

GRIDLOCKED

A long-term look at South Africa's electricity sector

Steve Hedden
Researcher, African Futures and Innovation
Institute for Security Studies
shedden@issafrica.org
@SteveHedden



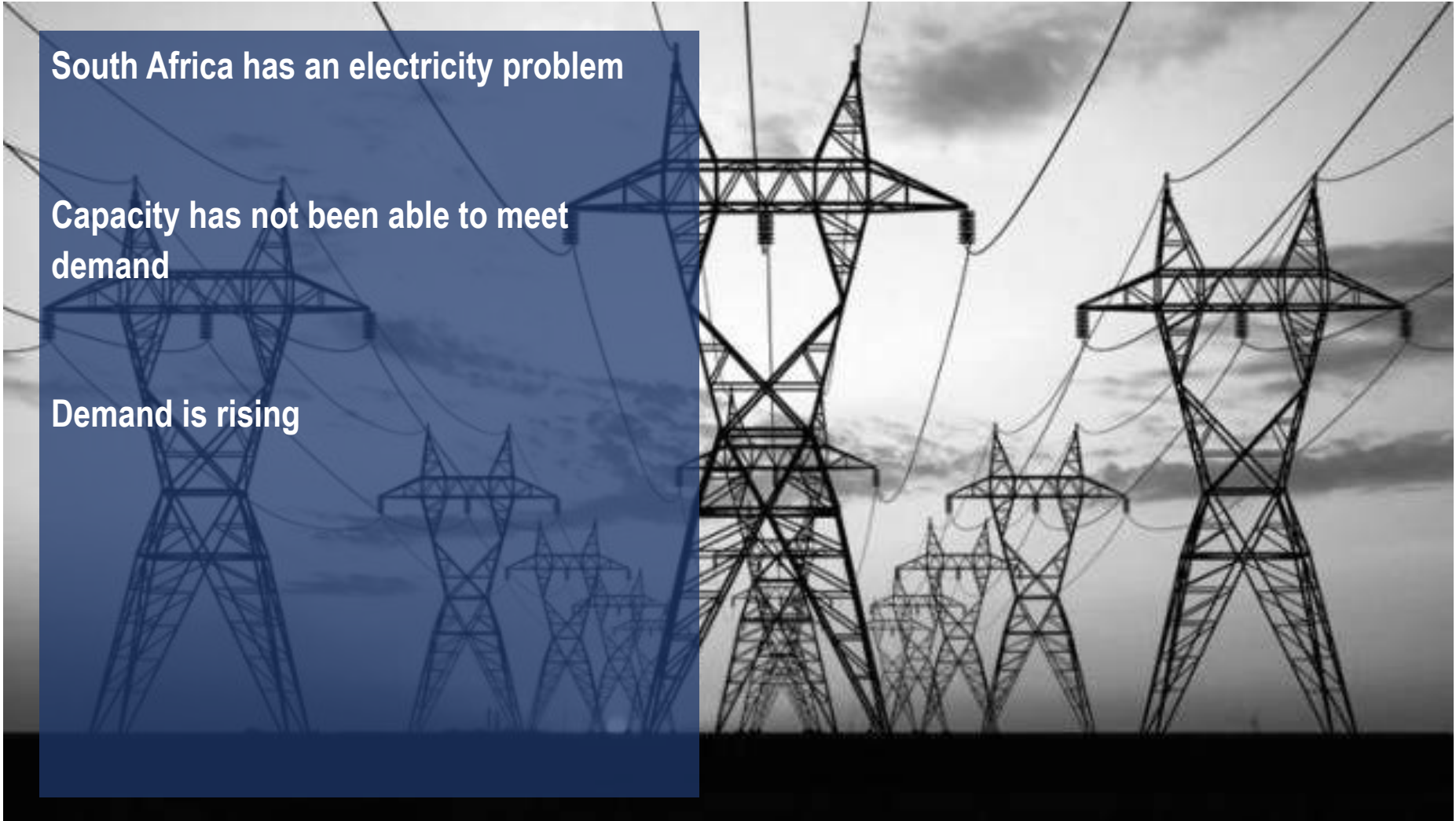


Background

How generation is changing

Effects on the grid

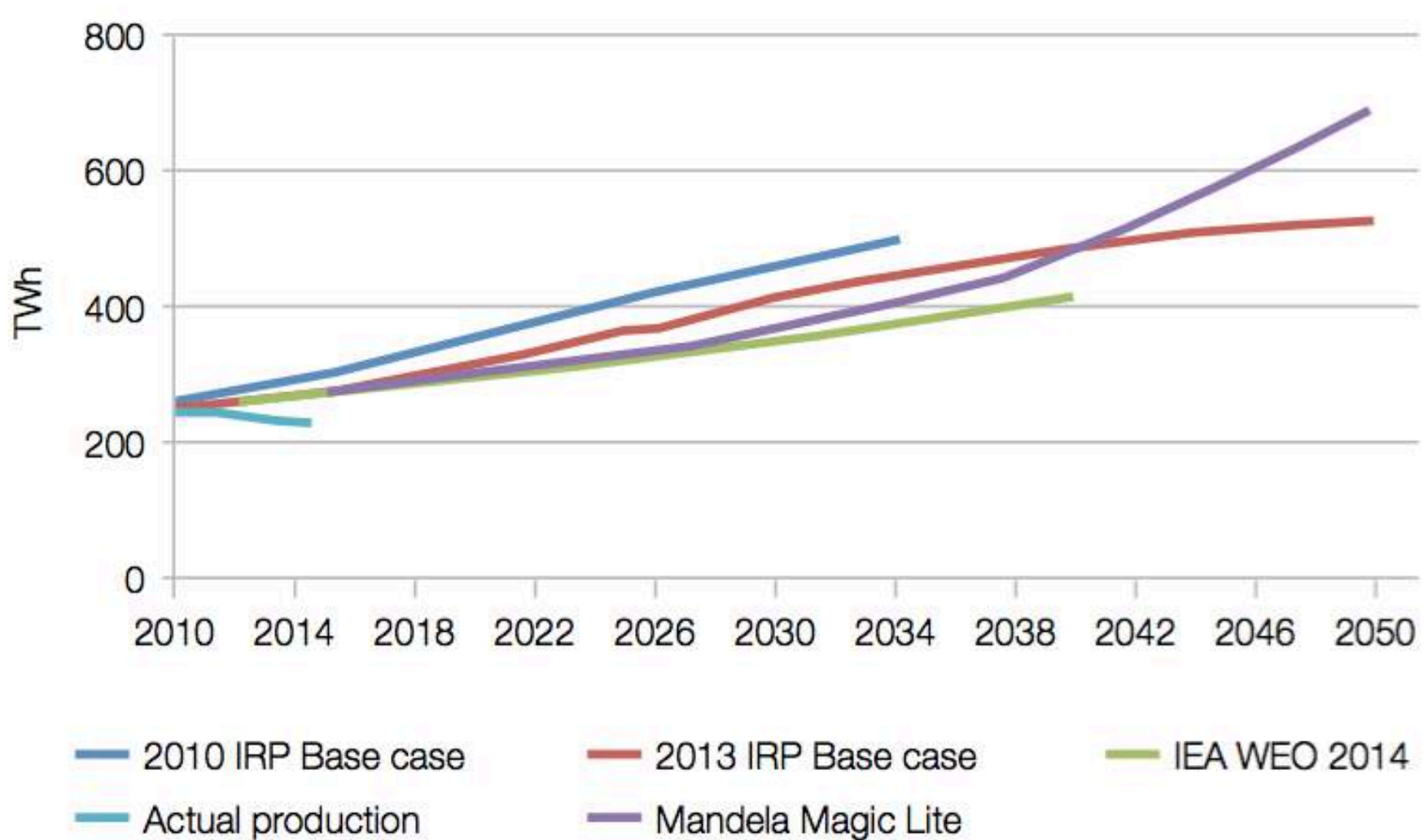
Response/Recommendations

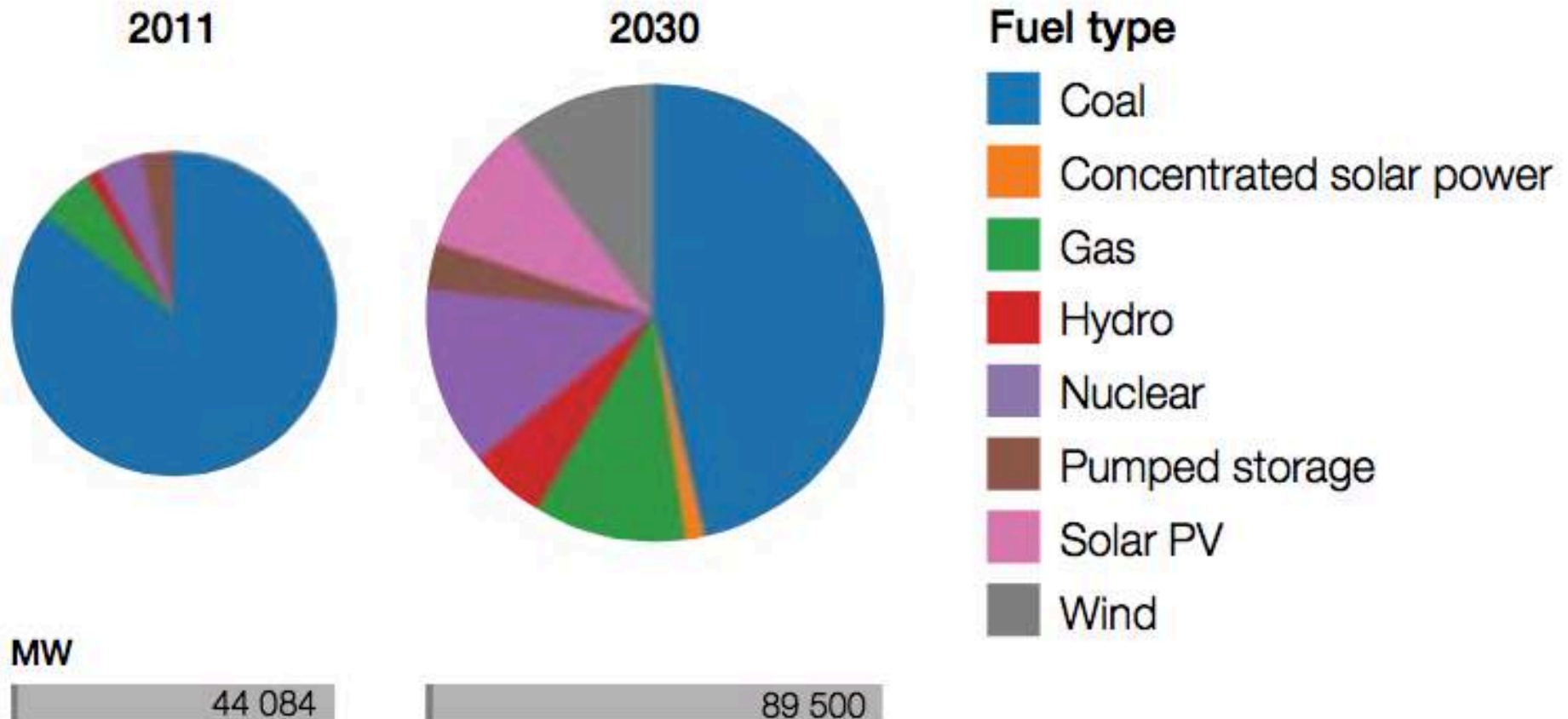


