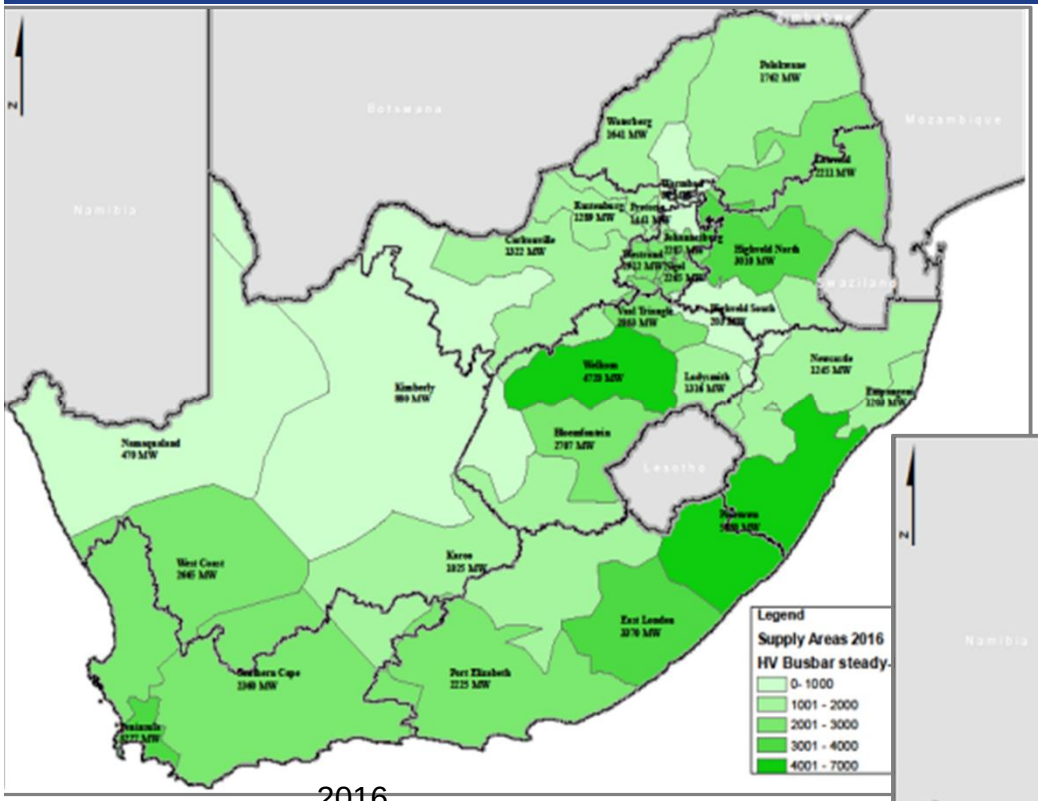
# Background

- The Generation Connection Capacity Assessment (GCCA)
- Created in response to the call from Govt. to connect IPPs
- First one issued in 2011 for 2012 Network – GCCA-2012
- Second issued for the 2016 Network – GCCA-2016 + Rev 2
- Both based on network with approved TDP projects
- REIPPPP Bid Windows 1 to 4B have projects up to 2020
- Next rounds need info on capacity beyond 2020

