RE Integration – Strategies /Approaches for Eskom

USAID Workshop on Clean Energy Development Strategies in East Africa

Arusha, Tanzania

17 July 2012

Crescent Mushwana - Eskom

Eskom's core business

Purpose

To provide sustainable electricity solutions to grow the economy and improve the quality of life of the people of South Africa and in the region

Our core business is electricity

Generating	**Transmitting**
Trading	**Distributing**

Values

Zero harm
Integrity
Innovation

Sinobuntu
Customer satisfaction
Excellence

Generation mix (2011)

Type	Number	Nominal capacity
Coal-fired	13 stations	37 745MW
Gas/liquid fuel turbine	4 stations	2 426MW
Hydroelectric	6 stations	661MW
Pumped storage	2 stations	1 400MW
Nuclear	1 station	1 910MW
Wind energy	1 station	3MW
TOTAL	27 stations	44 145MW

Grid plans

Integrated Resource Plan (Government Policy) - DoE

- The Department of Energy (Energy Planner) is accountable for the Country Electricity Plan which is called 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 - Eskom

- 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

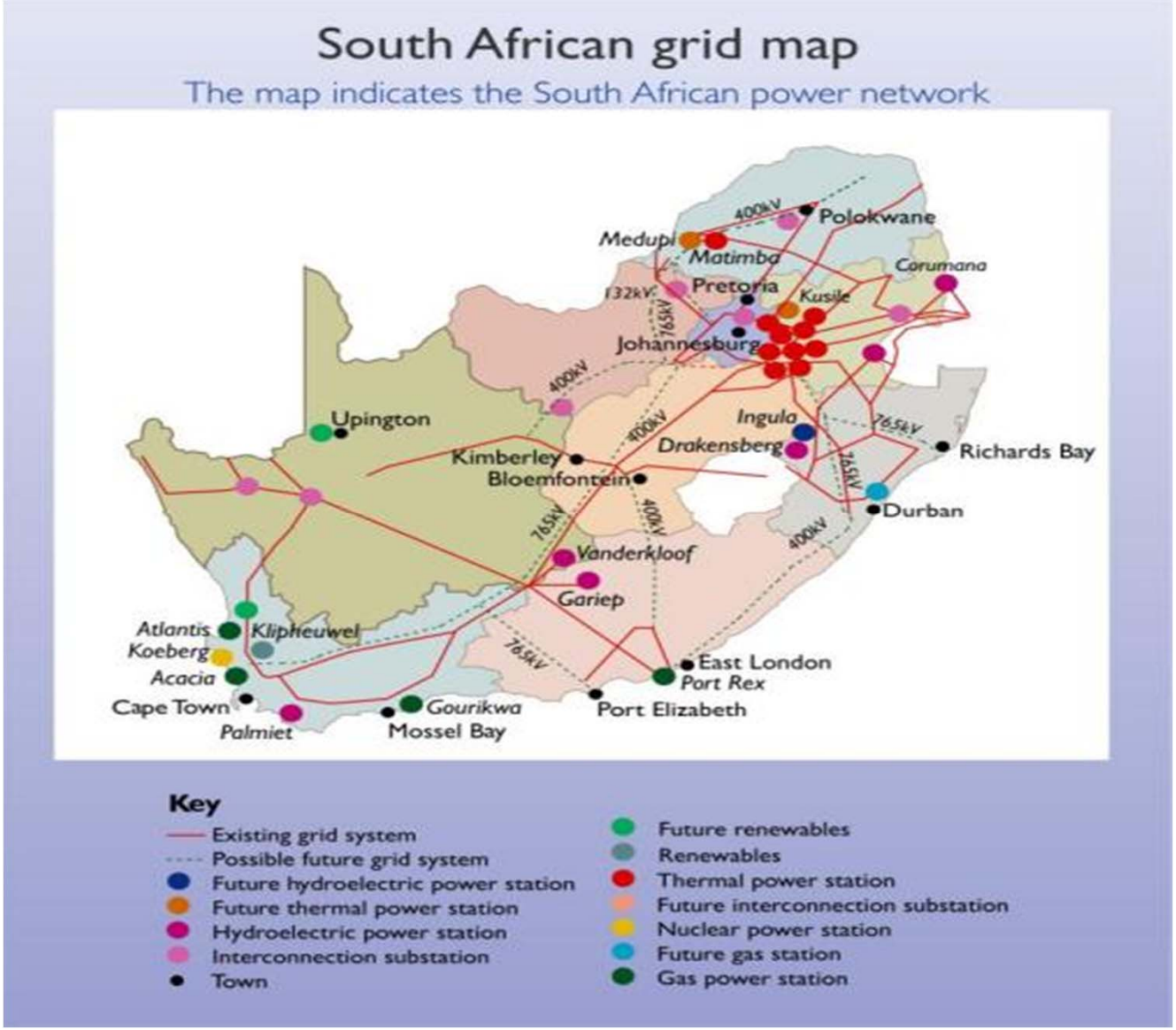
Transmission Development Plan - Eskom

- Transmission Development Plan (TDP) presents transmission network infrastructure investment requirements
- TDP covers a 10 year window
- Updated annually
- Indicates financial commitments required in short to medium term