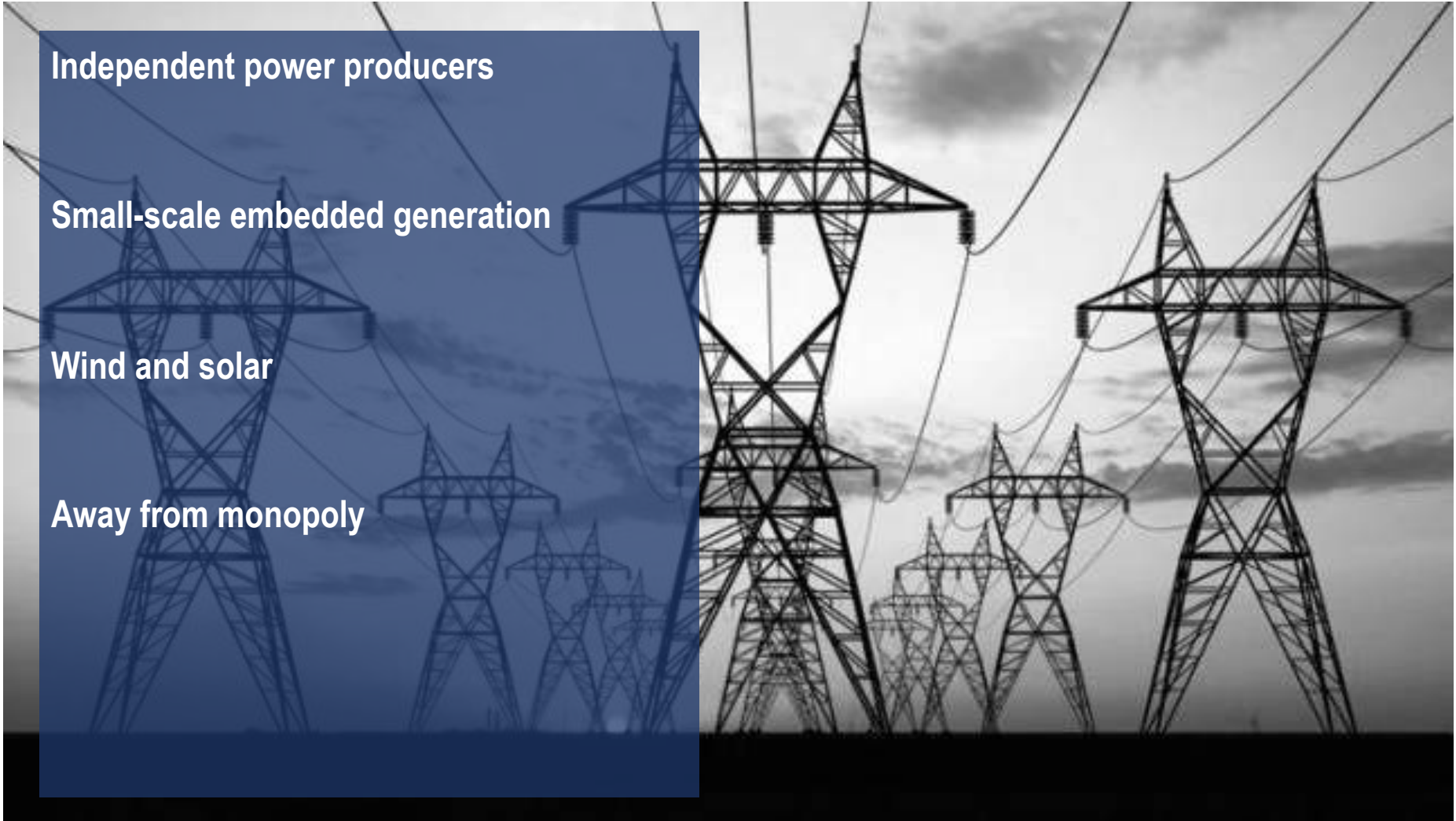
South Africa has an electricity problem

Capacity has not been able to meet demand

Demand is rising







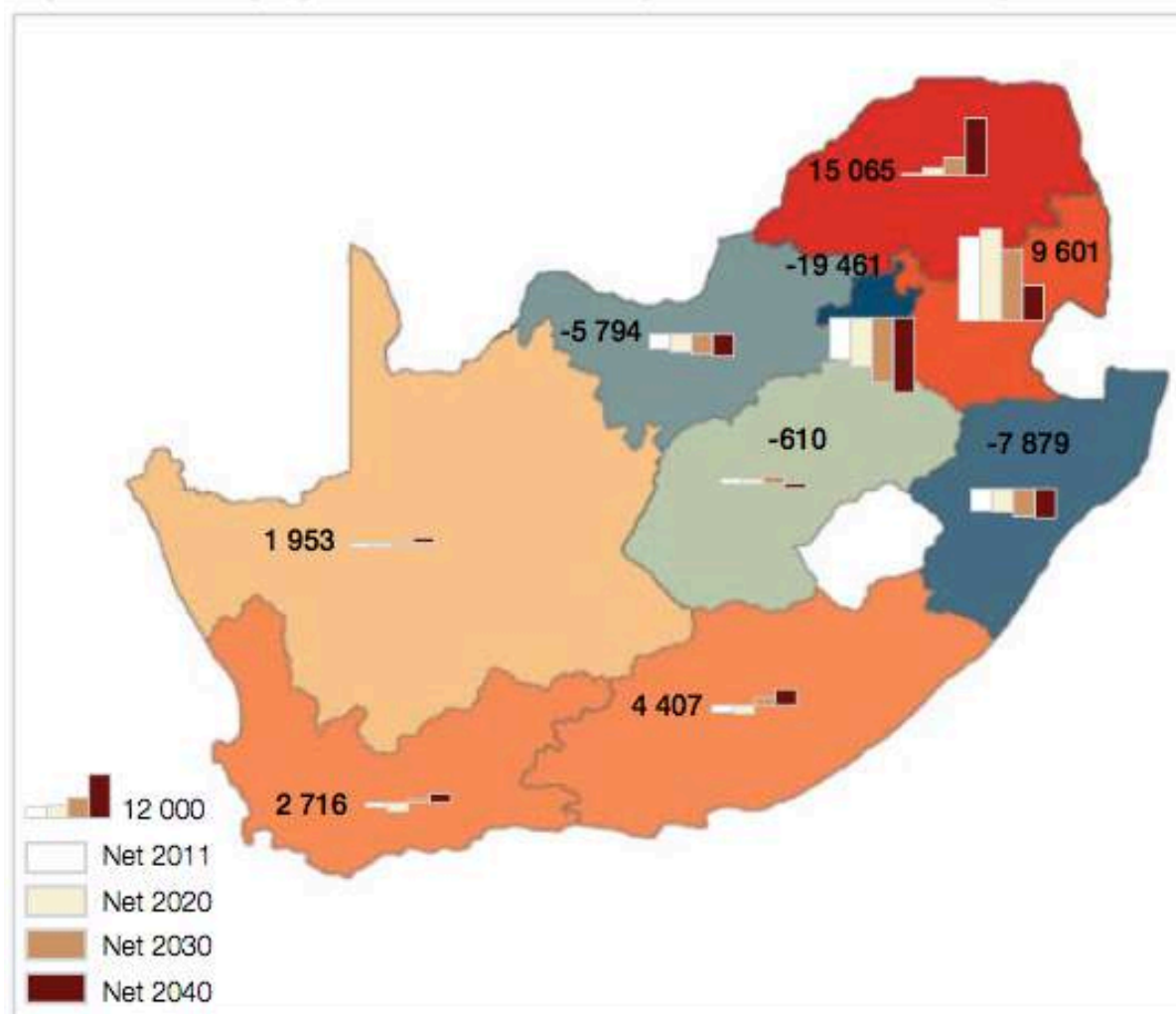
Independent power producers

Small-scale embedded generation

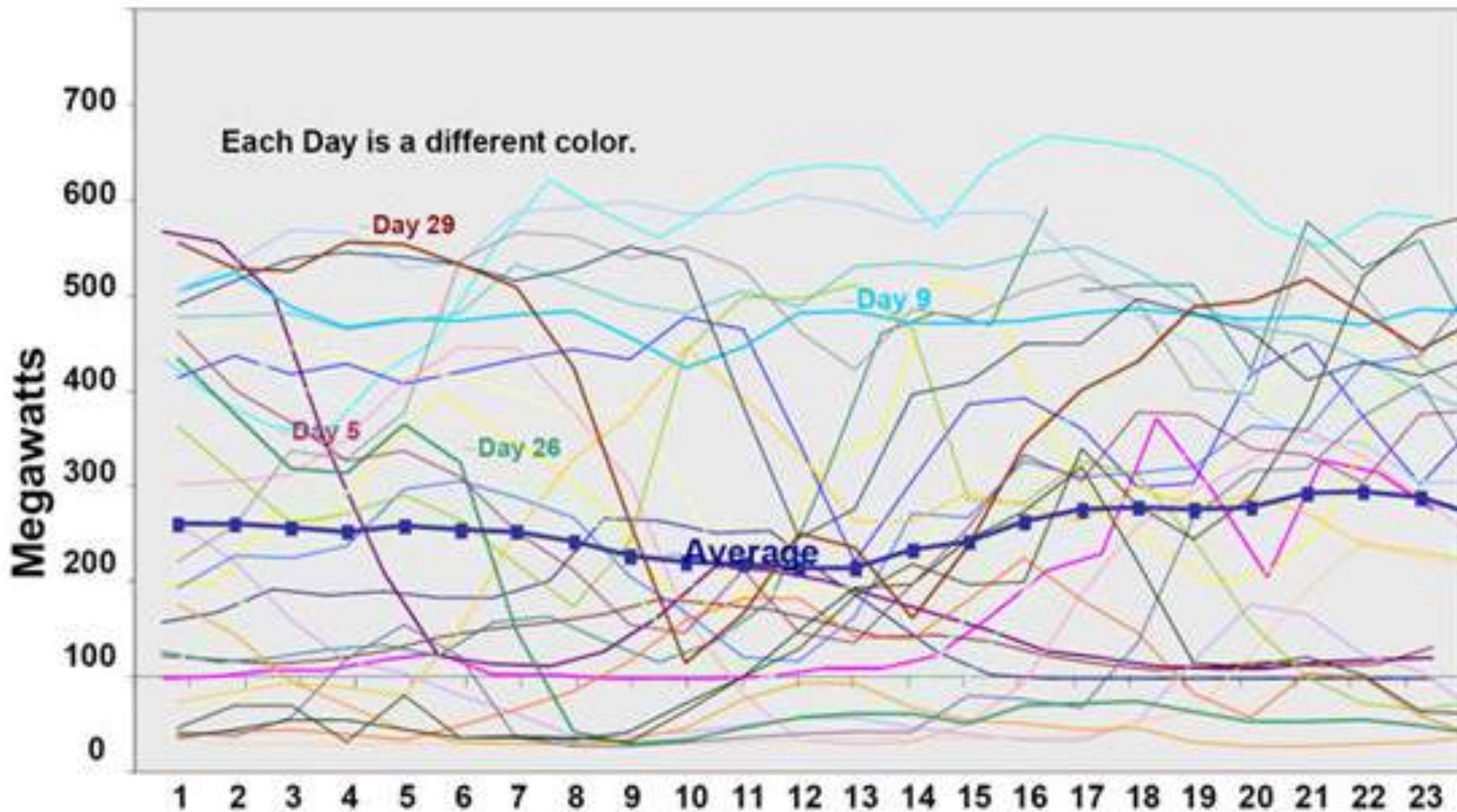
Wind and solar

Away from monopoly

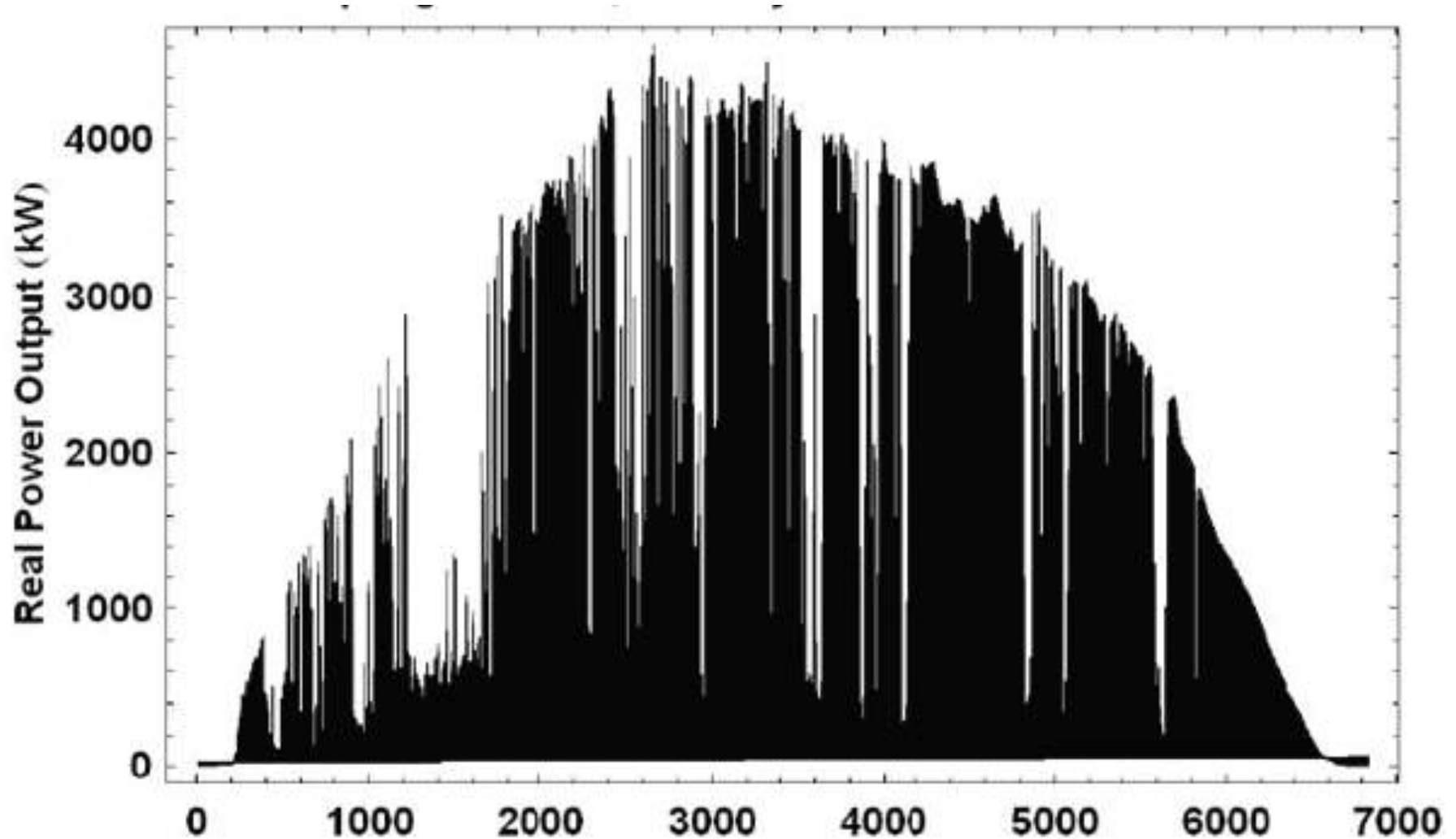