# Calculation changes from the GCCA-2016

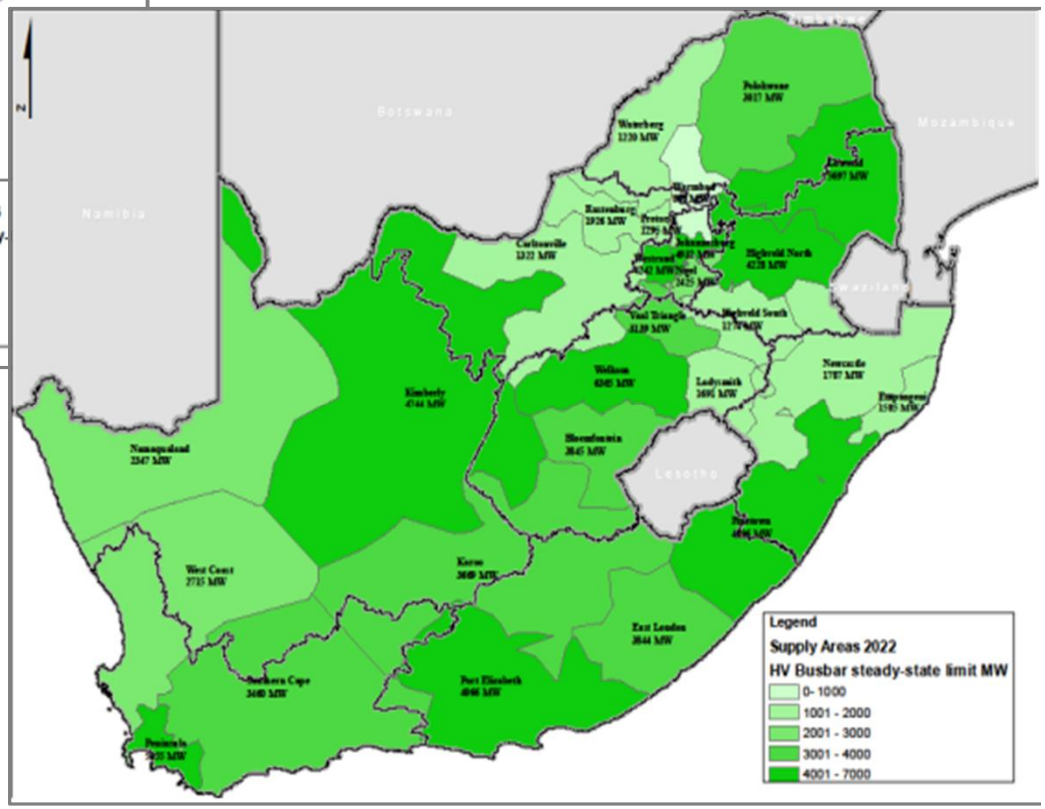
- **Longer period into future – now 2022**
  - Indicate all projects in TDP, approved and proposed, up to 2022
  - Show what the future potential connection capacity could be, not just new capacity from the approved Tx projects as in GCCA-2016
- **Local Connection Capacity is not based on N-1**
  - In GCCA-2016 local MTS capacity based on transformer N-1
  - Now based on total installed transformer MVA at MTS
  - Maximum connection capacity limited to 1000MW linking to Grid Code
- **MTS HV Busbar and Supply Areas based on N-1**
  - Potential connection capacity at HV busbar (400kV or 275kV) based on N-1 limit to the MTS
  - Supply Area is based on N-1 limit for the area grouping of MTS subs

# Impact of TDP on connection capacity from 2016 to 2022




2016

2022



# GCCA-2022 - Typical Table

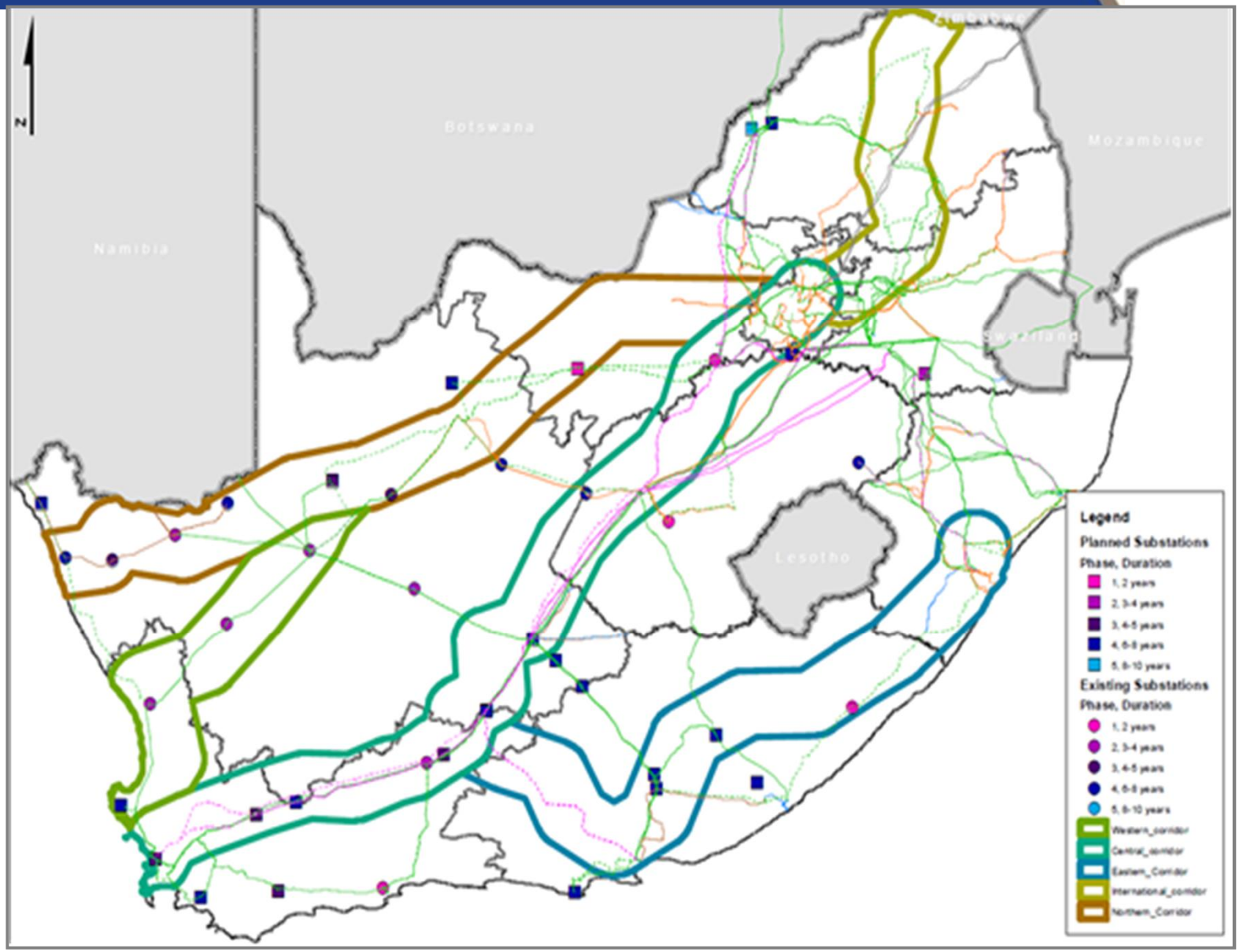
## Table A-9 Transmission supply area of Kimberley