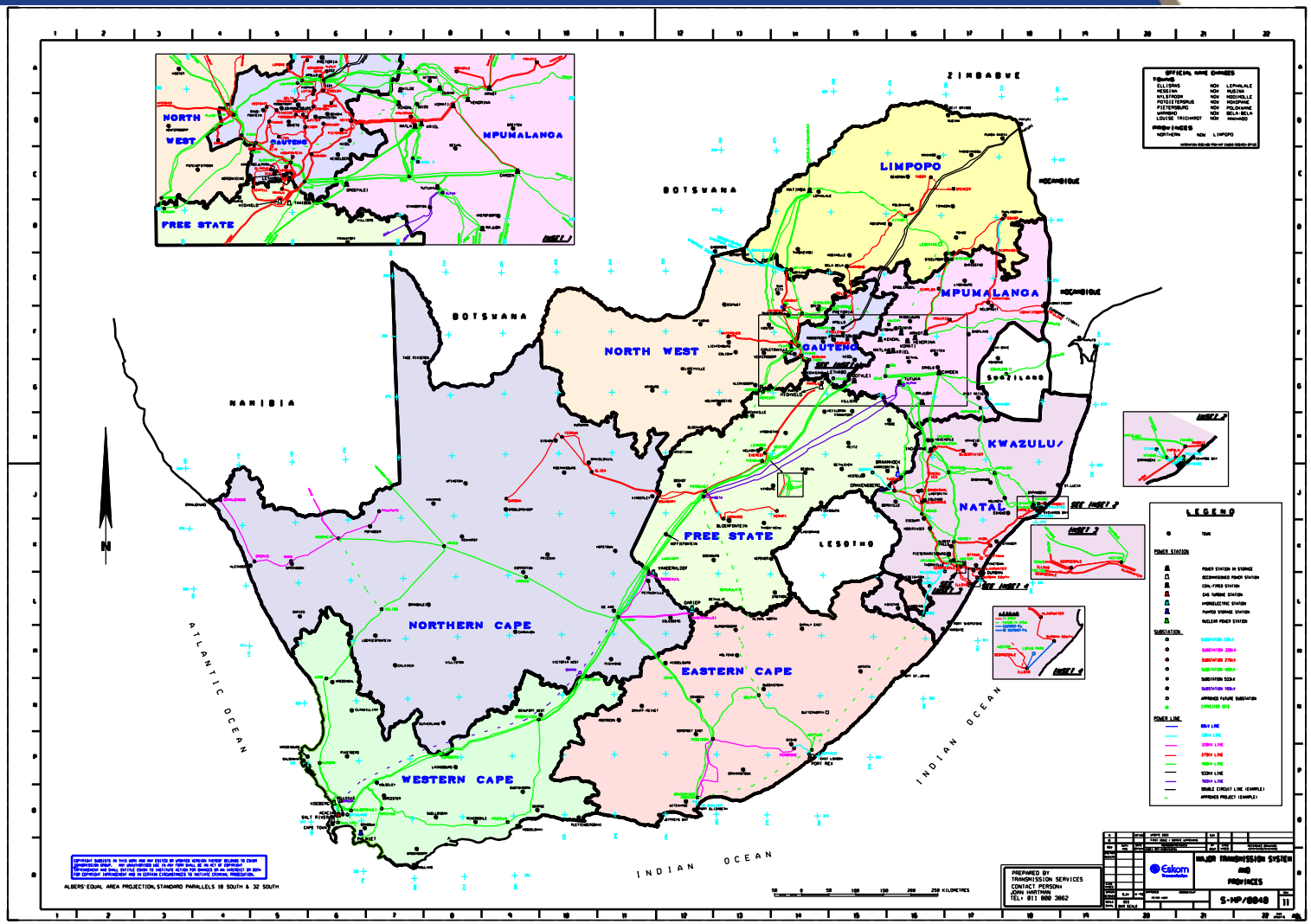
IRP (Government Policy) 2010 - 2030

Energy Source	Eskom MW	Eskom GWh	IRP 2010 MW
Coal-fired (13) [*]	37 745	220 219	6 250
Hydro-electric (6)	661	1 960	2 609
Pumped storage (2)	1 400	2 953	
Gas turbine (4)	2 426	197	6 280
Nuclear (1)	1 910	12 099	9 600
Renewable energy (1)	3.16 (wind)	2	**17 800**
Total production	44 145 [3]	237 430	*Engineering challenge*
Foreign imports		13 613	
Local IPP and co-generation [2]		1 833	

Grid Map – power station locations



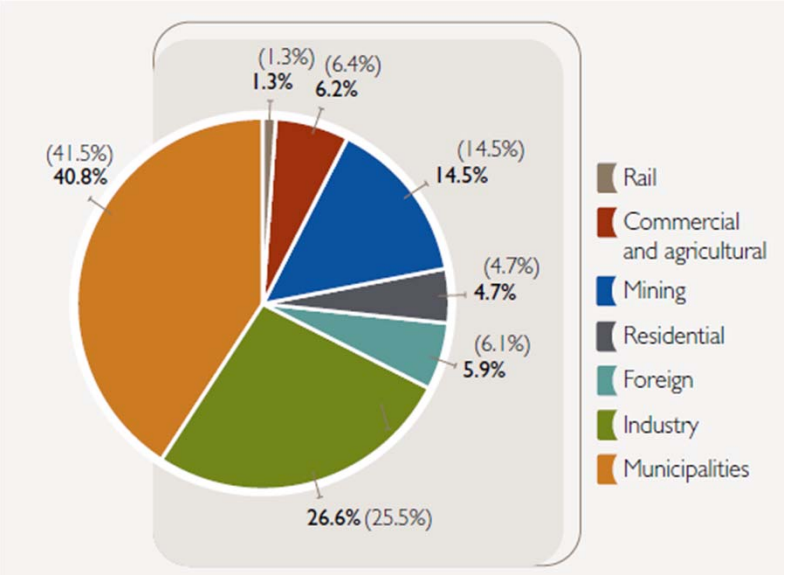
The Transmission Grid



Key facts (2011)

Electricity sales

	2011	2010	2009
Sales within South Africa, GWh	**211 150**	205 364	202 202
International sales, GWh	**13 296**	13 227	12 648
Total sales, GWh	**224 446**	218 591	214 850
Growth in GWh sales, %	**2.7**	1.7	(4.2)
Total revenue, Rm	**90 485**	69 942	53 100
Growth in revenue, %	**29.3**	31.7	21.9
Customers, number	**4 653 750**	4 463 301	4 361 007
Peak demand, MW	**36 664**	35 850	35 959



RE integration approach/strategy

1. **Resource assessment & grid impact studies**
   - Wind Resource GIS Map - Study Complete – Based on 3Tier Data. Ground measurements being correlated to satellite data.
   - Solar Resource GIS Map– Study Complete – Based on SolarGis Data.
   - New study: PV Plant's impact on the grid due to cloud cover/movement
   - New study: Geothermal, biomass & hydro GIS resource map
2. **Grid connection capacity assessment (GCCA) studies (Steady state & Transient Stability studies – 2012 & 2016)**
   - How much can be connection with no upgrades (Level 1)
   - Transmission Infrastructure requirements (Level 2)
   - Long-term strategic corridors to integrate RE(Level 3 – Strategic EIA's)
3. **Regulatory framework & government policy on RE**
   - Technical requirements for Grid connection: Grid Code (RE Code)
   - Integrated Resource Plan (IRP): Government Policy
   - RE IPP Procurement Programme (competitive bidding): IPP,Eskom, DoE
4. **Partnering (info sharing) with developers (IPPs) and RE Associations**
   - South African Wind Energy Association (SAWEA)
   - Southern African Solar Thermal Energy