HOW THIS AFFECTS THE GRID: DECENTRALISED

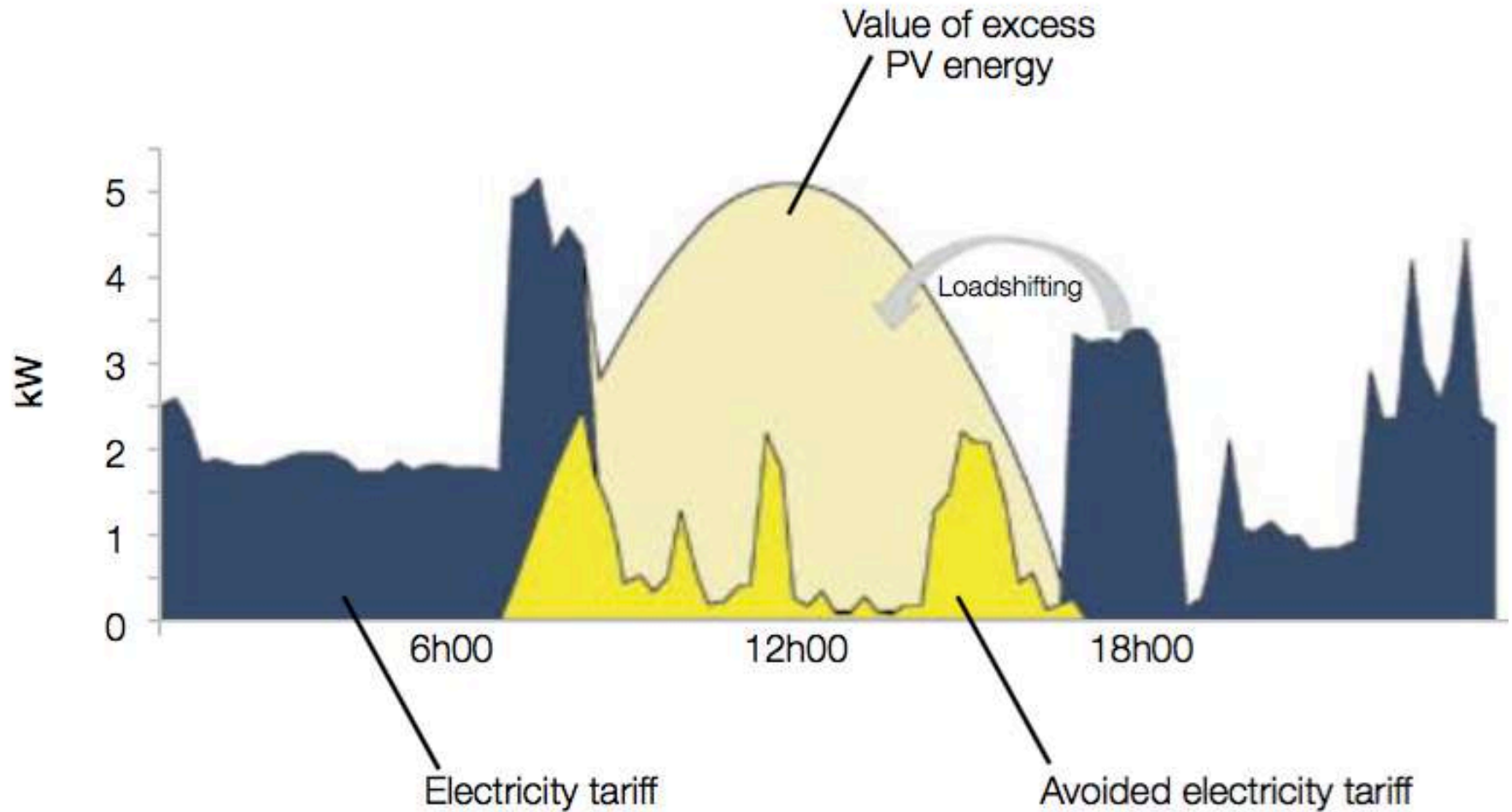


HOW GENERATION IS CHANGING: INTERMITTENT

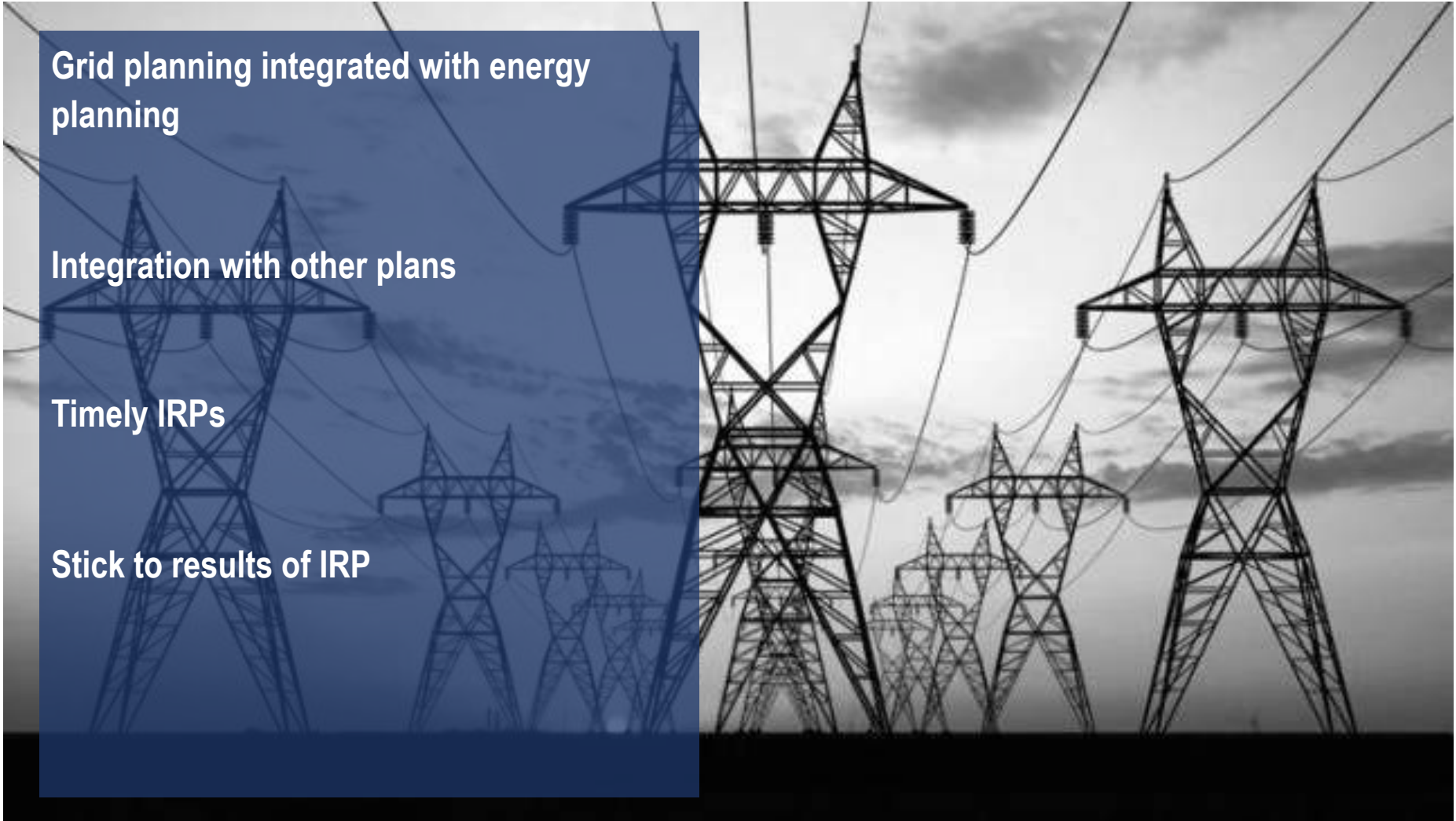


HOW GENERATION IS CHANGING: INTERMITTENT





	Energy planning	Grid planning	System operator	Grid operator	Municipality
Decentralised		X		X	
Intermittent	X		X	X	
Bi-directional				X	
Embedded					X
	Planning		Operations		Policies