| Substation | Transformer Voltages | No. of Trfrs | Trfr Size (MVA) | 2015 Installed Transformer (MVA) | Year of Trfr Upgrade | Upgrade Status | No. of Trfrs | Trfr Size (MVA) | 2022 Installed Transformer (MVA) | REIPPP Gen Allocated (MW) | 2022 LV Busbar Connection Capacity (MW) | 2022 HV Busbar Connection Capacity (MW) | 2022 Supply Area HV Busbar steady-state limit (MW) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Boundary | 275/132 | 2 | 250 | 500 | - | - | 2 | 250 | 500 | 228.15 | 266 | 1422 | |
| Ferrum | 132/66 | 3 | 80 | 240 | - | - | 3 | 80 | 240 | | 0 | | |
| | 275/132 | 2 | 250 | 500 | - | - | 2 | 250 | 500 | 224 | 270 | 974 | |
| | 400/132 | 2 | 500 | 1000 | - | - | 2 | 500 | 1000 | 100 | 882 | | |
| Garona | 275/132 | 1 | 125 | 125 | - | - | 1 | 125 | 125 | 50 | 74 | 241 | 4744 |
| Hotazel | 400/132 | 0 | 0 | 0 | 2020 | Proposed | 2 | 500 | 1000 | | 980 | 780 | |
| Mookodi | 400/132 | 2 | 500 | 1000 | - | - | 2 | 500 | 1000 | 75 | 907 | 924 | |
| Olien | 275/132 | 2 | 150 | 300 | - | - | 2 | 150 | 300 | 239 | 60 | 403 | |