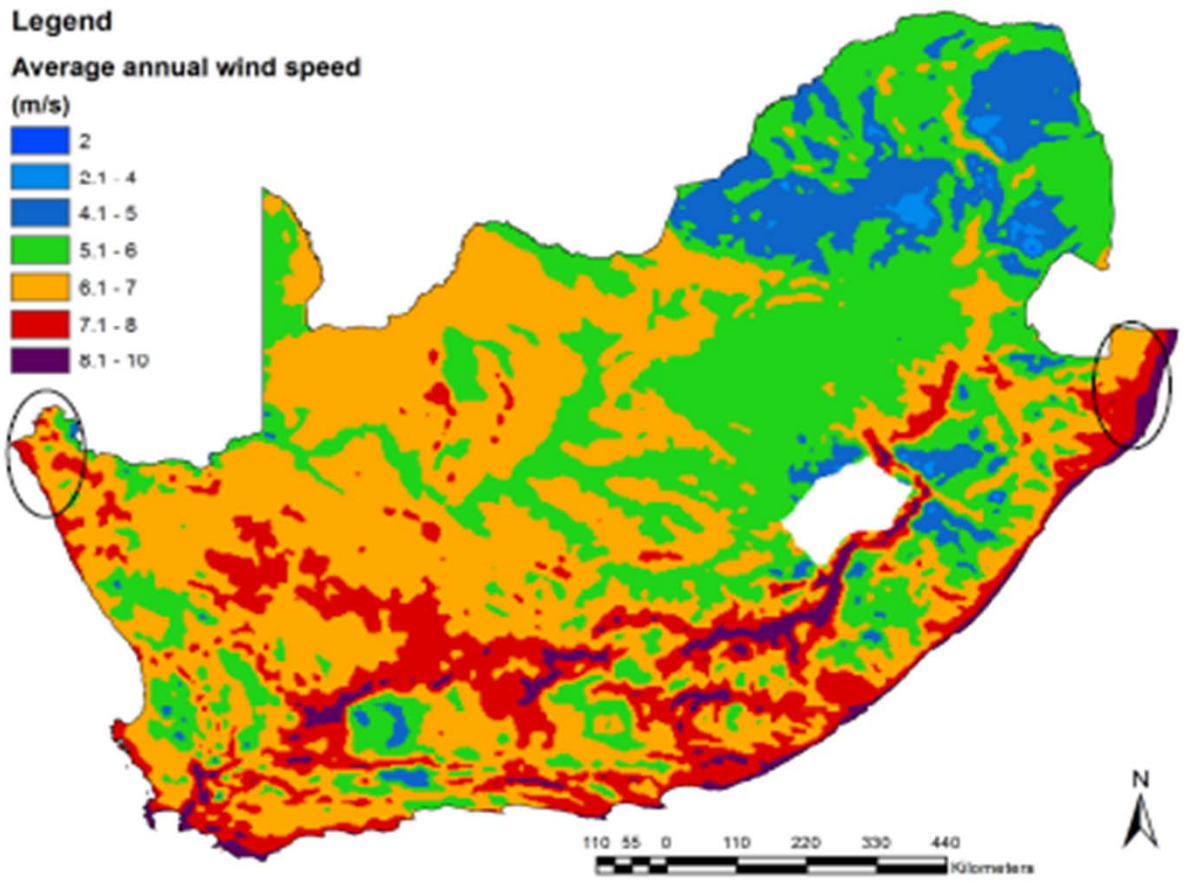
Generation Connection Capacity Assessment (GCCA) Studies

- Eskom Grid Planning undertook a study to determine the available connection capacity for new generation at Transmission substations in the Cape area for the integration of renewable energy generation. (*Note that Transmission refers to voltages > 132kV*)
- The objective of the study was to determine how much generation could be connected at each substation based on the expected 2012 network under three conditions:
  - **Level 1: (As quickly as possible – REBID)** No additional plant or lines on the Transmission network to connect the generation at the 132kV busbars of the substations
  - **Level 2: (Targeted projects : 2014 - 2018):** Localised Transmission network extension to collect the potential generation at 275kV or 400kV and connect to existing Transmission substations
  - **Level 3: (Strategic)**: Potential future generation connection capacity with the extension of the Transmission Grid including main corridors in the longer term beyond 2018.