Grid planning integrated with energy planning

Integration with other plans

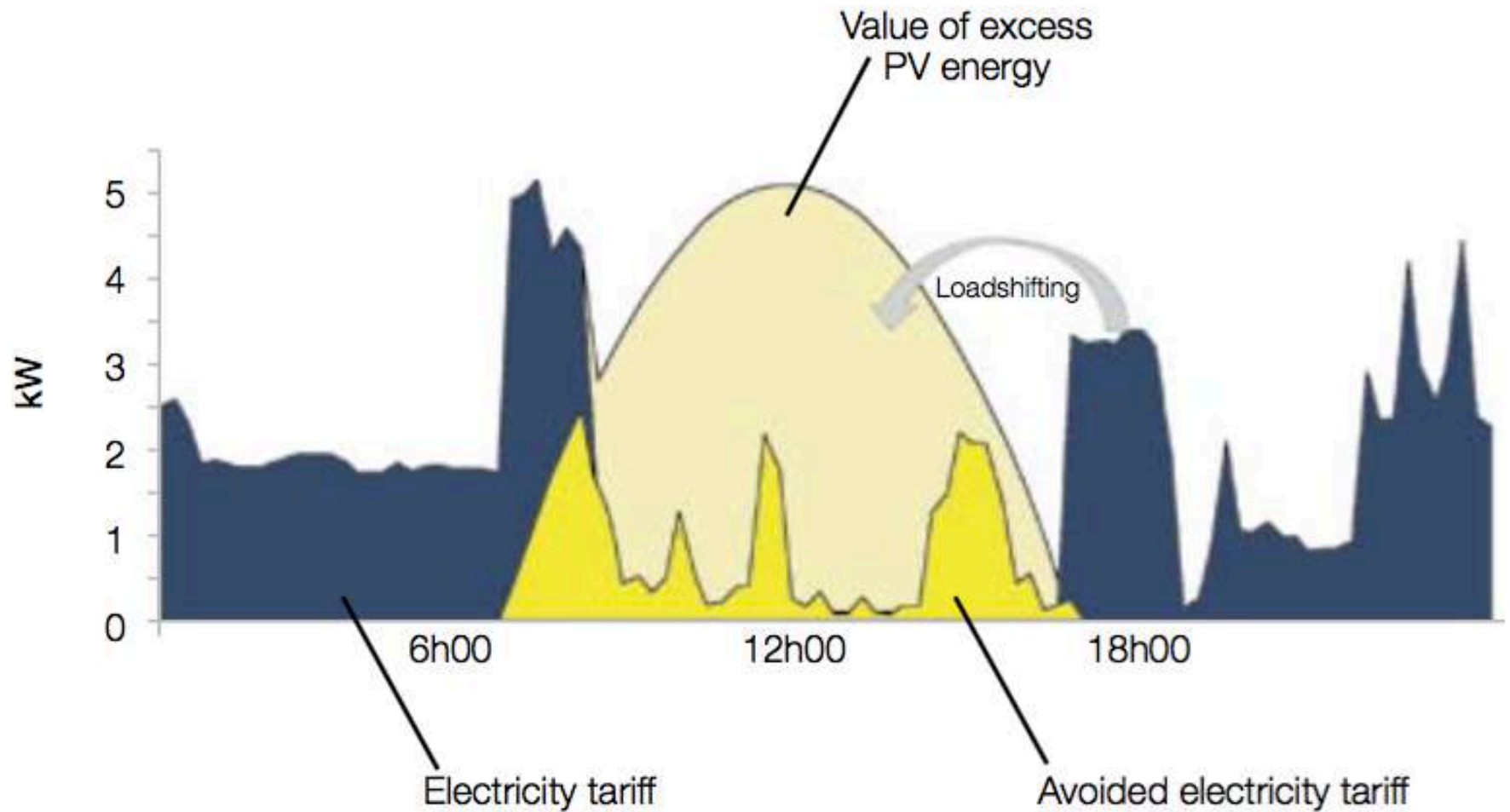
Timely IRPs

Stick to results of IRP



Flexible capacity to complement wind and solar

Innovative operational strategies





Generation capacity is changing

Grid must adapt

Structure of electricity sector must be clear

Rethinking South Africa's Power Grid

Institute for Security Studies

The Strategic Network Development for Connection of IPPs

Kevin Leask

Eskom, Transmission, Grid Planning

Brooklyn, Pretoria

15 September 2015

The Strategic Grid Plan

- The 2040 Tx Network Study
- Future Generation allocation
- Main Power Corridors

Grid Access for Future IPPs

- REDZs and RE Clusters
- Strategic IPP connection projects
- Way forward

STRATEGIC GRID PLAN

(2040 Transmission Network Study)

Integrated Resource Plan

- The Department of Energy (Energy Planner) is accountable for the Country Energy Plan as per the 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 3-5 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

The location of the future generation to supply the load demand growth is uncertain which means long term strategic studies must be done to determine the required transmission network needs for the future.

The 2040 Transmission Network Study was undertaken to:

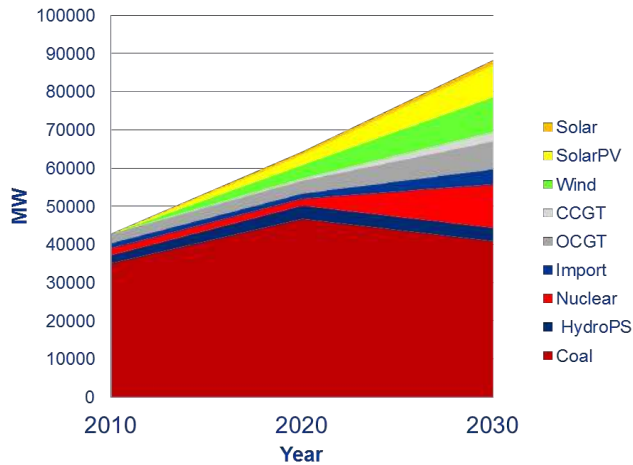
- **Adapt to the uncertainty of future** load and generation
- Identify the **critical power corridors** and constraints on the transmission network
- Unlock and create a **flexible and robust grid** to be able to respond to the changing future needs of the country

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.

2040 Tx Study – Generation Spatial Allocation

Transmission to enable the IRP requires Spatial Information

IRP 2010

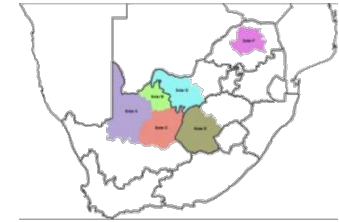
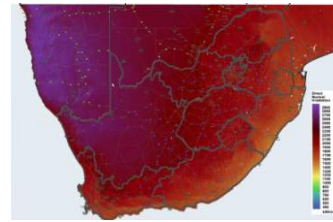


However there is uncertainty in

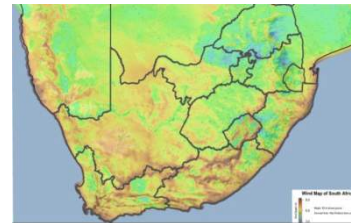
- Where is the location?
- What is the size?
- What is the type?

Generation Energy Resources for Electricity

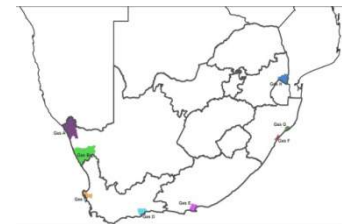
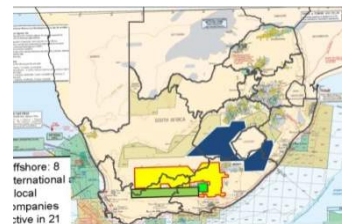
Solar



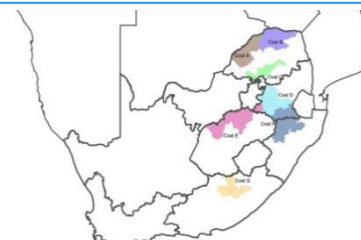
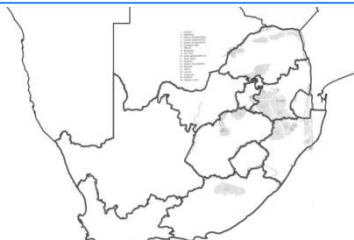
Wind



