

# Department of Energy

## *Renewable Energy Resource Assessment in South Africa*

*Ms. Mokgadi Modise, Chief Director: Clean Energy  
South Africa*

*Sofitel Hotel, Abu Dhabi*

*22 June 2013*



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# Mandate, Mission, Vision

## Mandate:

- *“Ensure secure and sustainable provision of energy for socio-economic development”*

## 2014 Vision:

- *“A transformed and sustainable energy sector with universal access to modern energy carriers for all by 2014”*

## 2025 Vision:

- *“Improving our energy mix by having 30% of clean energy by 2025”*

## Mission:

- *“To regulate and transform the sector for the provision of secure, sustainable and affordable energy”*



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# Legislative Framework

- **Energy Act of 2008**

- This is the primary legislative instrument that governs the evolution and transformation of the South African energy economy. It seeks to ensure that diverse energy resources are available in sustainable quantities and at affordable prices to the South African economy in support of economic growth and poverty alleviation.

- **Electricity Regulation Act as Amended**

- One of the objectives of this Act is to “promote the use of diverse energy sources and energy efficiency”.
- The Act has a provision for new generation capacity. In this provision, “The Minister may, in consultation with the Regulator determine that new generation capacity is needed to ensure the continued uninterrupted supply of electricity and determine the types of energy sources from which electricity must be generated, and the percentages of electricity that must be

energy generated from such sources.”



# South African RE Sector Governance Instruments

## Some applicable Policies, Strategies, Plans, Accords, etc

- White Paper on Energy Policy (1998)
- White Paper on Renewable Energy Policy (2003)
- Energy Efficiency Strategy (2005)
- Biofuels Industrial Strategy (2007)
- Industrial Policy Action Plan (1<sup>st</sup> & 2<sup>nd</sup> Iterations)
- New Growth Path Framework (2010)
  - National Skills Development Accord (2011) Local
  - Procurement Accord (2011)
  - Green Economy Accord (2011)
- National Climate Change Response White Paper (2011)
- National Development Plan

## Some legal & regulatory instruments

- Preferential Procurement Policy Framework Act (2000) & its Regulations
- Electricity Regulation Act, 2006 (as amended)
- National Energy Act, 2008
- Regulations on New Generation Capacity, 2009 (as amended)
- Integrated Resource Plan 2010 – 2030
- Regulations on the Allowance for Energy Efficiency Savings in terms of Section 12 I & 12L of the Income Tax Act (**still to be promulgated**)
- Petroleum Products Act, 1977 (as amended) and its Regulations

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## Some available incentives

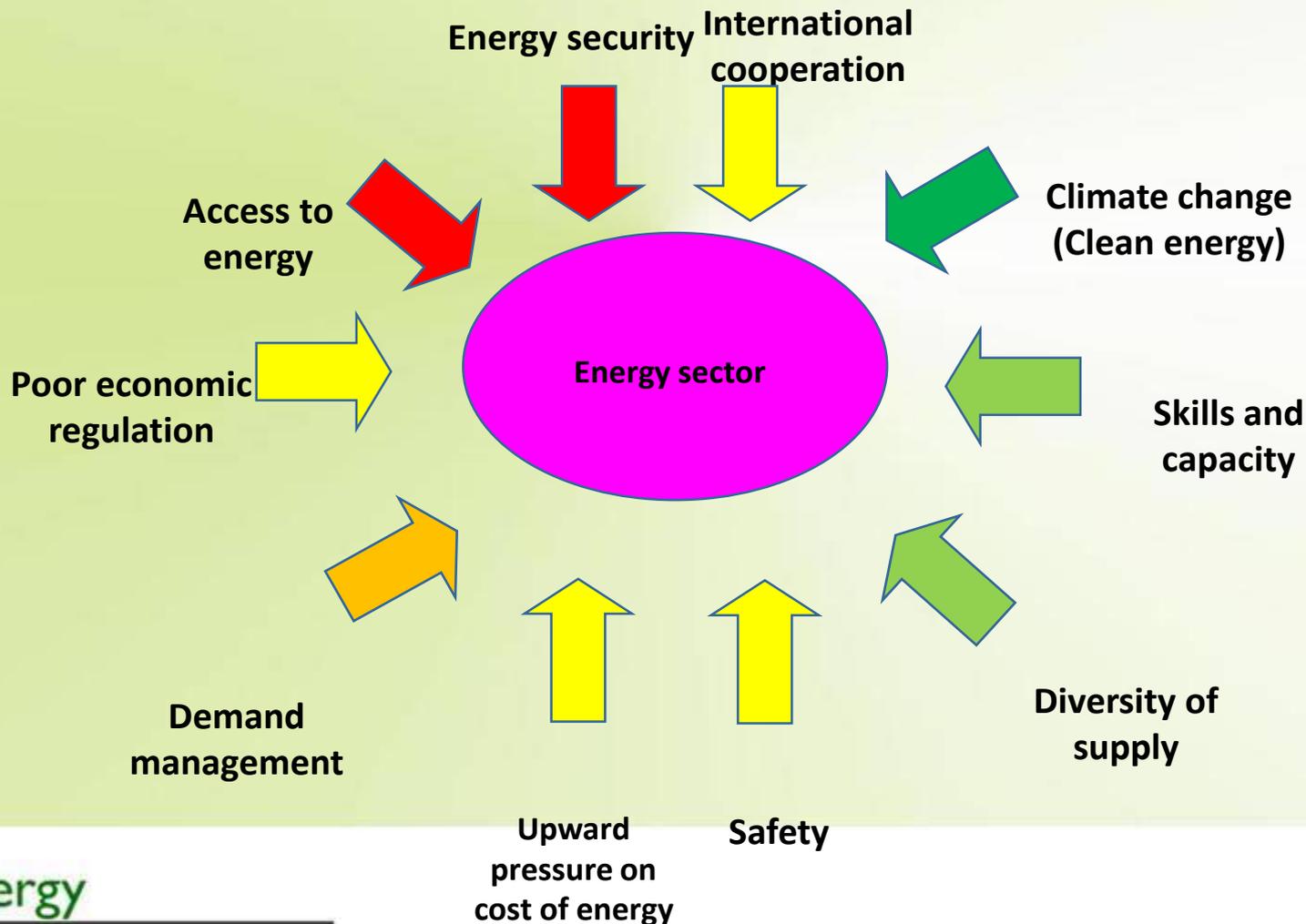
- Tax incentives for EE investments and Various Incentive Schemes by the Department of Trade and Industry - manufacturing
- R20bn credit facility set aside for investments in green projects
- R4.7bn SWH subsidy (over 3 years)
- 70% annual subsidy for solar home systems
- 50% annual fuel tax rebate for biodiesel