Wind Resource Results

IEC Class 4-7 (7 – 11.9 m/s): 20 GW

IEC Class 3-7 (6.4 - 11.9 m/s): 76 GW

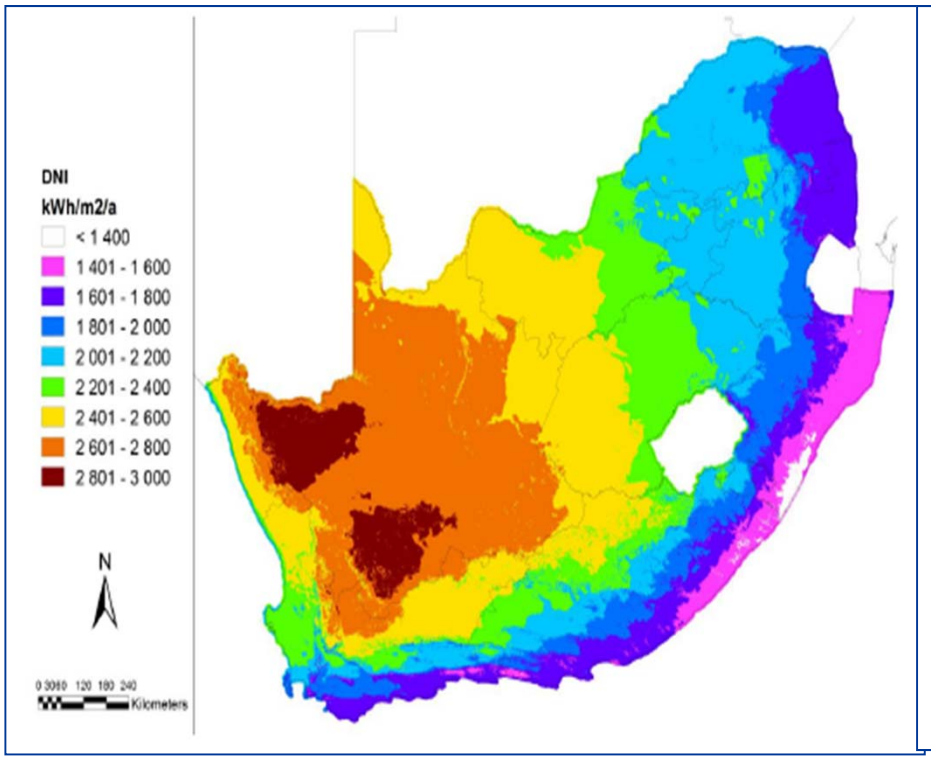


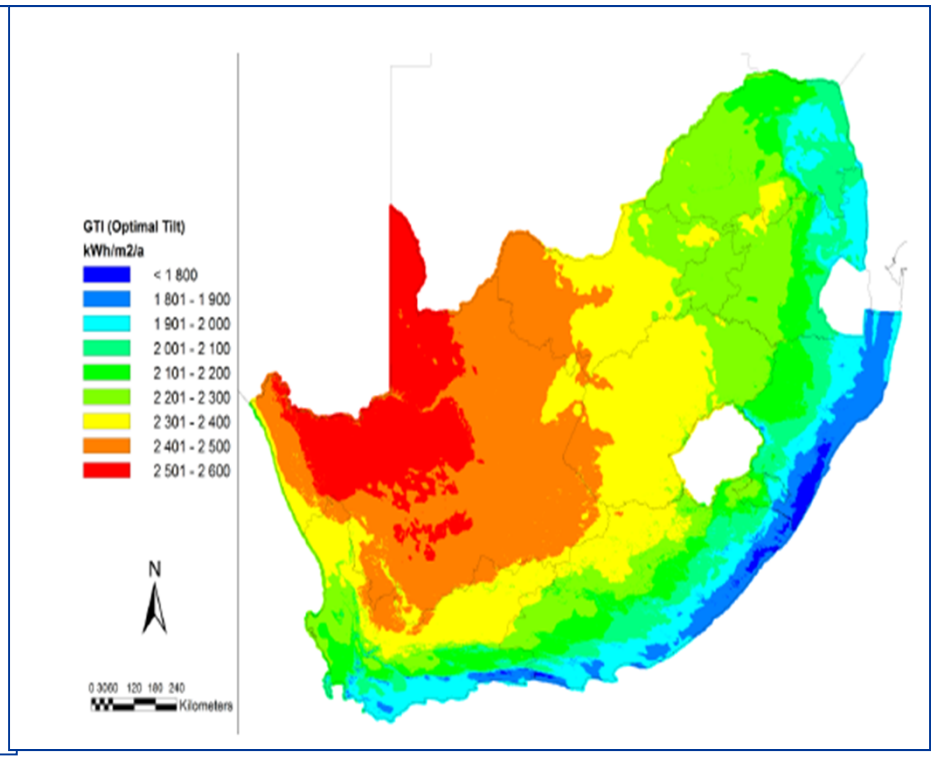
Solar Resource Results

PV: 886 GW

CPV: 806 GW

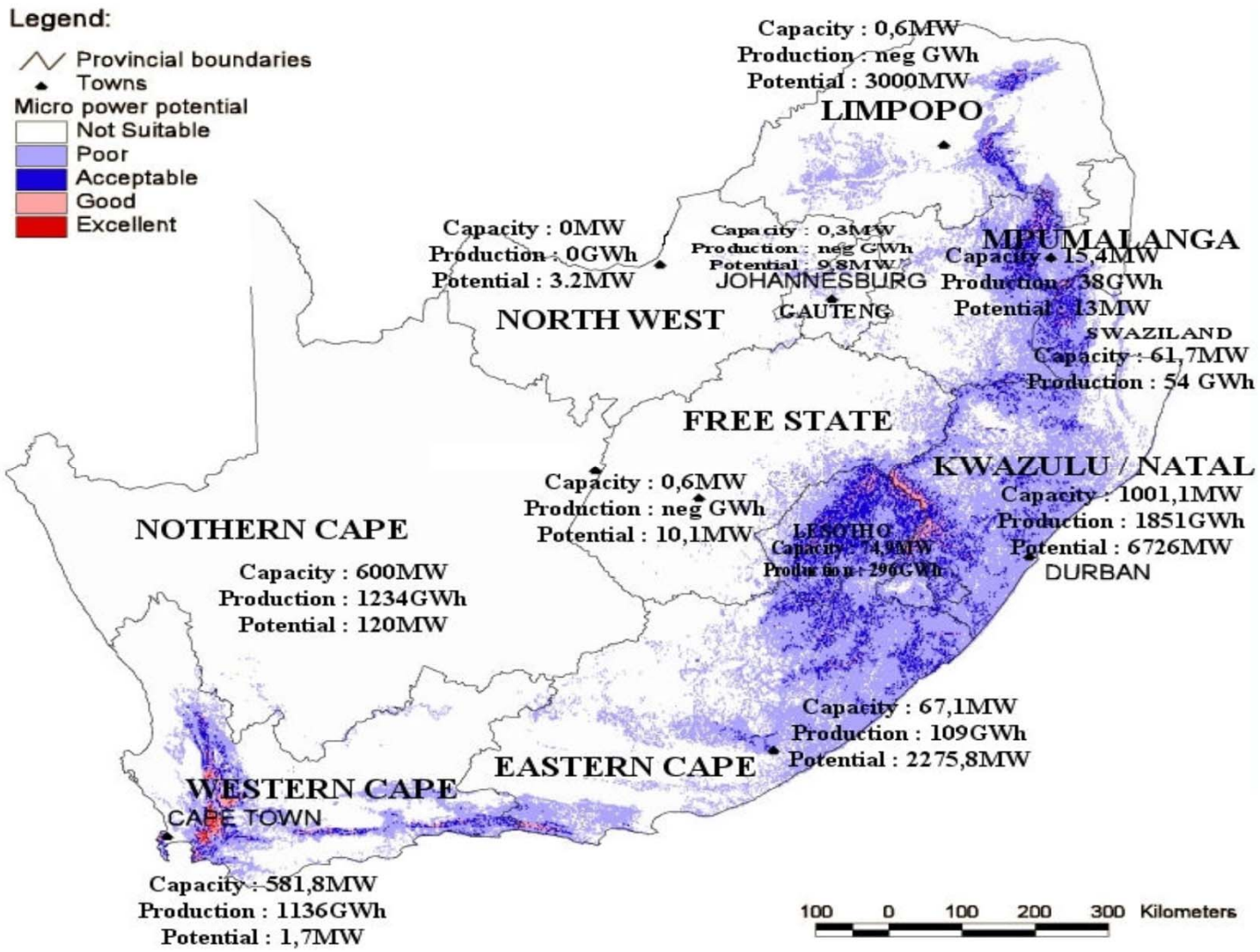
CSP: 480 GW (no Storage); 240 GW (with storage)