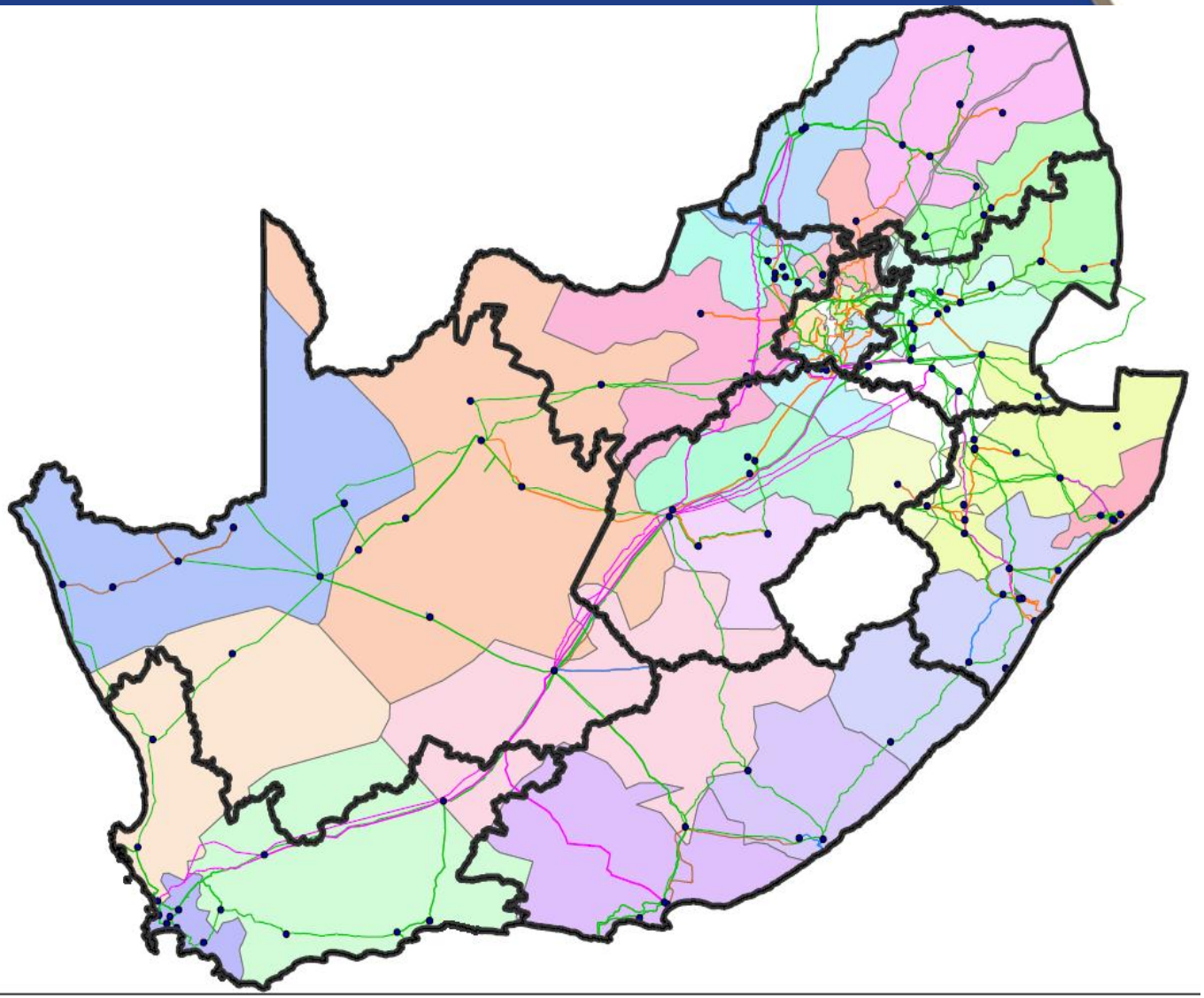
# Improvements in GCCA-2022

- **Identified potential Tx projects which could unlock additional connection capacity by 2022 which are not in the TDP**
- **Included the 5 Tx Power Corridors in the SIP 10 SEA project which will provide a flexible and robust network that can respond to meet the needs of future IRP and IPP requirements**
- **Creation of an interactive spatial map in PDF format to accompany the GCCA-2022 document.**
- **PDF map has a number of different levels of information displayed spatially which can be toggled on & off**