Gas



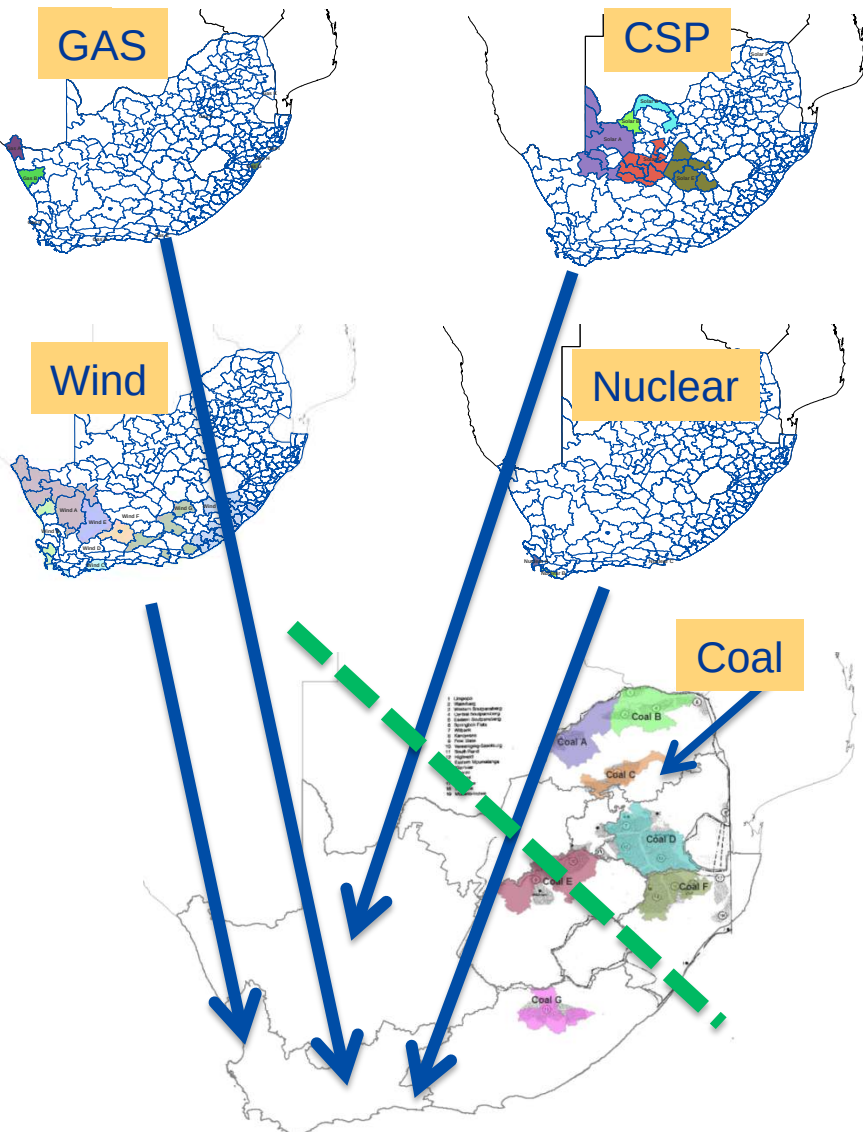
Coal



2040 Tx Study – New Generation Allocation

Generation

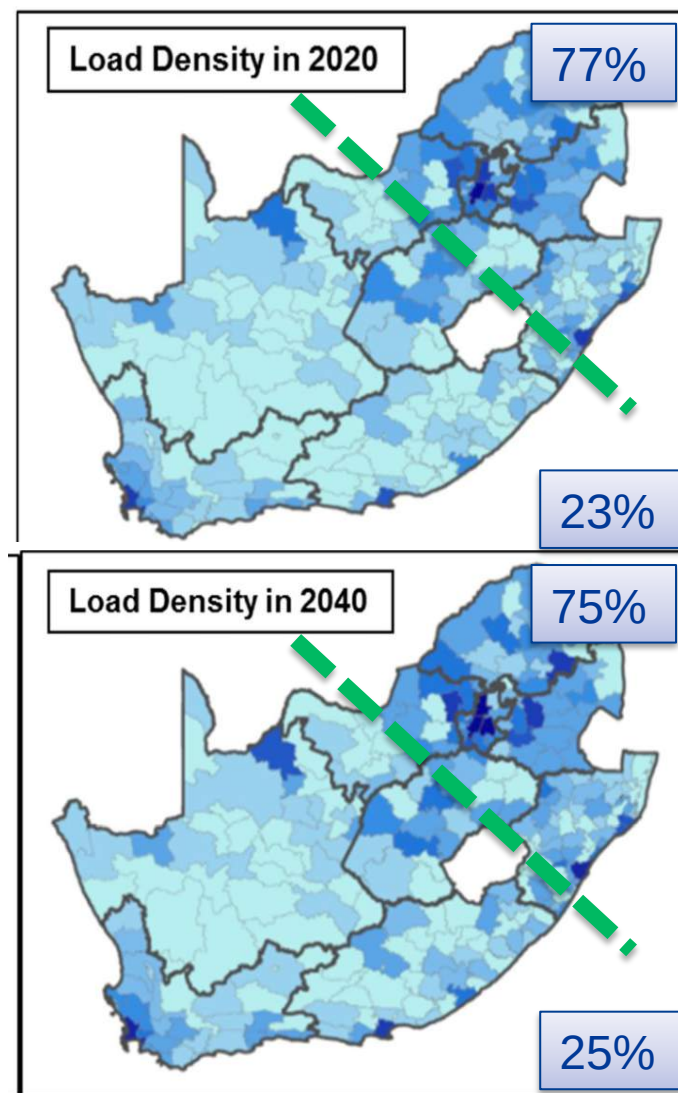
Energy resources for electricity



Significant change in Generation location

Demand

Load Demand for each area for 2020 & 2040



No significant change in load location

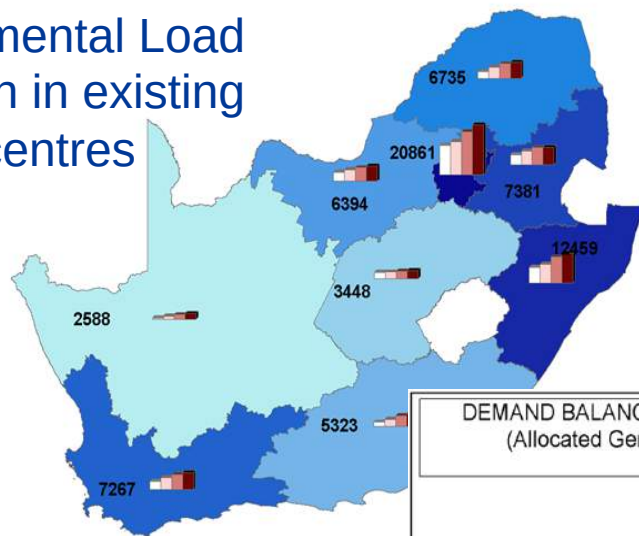
Mapping the Demand and Generation

- Spatial Location of Load



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

Incremental Load
growth in existing
load centres

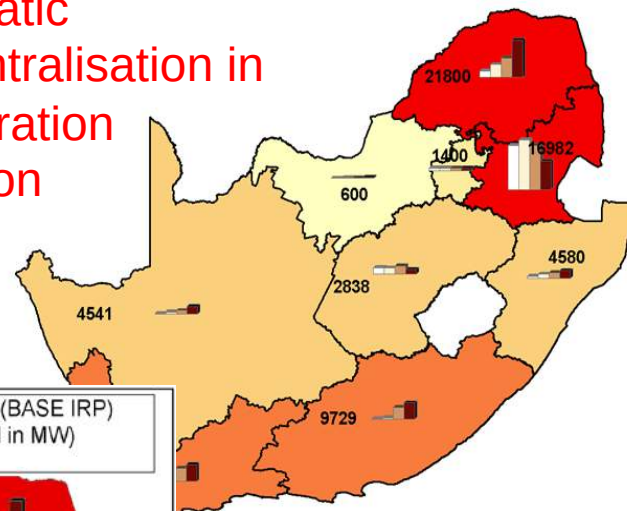


- Spatial location Generation

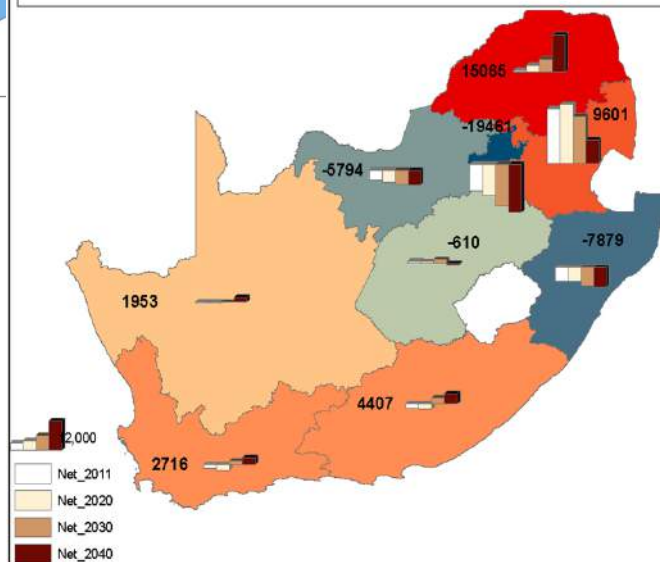


GENERATION DEVELOPMENT FOR SCENARIO A (BASE IRP)
(Maximum Demand in MW)

Dramatic
decentralisation in
Generation
location



DEMAND BALANCE BY 2040 FOR SCENARIO A (BASE IRP)
(Allocated Generation less Maximum Demand in MW)



Load

Gx

Excess /
Deficit

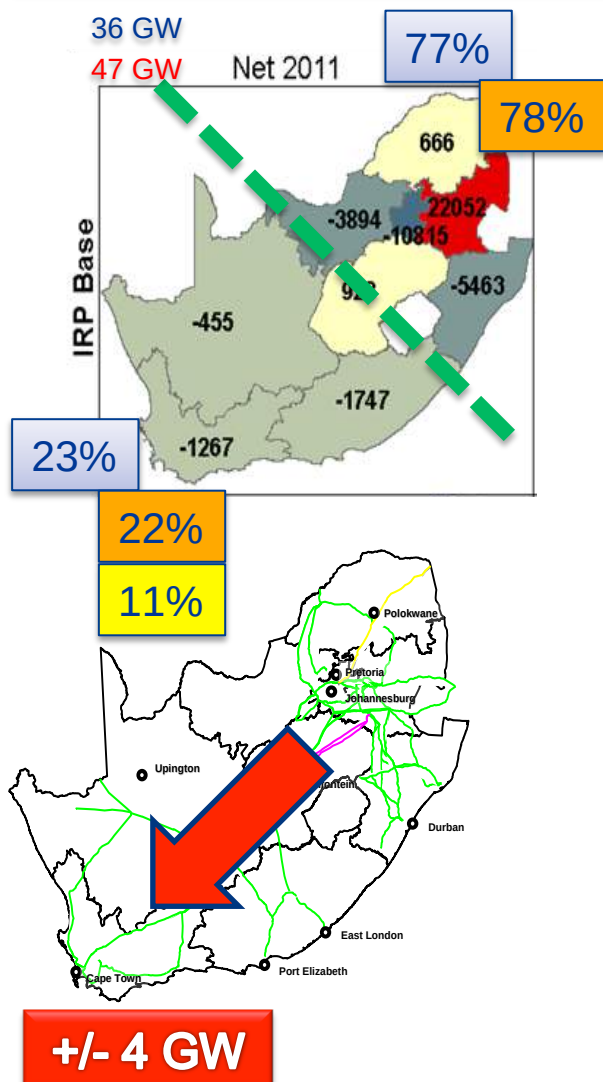
-	+
■	+

+
■

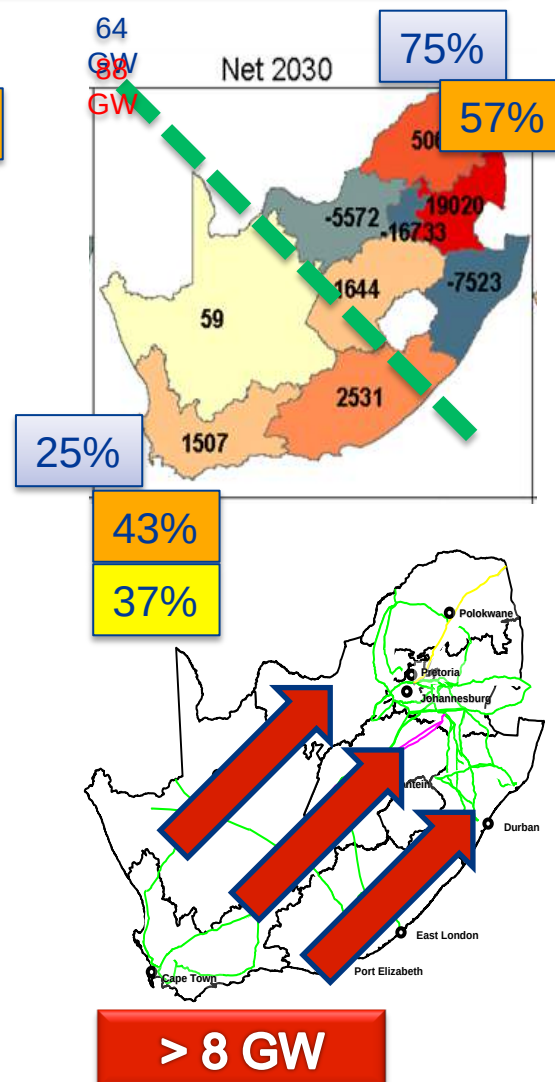
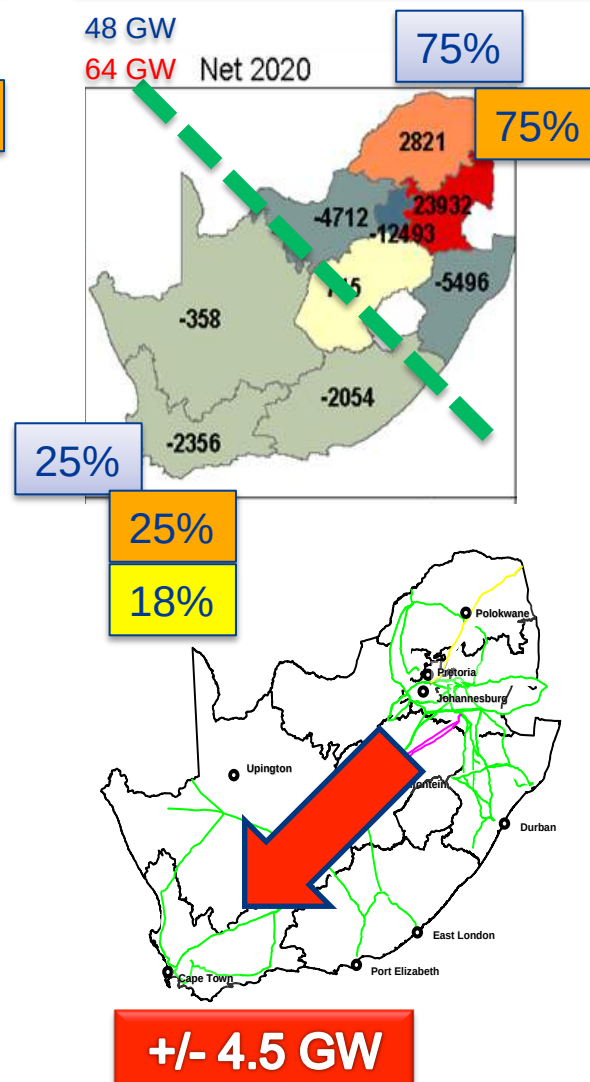
Generation Excess
Demand Excess