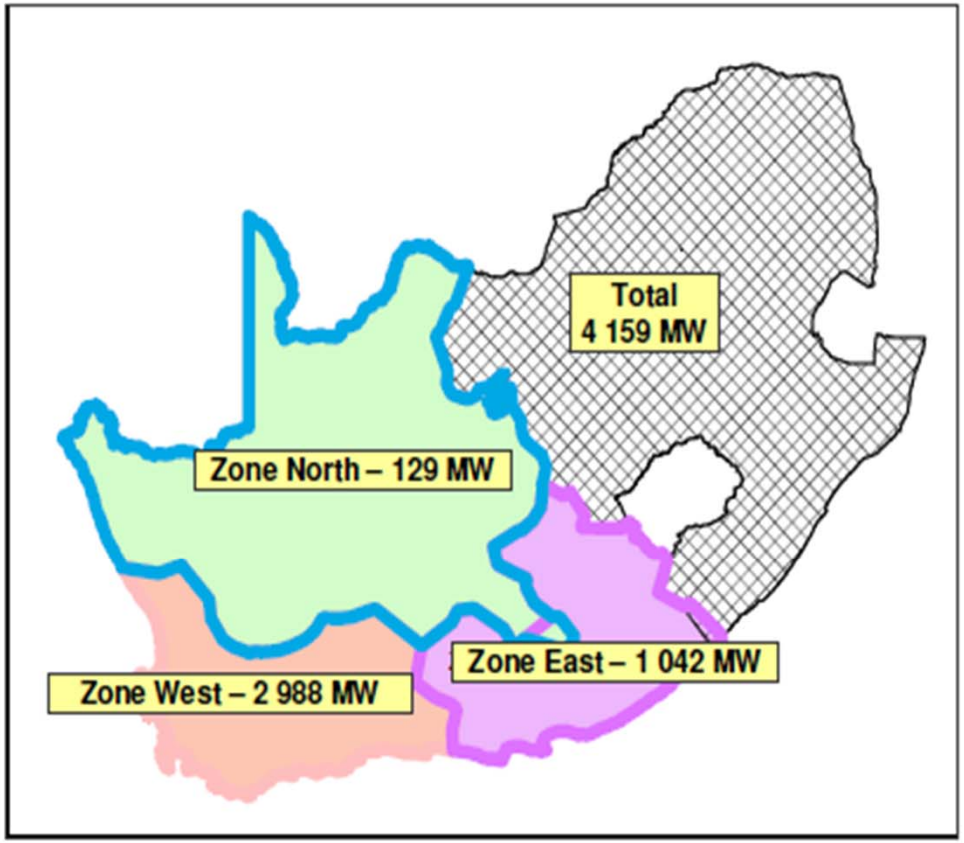
Hydro Resources (Not confirmed – OLD Map)

Hydro : Capacity= 2.4 GW; Potential = 12.2 GW



GCCA LEVEL 1 (2012 Network)

System N-1 Generation Capacity per Zone

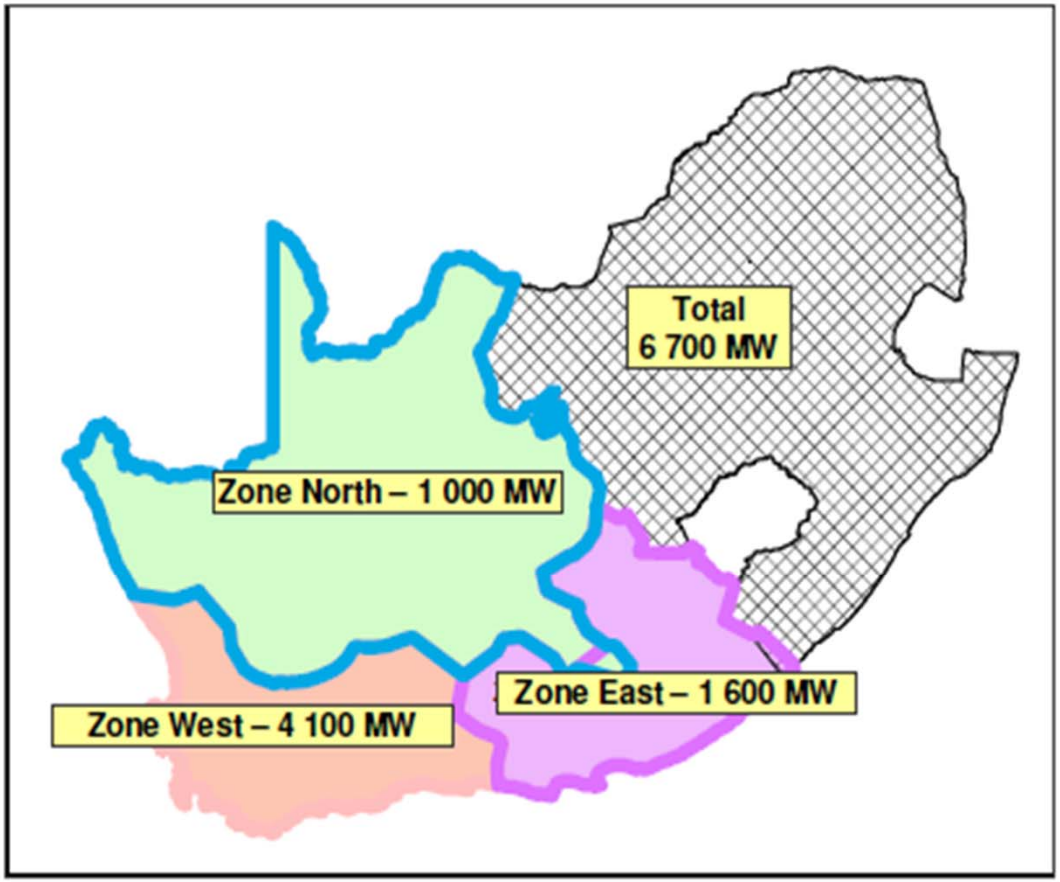


Area	Level 1
Western Cape Zone	2 988 MW
Eastern Cape Zone	1 042 MW
Northern Cape Zone	129 MW
TOTAL	4 159 MW

22

GCCA LEVEL 2 (2012 Network)

System N-1 Generation Capacity per Zone



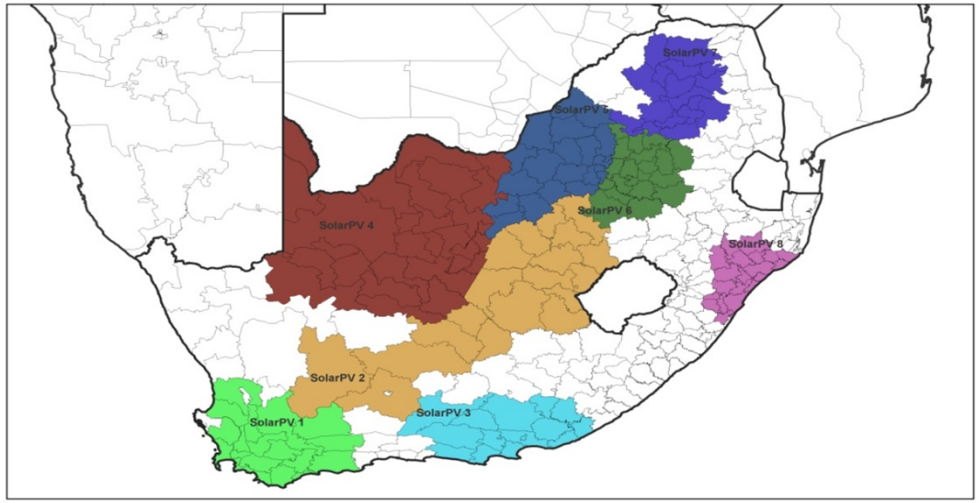
Area	Level 2
Western Cape Zone	4 100 MW
Eastern Cape Zone	1 600 MW
Northern Cape Zone	1 000 MW
TOTAL	6 700 MW