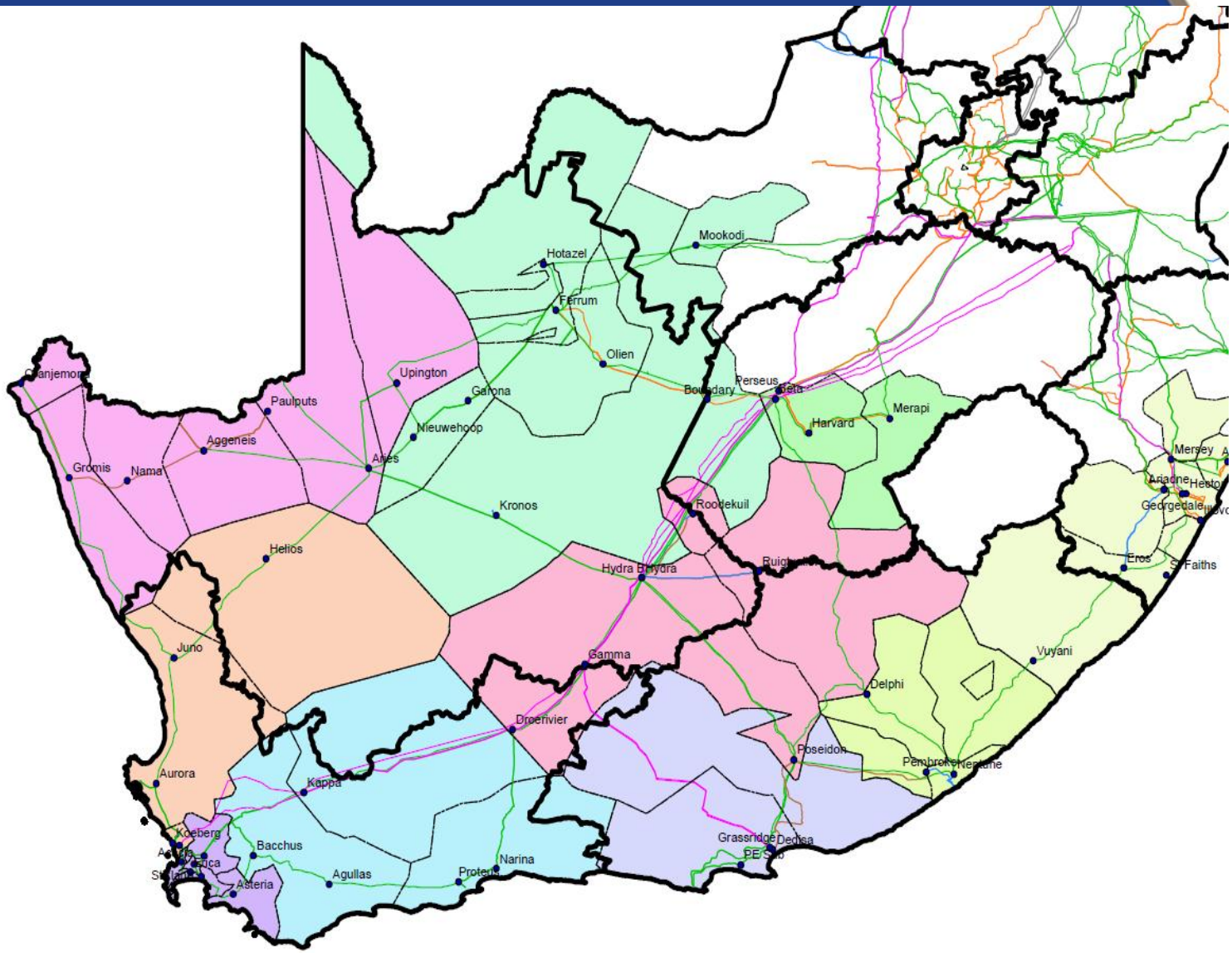
# GCCA-2022 - Projects for additional connection capacity