Demand Balance change into the future

Current Network Transfer

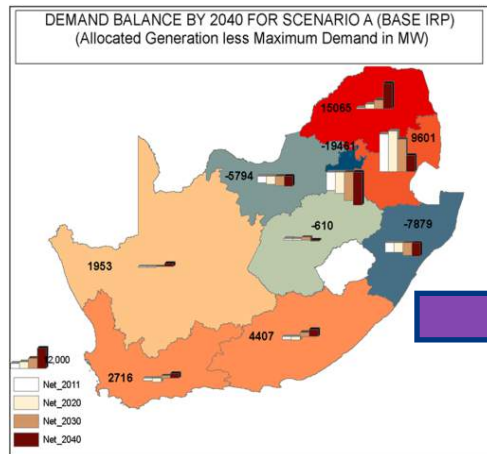


Future Network Transfer

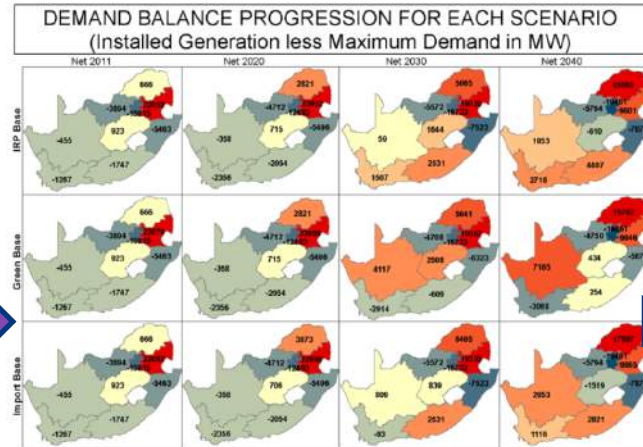


Summary of Strategic Tx Grid Study

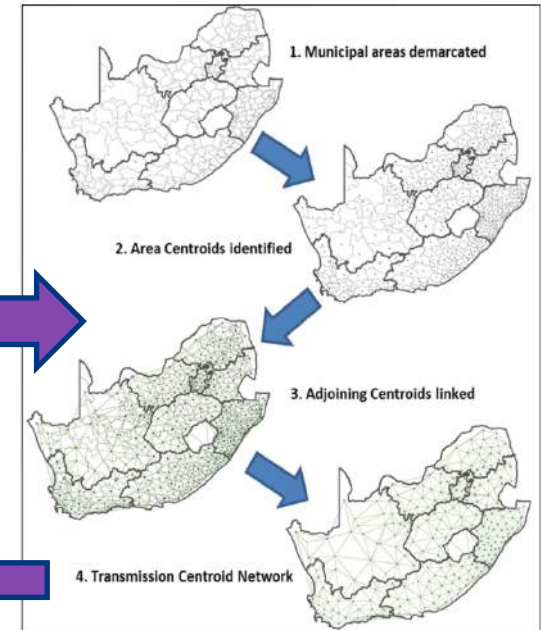
Demand Balance



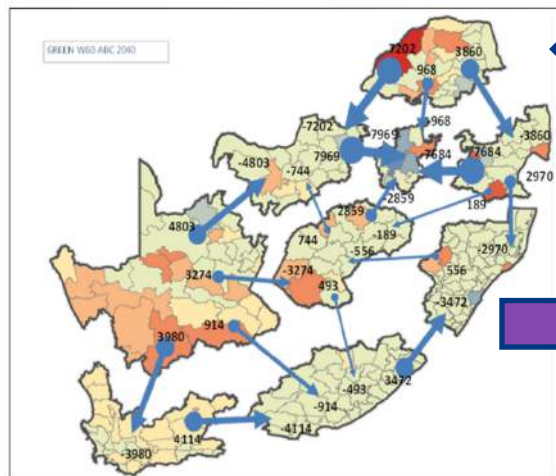
Multiple Scenarios



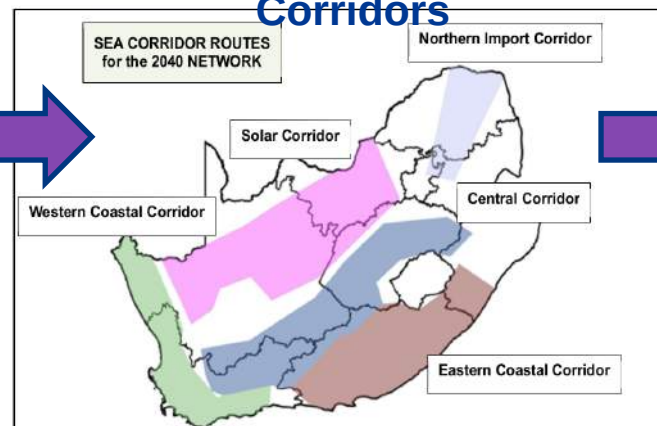
Centroid Network



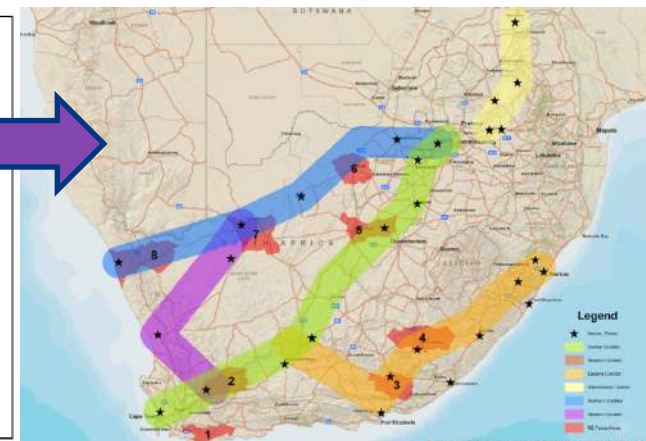
Power Flows



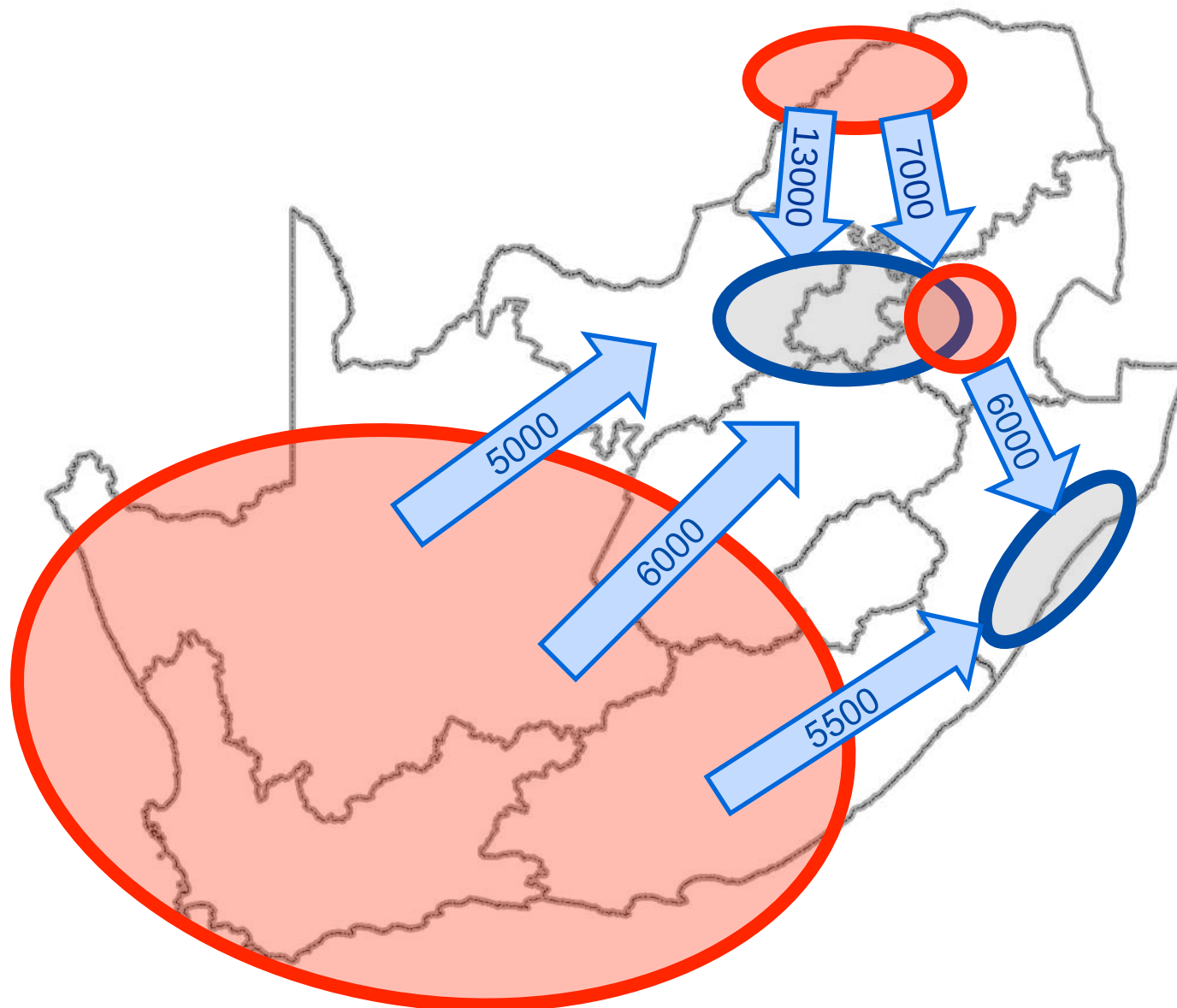
Common Power Corridors



SIP 10 SEA Study



Tx 2040 Study – Future Main Corridors Overview



LOAD CENTRES

Gauteng & Central areas

KZN areas

POWER POOLS

2 Concentrated areas in the North

1 large Dispersed area in the South

MAIN POWER CORRIDORS

3 from the North – two already secured

3 from the South – only one partially secured

GRID ACCESS FOR FUTURE IPPs

What has Eskom done to enable connection of IPPs

- 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
- Developed a simpler, faster **connection application process** for **all new generation** plant
- **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 programmes 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 “*self build*” 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**