RE Applications Generation mix and Renewable Energy Resource Map

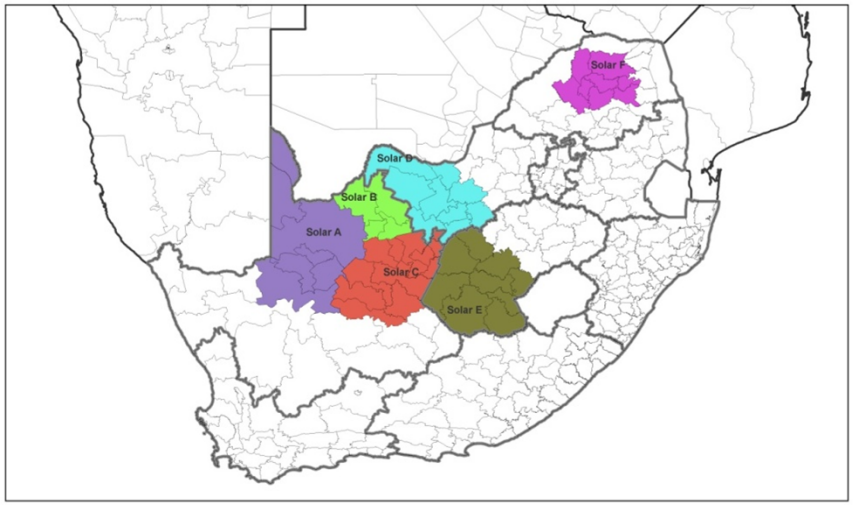
Applications Received till March 2012

Technology	MW (Max)	%
Landfill	13	0.0%
CPV	30	0.1%
Biotherm	36	0.1%
Biogas	51	0.1%
Hydro	122	0.4%
Biomass	229	0.7%
Gas	332	1.0%
Steam	350	1.0%
Co-Gen	373	1.1%
CSP	1534	4.5%
Coal	4870	14.3%
PV	9606	28.1%
Wind	16615	48.6%
	34160	100%

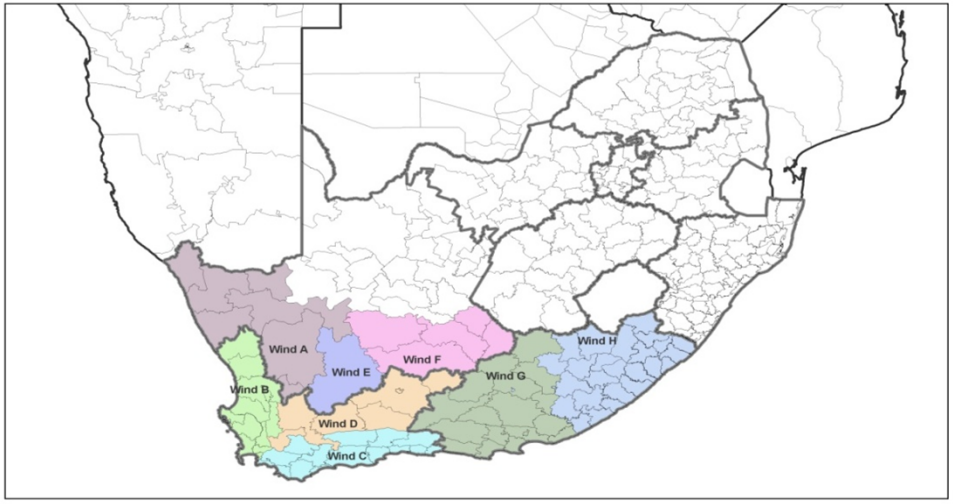
SOLAR PV GENERATION AREAS



SOLAR CSP GENERATION AREAS

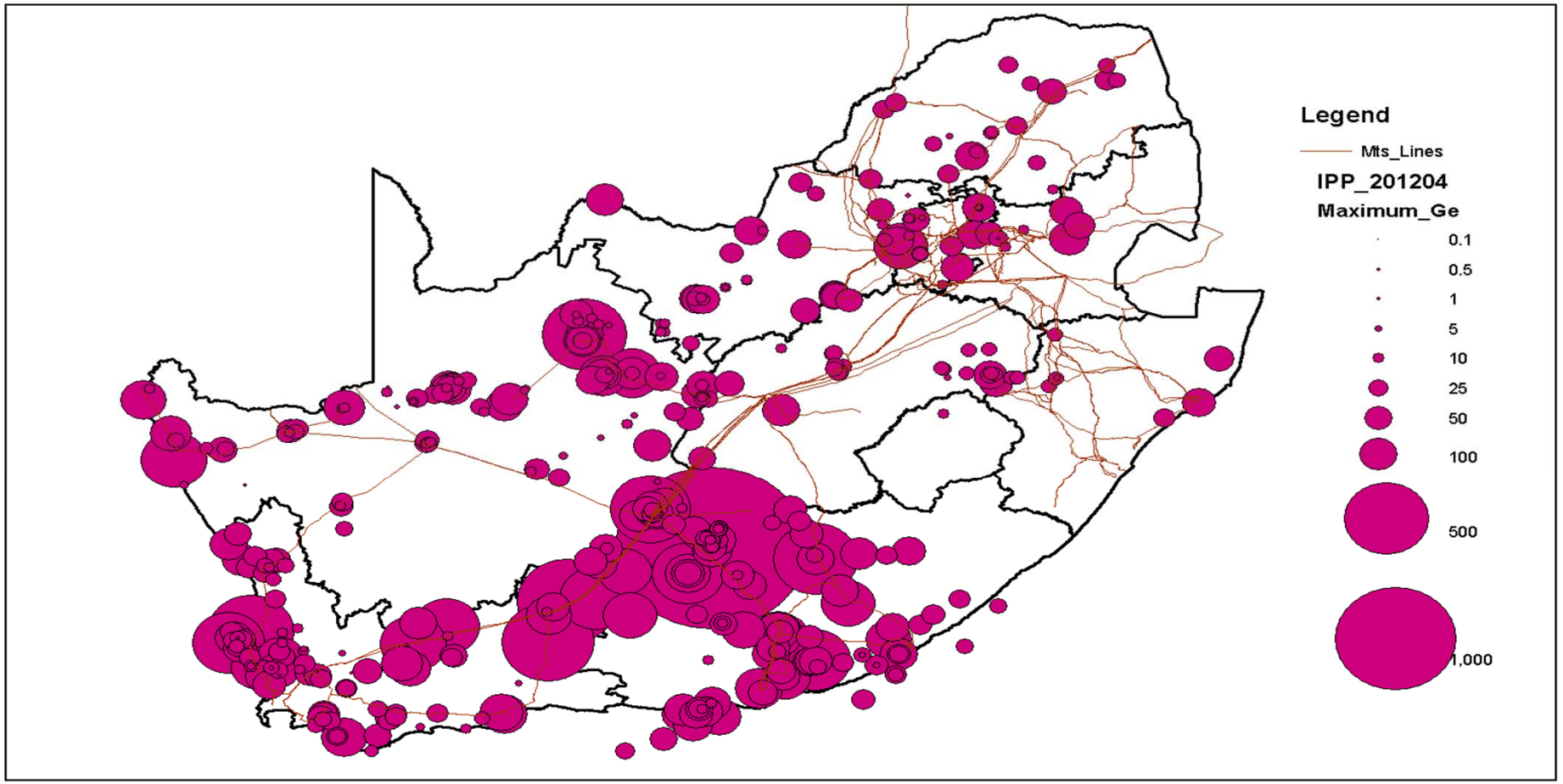


WIND GENERATION AREAS



IPP Applications – Relative sizes (MW)