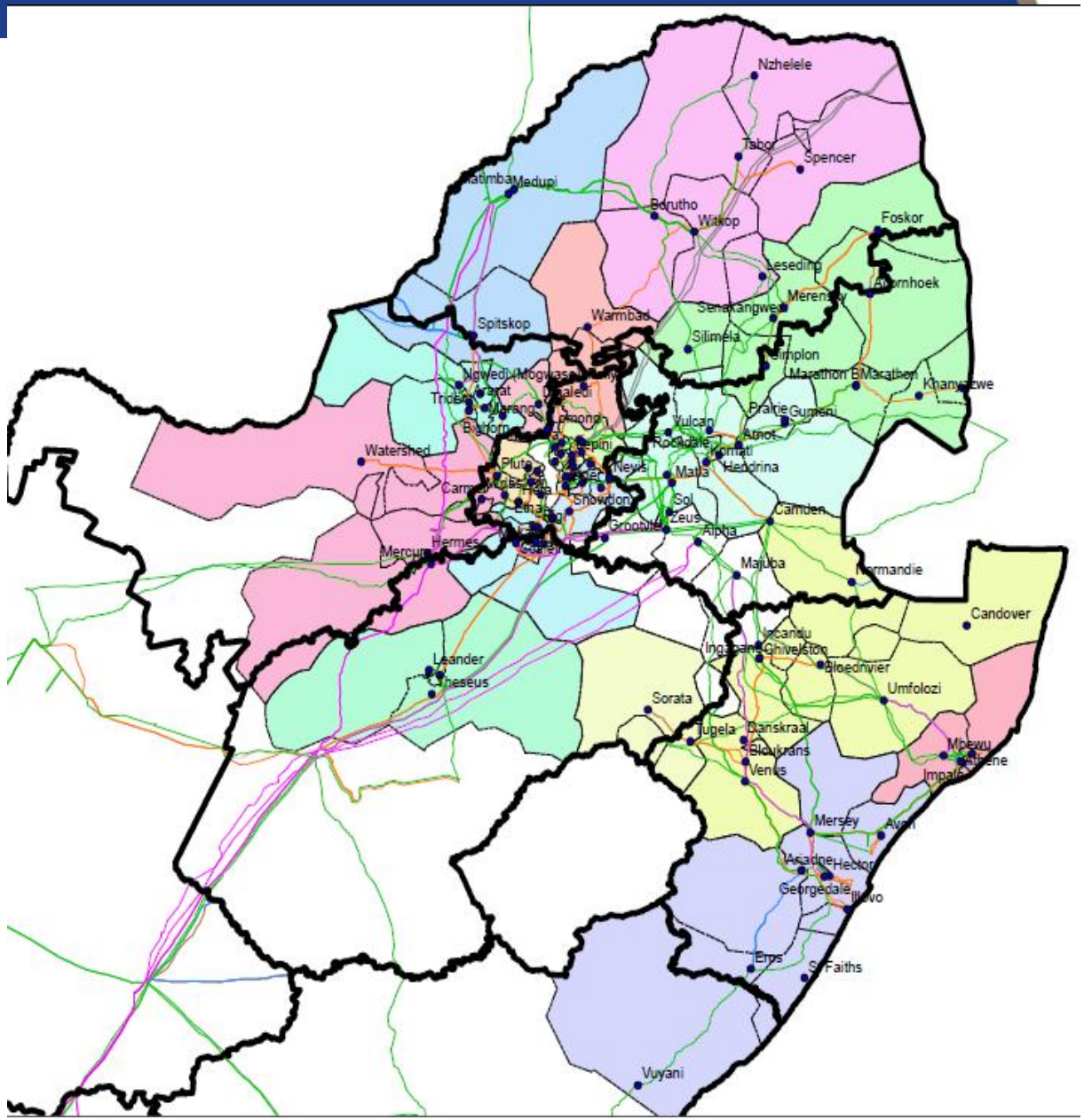
# GCCA-2022 - Maps - National



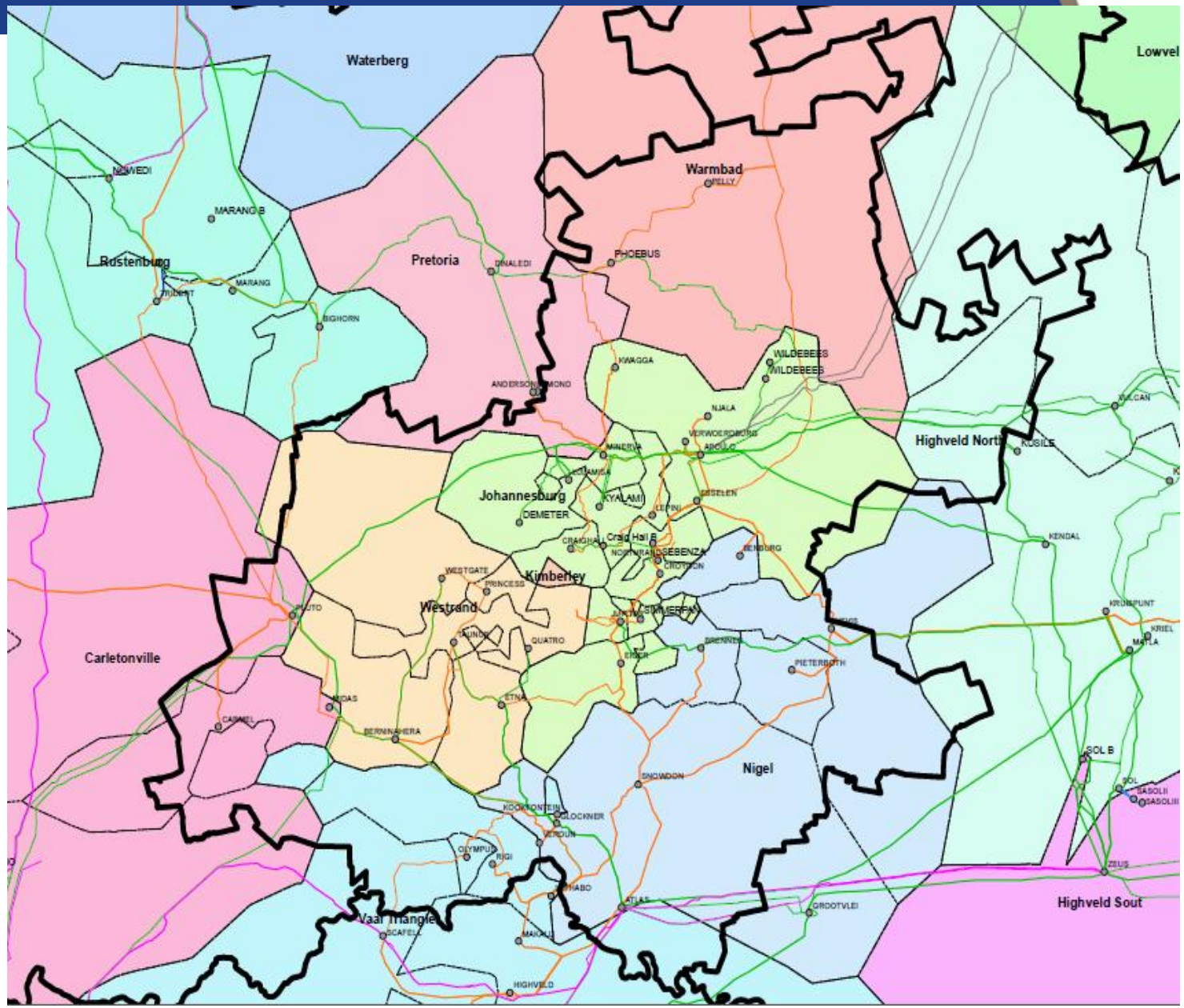
# GCCA-2022 - Maps – Southern Block



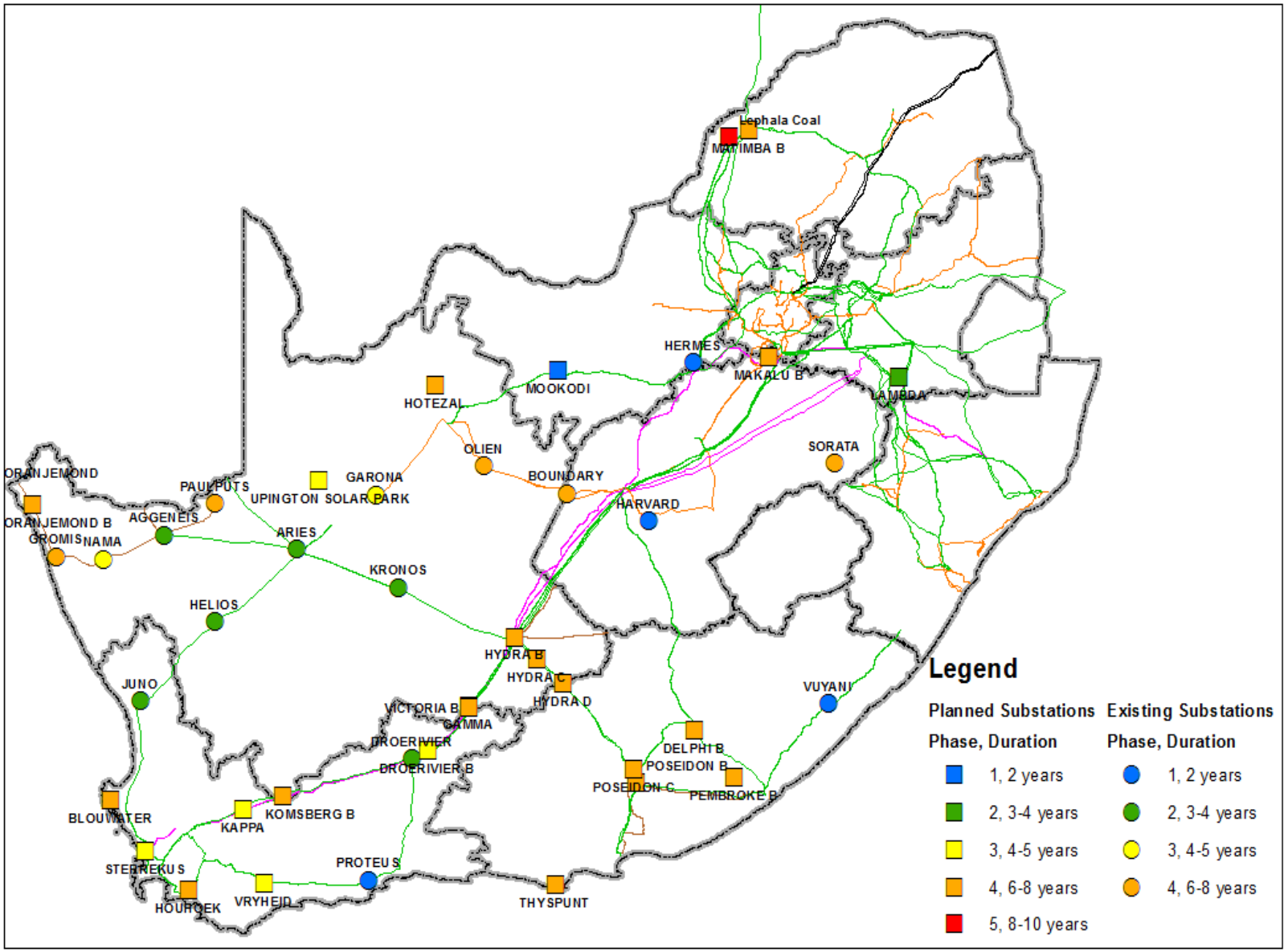
# GCCA-2022 - Maps – Northern Block



# GCCA-2022 - Maps – Central Block



# GCCA-2022 - Maps – Potential Capacity not in TDP



PDF map has a number of different levels of information displayed spatially which can be toggled on & off