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

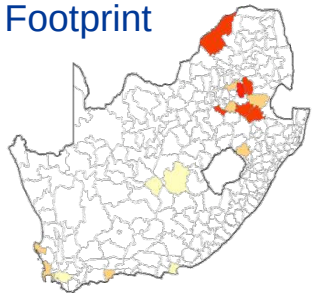
- Grid Access – Increased connection capacity needed in new areas (delivery time > 8yr)
- On Time Connection – Smaller IPP generation plant can be constructed faster (delivery time < 5yr)
- Unknown locations - Multiple unspecified IPP sites require market access for best price

Change in Location - Spatial Footprint

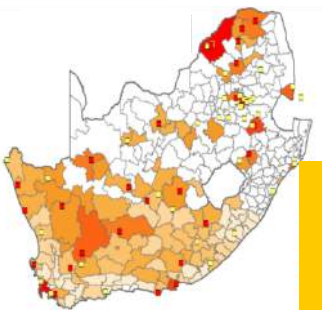
Change in Construction 3yr - 5yr Speed of IPP plant rollout

Strategic EIAs & Servitudes can enable faster grid development

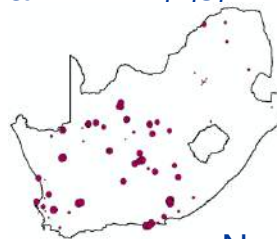
Current Generation Footprint



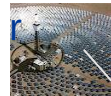
Future Generation Potential Footprint



Current
Eskom Wind, Solar
& REIPP 1,2,3,4



Sola



Wind



Gas



Nuclear



Beyond 2020 Demand Balance
significantly changed by
dispersed generation in South

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

Significantly
More
Transmission
Corridors and
Grid Access
required

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

Transmission Line Project Timeline



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

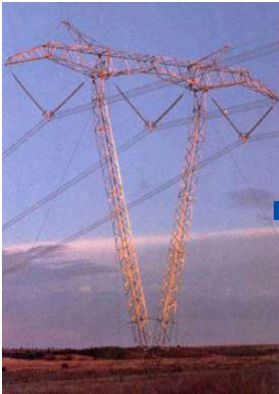
2. Reducing Tx investment today compounds future Tx Grid roll out leading to high risk of Gx capacity delays

SEA Corridor:



RE Gen to connect via Dx Collector 132kV networks

The collated output from the multiple RE generation sources are then transported on the Tx grid



The output from the distributed plants are collected at Dx network “Collector” and “Satellite” substations



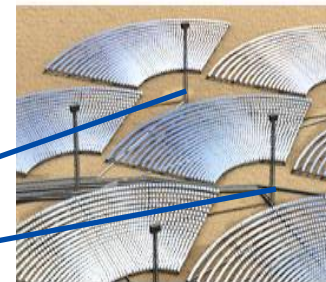
“Collector” substation



“Satellite” substation



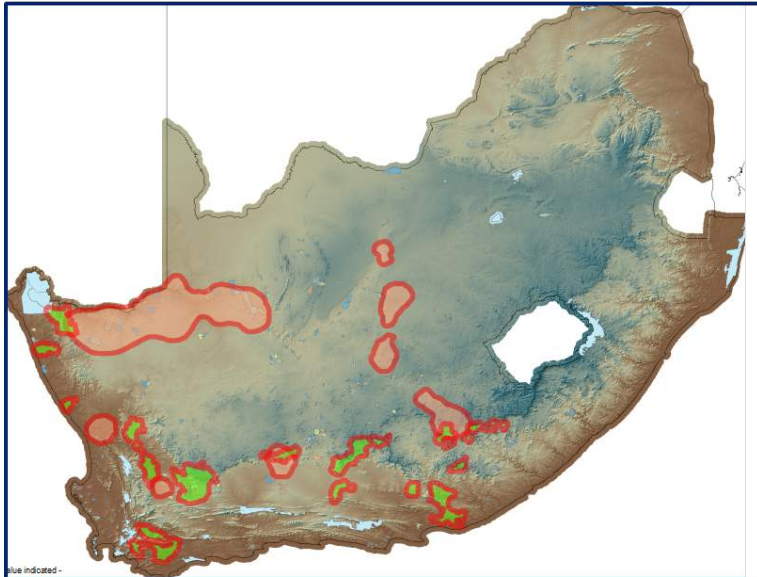
Individual wind turbines are widely distributed and the output needs to be collected



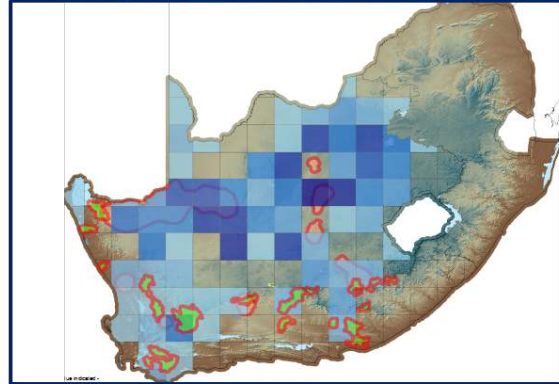
Individual PV and CSP plants are widely distributed and the output needs to be collected