Renewable Generation Application



RE IPP Programme (Nr Projects/MW)

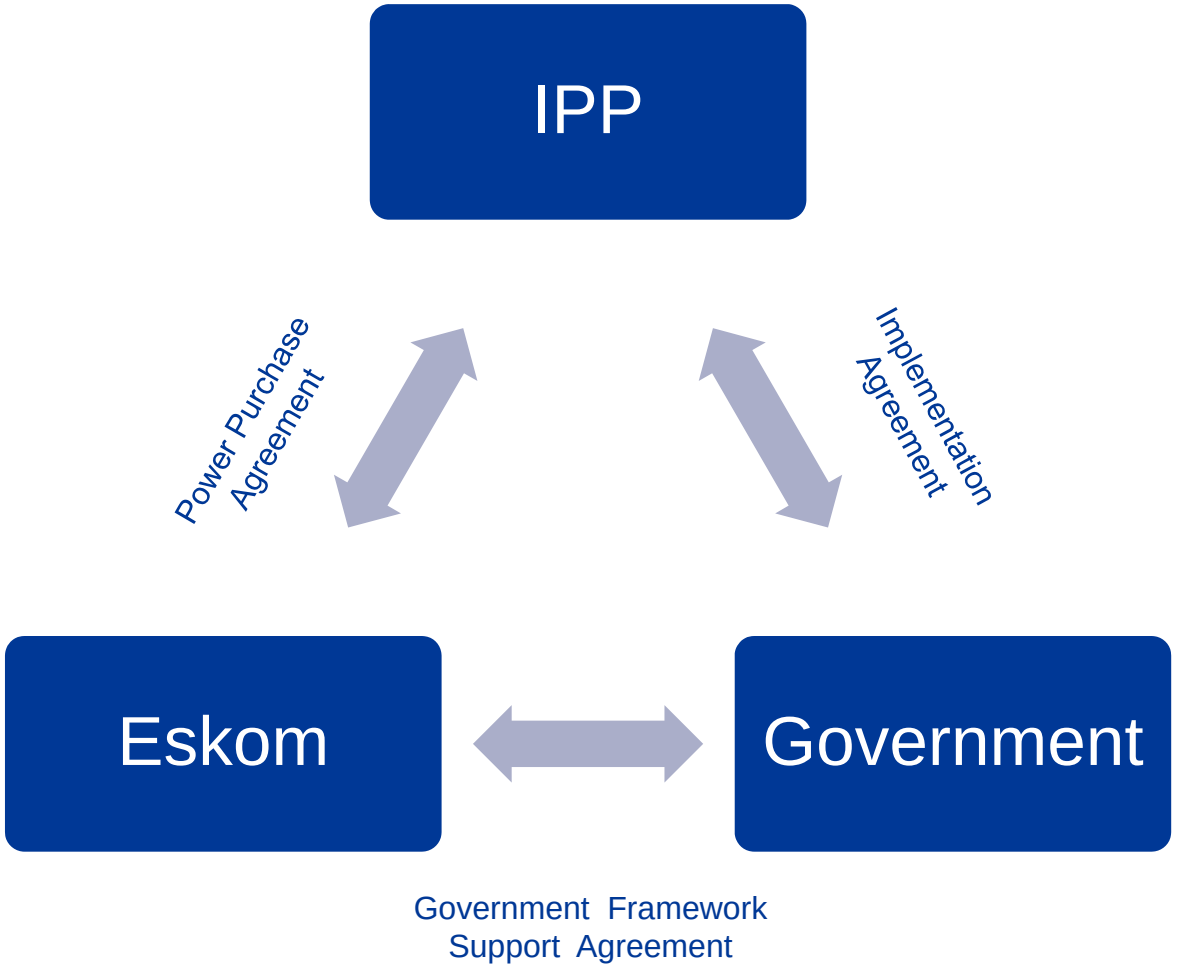
Eskom

	Wind	PV	CSP	Other	Interest	TOTAL
Interest / Ideas *Constantly changing*	*158/ 17 400*	*311/ 11 344*	*17/ 1 734*	*55/ 364*		*541/ 30 900*
RE IPP Prgm	1850	1450	200	125+100		3625+100
RE IPP Bid 1 Allocated (2014)	8/634	18/632	2/150	0	53/2160	28/1416
RE IPP Bid 2 Allocated (2016)	7/563	9/417	1/50	2/14	79/<3300	19/1044
Price c/kWh (2011 >2012)	114 >89	275 >165	268 >251			
RE IPP Bid 3 Available	653	401	0	111		1165
Future	6550?	6950?	800?	?	***Till 2030***	***17 800***
Annual allocation	400	300	100	?		