# GCCA-2022 - Table interpretation

## Table A-12: Transmission supply area of Namaqualand

| Substation | Transformer Voltages | No. of Trfrs | Trfr Size (MVA) | 2015 Installed Transformer (MVA) | Year of Trfr Upgrade | Upgrade Status | No. of Trfrs | Trfr Size (MVA) | 2022 Installed Transformer (MVA) | REIPPP Gen Allocated (MW) | 2022 LV Busbar Connection Capacity (MW) | 2022 HV Busbar Connection Capacity (MW) | 2022 Supply Area HV Busbar steady-state limit (MW) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aggeneis | 220/66 | 2 | 40 | 80 | - | - | 2 | 40 | 80 | 40 | 39 | 121 | |
| | 400/220 | 2 | 315 | 630 | - | - | 2 | 315 | 630 | 471.35 | 155 | | |
| Aries | 400/22 | 1 | 40 | 40 | - | - | 1 | 40 | 40 | 9.65 | 30 | 116 | |
| Gromis | 220/66 | 2 | 40 | 80 | - | - | 2 | 40 | 80 | | 78 | 180 | |
| | 400/220 | 0 | 0 | 0 | 2020 | Proposed | 1 | 315 | 315 | | 0 | | |
| Nama | 220/66 | 2 | 80 | 160 | - | - | 2 | 80 | 160 | | 157 | 150 | 2348 |
| Nieuwehoop | 400/132 | 0 | 0 | 0 | 2016 | Approved | 1 | 250 | 250 | | 245 | 750 | |
| Oranjemond | 220/66 | 2 | 80 | 160 | - | - | 2 | 80 | 160 | | 157 | 100 | |
| Paulputs | 132/33 | 1 | 10 | 10 | - | - | 1 | 10 | 10 | 10 | 0 | 120 | |
| | 220/132 | 1 | 125 | 125 | 2019 | Proposed | 2 | 250 | 500 | 119.65 | 373 | | |
| Upington | 400/132 | 1 | 500 | 500 | 2022 | Proposed | 2 | 500 | 1000 | 383.9 | 604 | 680 | |

# Future Amendment of GCCA-2022

- GCCA-2022 was rushed out for the Expedited Bid Window programme
- Some minor corrections and a review of some results will result in updated values at certain substations
- Amended GCCA-2022 document will be issued in September
- However the values in the published GCCA-2022 are still valid as guideline for high level assessment
- Engagement with Eskom required for each IPP project

# Expedited Bid Window – 2019 Risk Assessment

| Province | MTS Substation Supply Area | 2019 Potential Capacity in MW | BW4 Accelerated Interest in MW | Ability to Connect Risk | Comments on Risk to Connect |
|---|---|---|---|---|---|
| E Cape | Delphi | 138 | 392.5 | High Risk | Interest exceeds capacity. Large cluster of interest around 80km away. New 400/132kV substation and 400kV lines required. |
| E Cape | Grassridge | 359 | 186.5 | Medium Risk | Capacity available on 132kV busbar, but access to substation may be constrained. |
| E Cape | Jefferys Bay Area | 0 | 166.6 | High Risk | No existing capacity. New 400/132kV substation (Thyspunt) and new 400kV lines required. |
| E Cape | Pembroke | 436 | 34.5 | Low Risk | Capacity available on 132kV or 66kV busbar. |
| E Cape | Poseidon | 95 | 415 | High Risk | Interest exceeds the capacity. New 400/132kV substation (Poseidon B) closer to IPP clustering and 400kV lines required. |
| Free State | Everest | 980 | 150 | Low Risk | Capacity available on 132kV busbar. |
| Free State | Harvard | 670 | 225 | Low Risk | Capacity available on 132kV busbar. |
| Free State | Leander | 975 | 150 | Low Risk | Capacity available on 132kV busbar. |
| Free State | Mercury | 284 | 75 | Low Risk | Capacity available on 132kV busbar. |

2019 Connection Capacity is estimated based on approved Tx projects

Relative Risk is based on this capacity and the level of interest in MTS Supply area

Not used to determine if IPP project can or cannot be connected

# Thank you