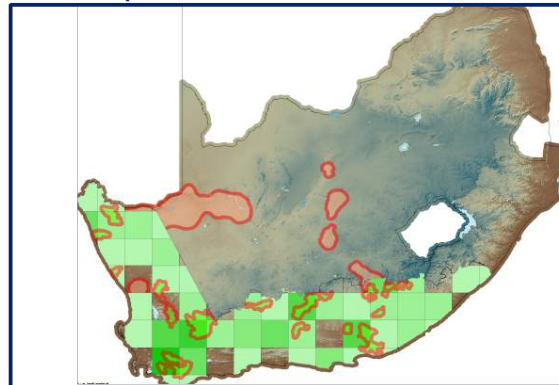
SEA - Wind and Solar Preferred Location



Developers - Solar Preferred Location



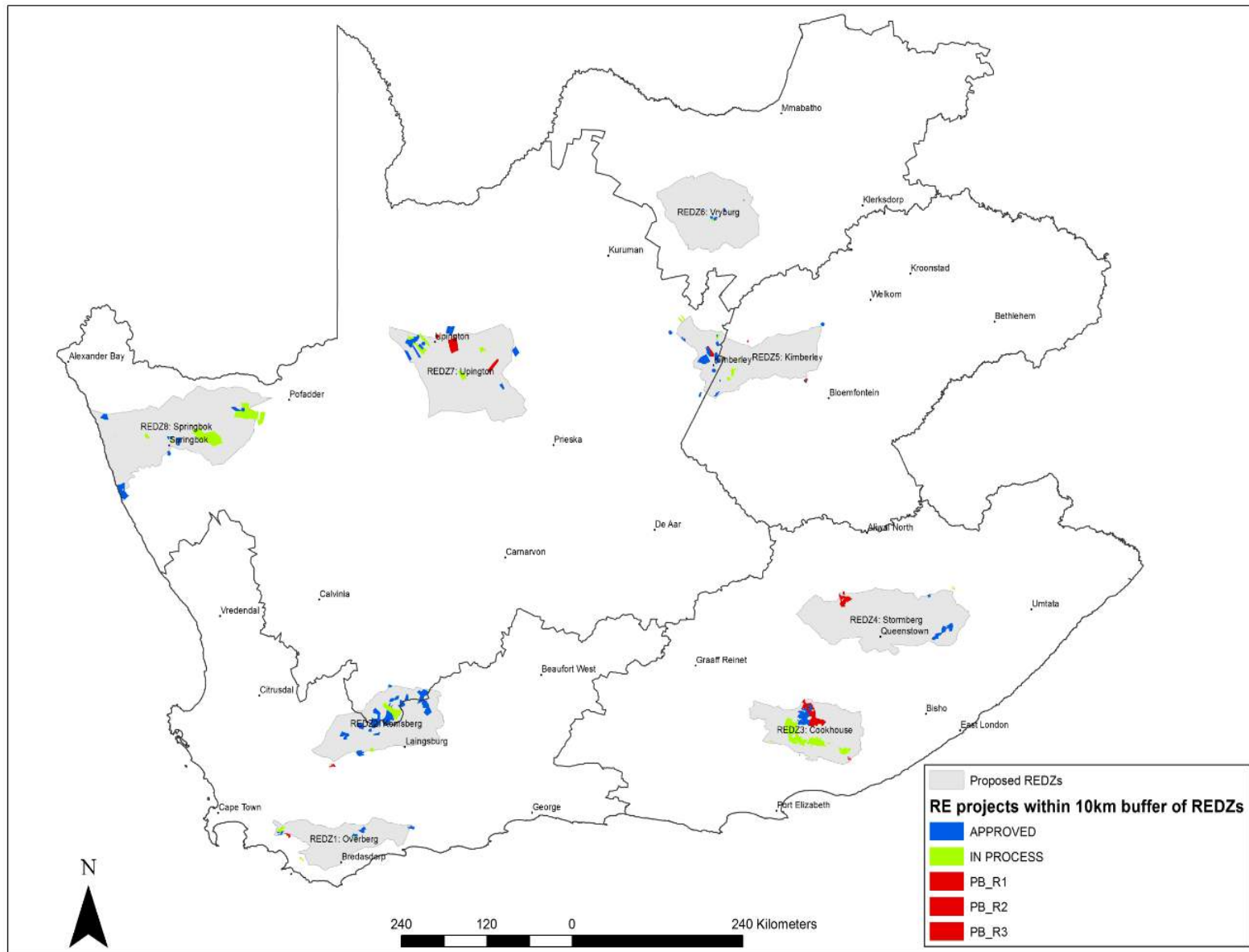
Developers - Wind Preferred Location



Correlation
of interest
by RE IPP
Developers
and the 8
REDZs

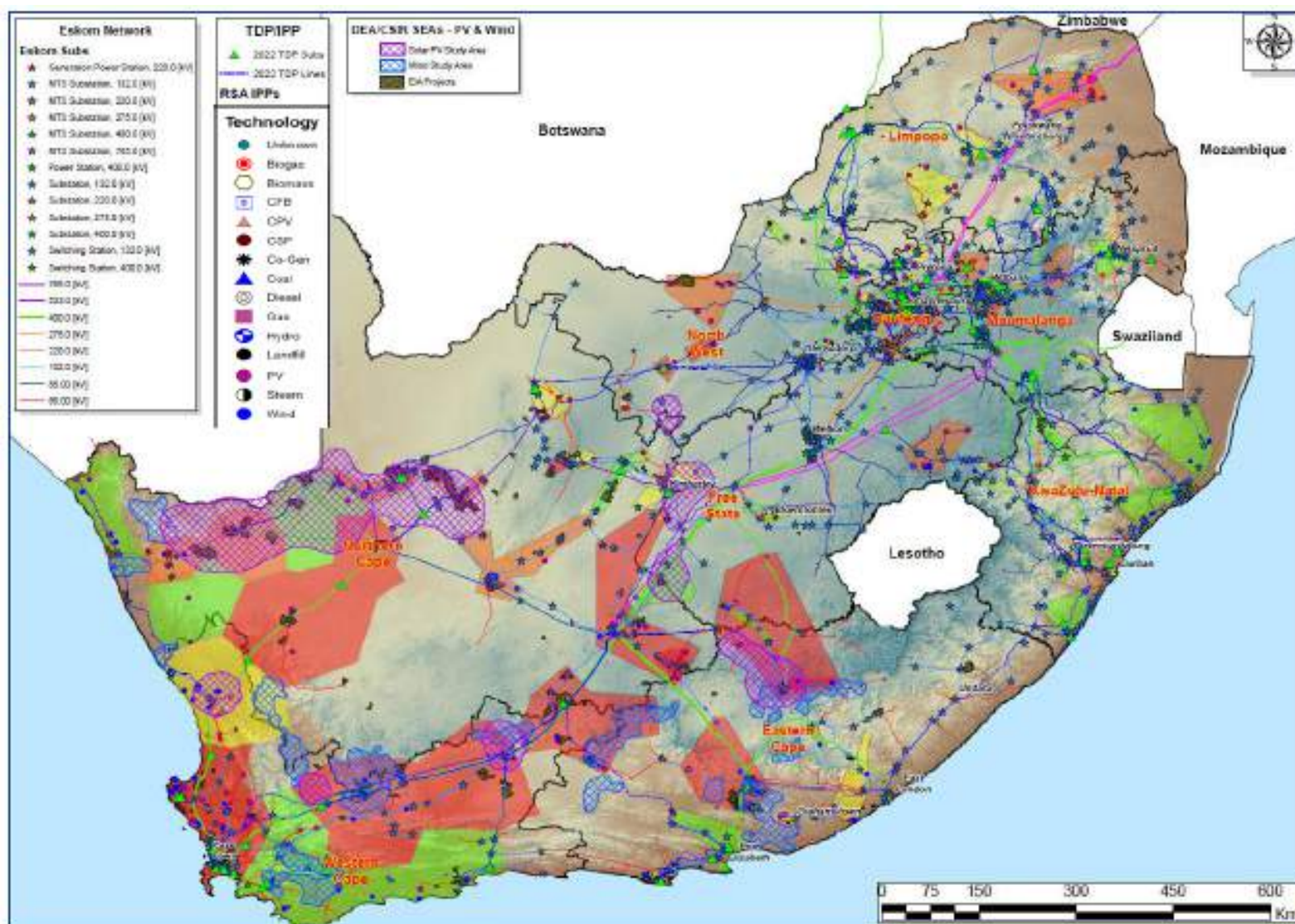
- The CSIR were appointed to undertake a study to identify suitable corridors and zones for the efficient and effective rollout of wind and solar PV energy as part of NDP - SIP 8.
- The selection criteria included amongst others the environmental suitability of the land, the resource potential, exclusion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

RE IPP Projects underway in REDZs



Many REBID Windows 1–3 and preferred bidder projects are within the REDZs

RE Project Cluster Areas Study (Internal Eskom 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 and REDZs

- GP identified Tx projects to create additional grid connection capacity as quickly as possible for the on-time connection of DOE programmes
- These consisted of phased transmission substation and line projects
- Proposal is to undertake the preparation works for all the projects to reduce the response time to implement

Tx Project Phasing

Phase 1: Limited work at existing substations/projects (<2 yrs)

Phase 2: Limited work at existing substation with limited Tx line work (2-4 yrs)

Phase 3: Existing projects or New substations with some Tx line work that requires full EIA studies and long lead lines (4-5 yrs)

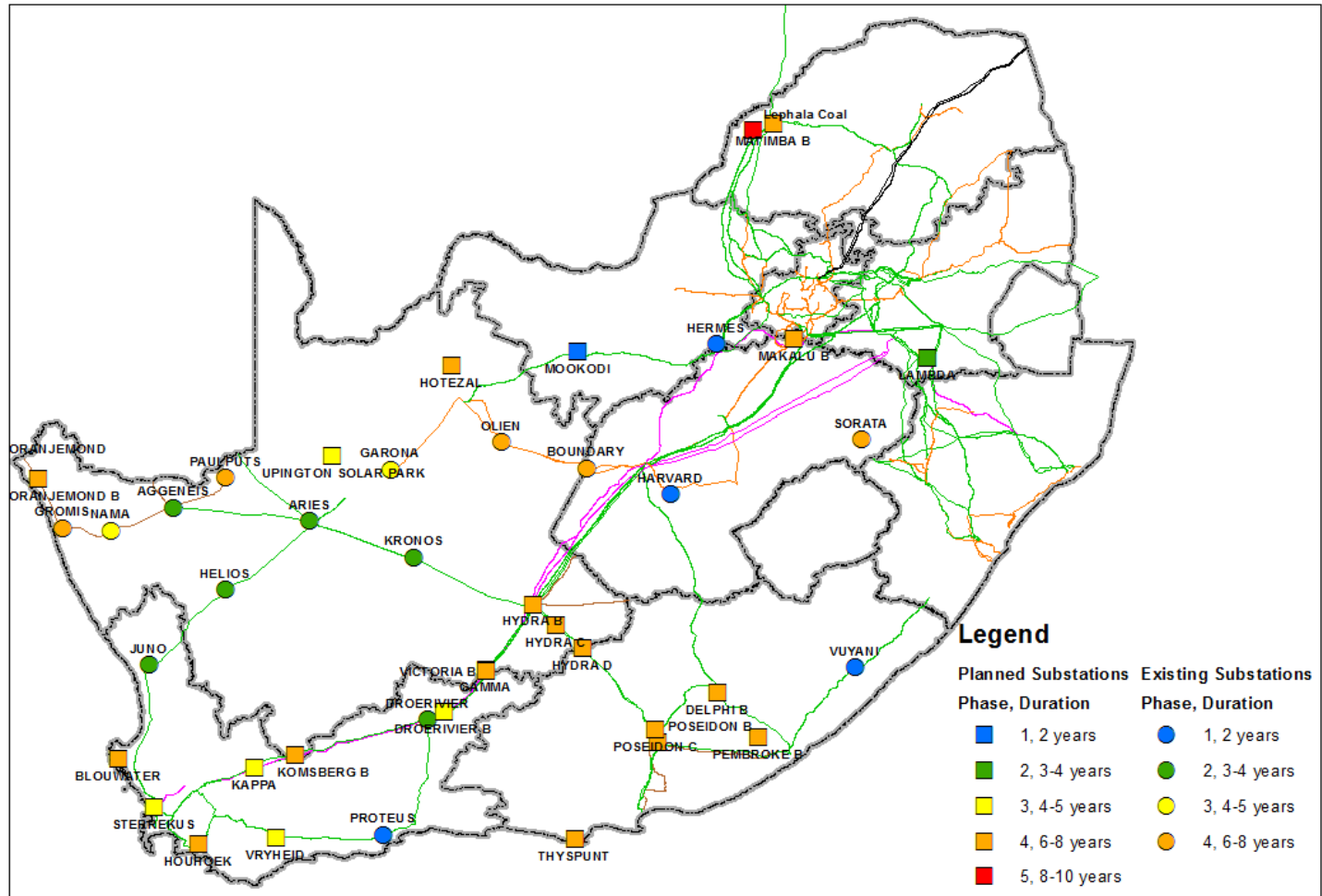
Phase 4: Existing projects or New substations with backbone Tx line work required with longer lead time (6-8 yrs)

Phase 5: New projects or New substations with backbone Tx line work required with longest lead time. (8-10 yrs)

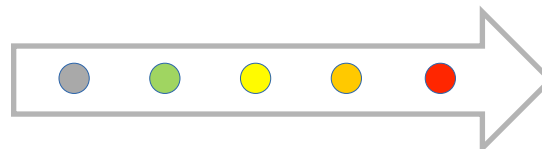
Location of Strategic Tx Projects

Potential projects include:

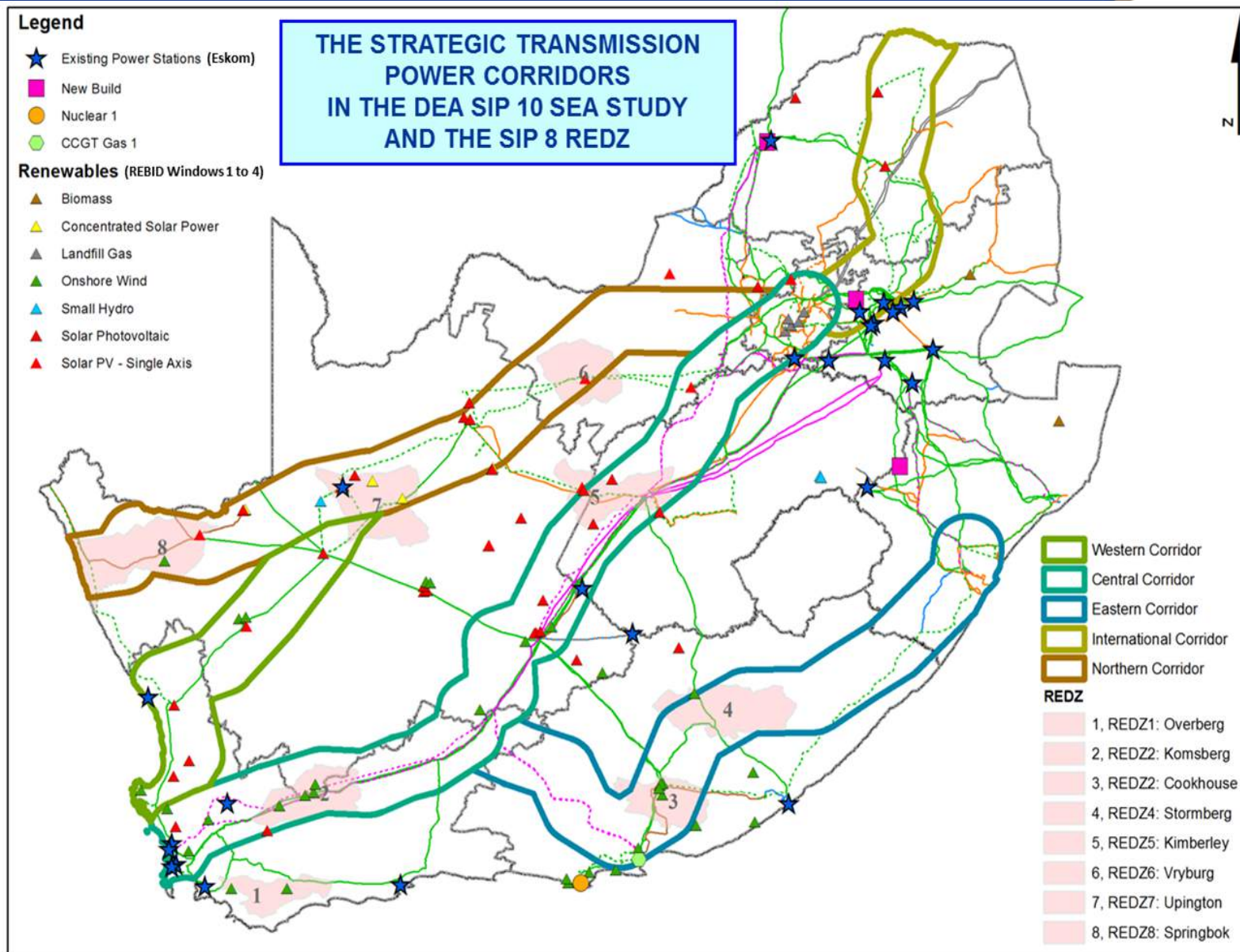
- at existing MTS substations
- at new TDP substations
- at possible new RE gen collection MTS substations



Strategic Unlocking
Implementation Time



The REDZs & Strategic Power Corridors



- Complete the funded projects already underway
- Undertake the preparation work for all the Strategic IPP Connection projects which includes the following:
 - Initiate the EIA studies
 - Acquire the servitudes and substation sites
 - Coordinate and confirm the supporting Dx 132kV collection networks
 - Complete all the detailed engineering designs
- Source funding for the above preparation work
- Outcome is a set of defined Tx & Dx “**IPP Connection Capacity**” projects that are ready for approval and funding
- Only approve and implement the selected projects as required by the DOE IPP programmes

THANK YOU