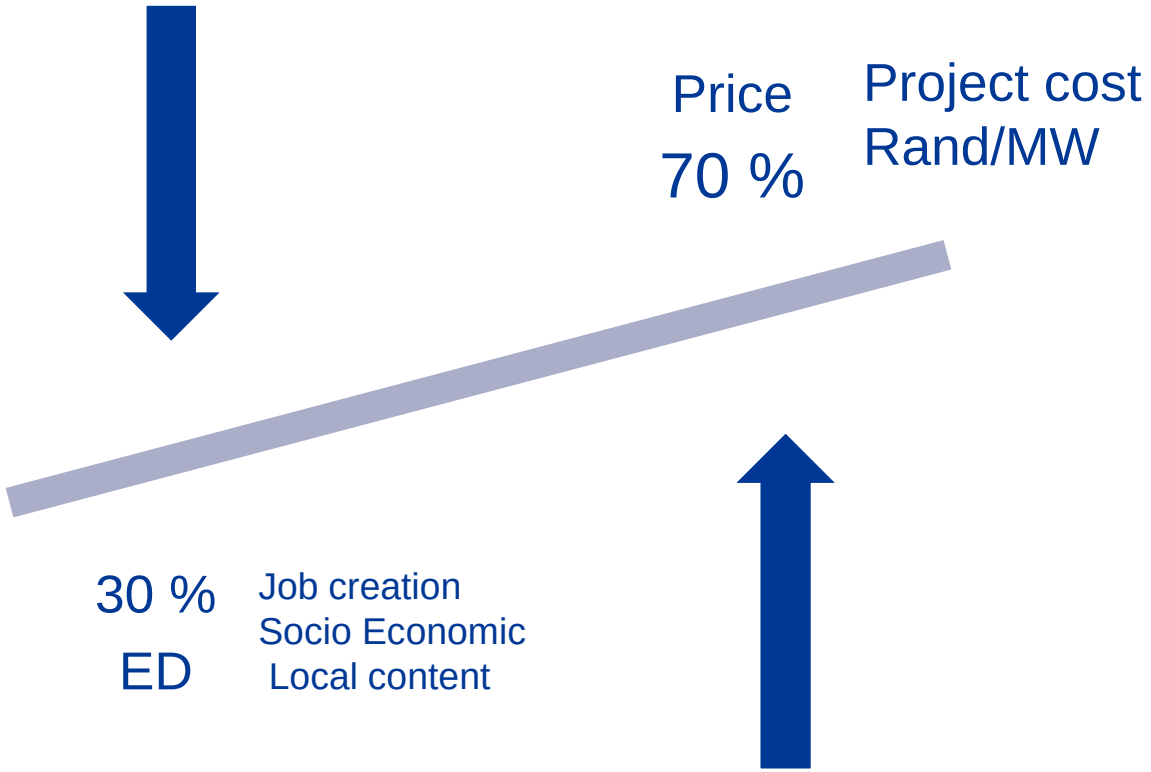
RE IPP Programme

	REFIT (R/kWh): MW	REBID 1 (2011) Cap (R/kWh)
Wind	1.25:	1.15
PV	3.95	2.85
CSP	2.31	2.85
CSP no storage	3.14	2.85
Small Hydro	0.94	1.03
Landfill gas	0.9	0.6
Biomass	1.18	1.07
Biogas	0.96	0.8

RE IPP Prgm: Contractual Arrangement



RE IPP Prgm: Evaluation



RE IPP Prgm: Evaluation

- Evaluation team:
  - **International reviewers**
    - Legal review – Linklaters (UK)
    - Technical review – Blueprint consult
    - Financial review – cross-moderation between the two Financial Advisory firms
    - Governance review – Ernst & Young
  - **Legal evaluation team**
    - Bowman Gilfillan
    - Edward Nathan Sonneberg
    - Ledwaba Mazwai
    - Webber Wentzel
    - BKS
  - **Technical evaluation team**
    - Matt Macdonald
  - **Financial evaluation team**
    - Ernst & Young
    - PWC

- Evaluation Streams:
  - Legal Environment
    - Environmental Authorization
  - Legal Land
    - Land right
    - Notarial lease registration
    - Proof of land use application
  - Legal Commercial
    - Acceptance of the PPA
    - Project structure
  - Economic Development
    - Contributor status level 5
    - Compliance with threshold
  - Financial
    - Full and partial price indexation
  - Technical
    - Eligibility
    - Energy resource

IRP 2010 – 2030: Load forecast & Gen Plants

	Committed build											New build options											
	RTS Capacity (coal)	Medupi (coal)	Kusile (coal)	Ingula (pumped storage)	DOE OCGT IPP (diesel)	Co-generation, own build	Wind	CSP	Landfill, hydro	Sere (wind)	Decommissioning	Coal (PF, FBC, Imports)	Co-generation, own build	Gas CCGT (natural gas)	OCGT (diesel)	Import Hydro	Wind	Solar PV, CSP	Renewables (Wind, Solar CSP, Solar PV, Landfill, Biomass, etc.)	Nuclear Fleet	Total new build	Total system capacity	Peak demand (net sent-out) forecast	Demand Side Management
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW
2010	380	0	0	0	0	260	0	0	0	0	0	0	0	0	0	0	0	0	0	0	640	44535	38885	252
2011	679	0	0	0	0	130	200	0	0	0	0	0	103	0	0	0	0	0	0	0	1112	45647	39956	494
2012	303	0	0	0	0	0	200	0	100	100	0	0	0	0	0	0	0	0	0	0	703	46350	40995	809
2013	101	722	0	333	1020	0	300	0	25	0	0	0	124	0	0	0	0	0	0	0	2625	48975	42416	1310
2014	0	722	0	999	0	0	0	100	0	0	0	0	426	0	0	0	200	0	0	0	2447	51422	43436	1966
2015	0	1444	0	0	0	0	0	100	0	0	-180	0	600	0	0	0	400	0	0	0	2364	53786	44865	2594
2016	0	722	0	0	0	0	0	0	0	0	-90	0	0	0	0	0	800	100	0	0	1532	55318	45786	3007
2017	0	722	1446	0	0	0	0	0	0	0	0	0	0	0	0	0	800	100	0	0	3068	58386	47870	3420
2018	0	0	723	0	0	0	0	0	0	0	0	0	0	0	0	0	800	100	0	0	1623	60009	49516	3420
2019	0	0	1446	0	0	0	0	0	0	0	0	0	0	474	0	0	800	100	0	0	2820	62829	51233	3420
2020	0	0	723	0	0	0	0	0	0	0	0	0	0	711	0	360	0	0	800	0	2594	65423	52719	3420
2021	0	0	0	0	0	0	0	0	0	0	-75	0	0	711	0	750	0	0	800	0	2186	67609	54326	3420
2022	0	0	0	0	0	0	0	0	0	0	-1870	0	0	0	805	1110	0	0	800	0	845	68454	55734	3420
2023	0	0	0	0	0	0	0	0	0	0	-2280	0	0	0	805	1129	0	0	800	1600	2054	70508	57097	3420
2024	0	0	0	0	0	0	0	0	0	0	-909	0	0	0	575	0	0	0	800	1600	2066	72574	58340	3420
2025	0	0	0	0	0	0	0	0	0	0	-1520	0	0	0	805	0	0	0	1400	1600	2285	74859	60150	3420
2026	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	600	1600	2200	77059	61770	3420
2027	0	0	0	0	0	0	0	0	0	0	0	750	0	0	805	0	0	0	1200	0	2755	79814	63404	3420
2028	0	0	0	0	0	0	0	0	0	0	-2850	2000	0	0	805	0	0	0	0	1600	1555	81369	64867	3420
2029	0	0	0	0	0	0	0	0	0	0	-1128	750	0	0	805	0	0	0	0	1600	2027	83396	66460	3420
2030	0	0	0	0	0	0	0	0	0	0	0	1500	0	0	345	0	0	0	0	0	1845	85241	67809	3420
TOTAL	1463	4332	4338	1332	1020	390	700	200	125	100	-10902	5000	1253	1896	5750	3349	3800	400	7200	9600	41346			

Thank you