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# Drivers And Pressures in the Energy Sector in South Africa



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# Strategic objectives

- The Department of Energy's vision by 2025 is to improve the energy mix by having 30% of clean energy.
- This will be achieved through the following strategic objectives:
  - develop effective legislation, policies and guidelines, encourage investment in the energy sector;
  - diversify energy mix, improve access and connectivity, provision of quality and affordable energy, promote safe use of energy and transform the energy sector;
  - develop enabling policies, encouraging energy efficient technologies as well as promoting;
  - promote clean energy alternatives, encourage economic development, promote job creation, etc.
  - facilitate the implementation of Renewable Energy, Energy Efficiency Technologies and also promotes and regulates the Clean Development

**energy** Mechanism (CDM) activities.

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# Background on South Africa's Integrated Resource Plan

- The Integrated Resource Plan (IRP) is 20 year electricity plan which was promulgated in May 2011 pursuant to Cabinet approval in March 2011.
- The primary objective of the IRP is to determine South Africa's long-term electricity demand and detail how this demand should be met in terms of generating capacity, type and cost.
- First introduced as Integrated Resource Plan 1 (IRP1) in 2009, a second draft version was released in October 2010 (Revised Balanced Scenario (RBS)) and was open for comments for 60 days.
- Policy adjusted IRP's principle amendments from the Revised Balanced Scenario include:
  - The installation of renewables (solar PV, CSP and wind) have been brought forward in order to accelerate a local industry;
  - Allows for cost optimization on import hydro options leading to a reduction compared to the RBS;
  - Recent developments with respect to prices for renewables
- The policy adjusted IRP has been recommended for adoption and for subsequent promulgation as the final IRP



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# *Objectives and Scope of the IRP 2010*

- The objective of the IRP is to develop a sustainable electricity investment strategy for South Africa over the next 20 years
- The strategy encompasses both implications from demand-side management and pricing as well as capacity provided by generators.
- **The intent of the IRP is to:**
  - Improve the reliability of electricity generation;
  - Ascertain South Africa's capacity investment needs;
  - Consider environmental impact and the effect of renewables energy technologies; and
  - Provide a framework for Ministerial determination of new generation capacity



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# ***Objectives and Scope of the IRP 2010***

- Is a “**living**” plan, which will be updated on an on-going basis to reflect the changing needs of South Africa and to learn from the inevitable changes in our economical, social and technological environment.
- This was the first IRP that government directed and sought to find a balance between competing government objectives:
  - **Affordability**
  - **Reducing carbon emissions (Towards a Green Economy)**
  - **Water conservation**
  - **Localization and,**
  - **Regional development**



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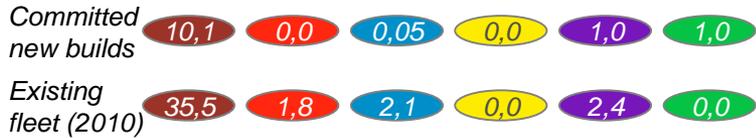
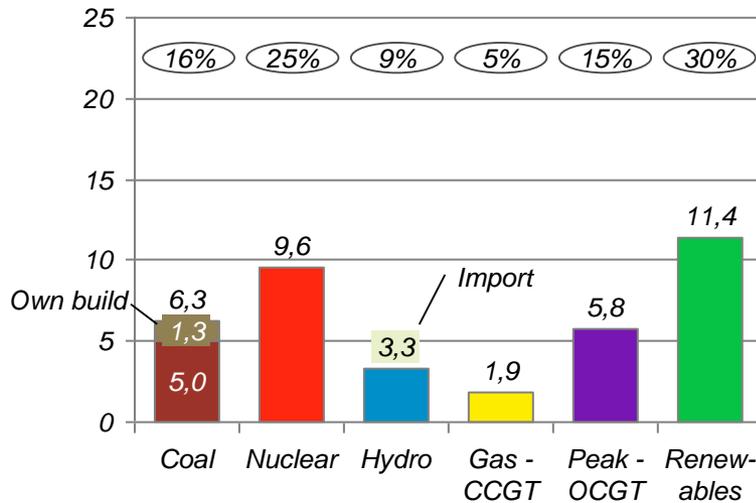
# Decreasing costs of renewables allow for a higher renewables share at the same total system cost

Revised Balanced Scenario and Policy-Adjusted IRP in comparison

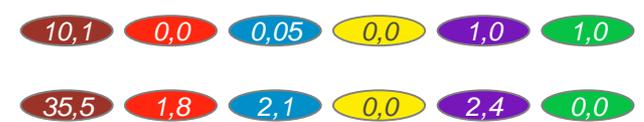
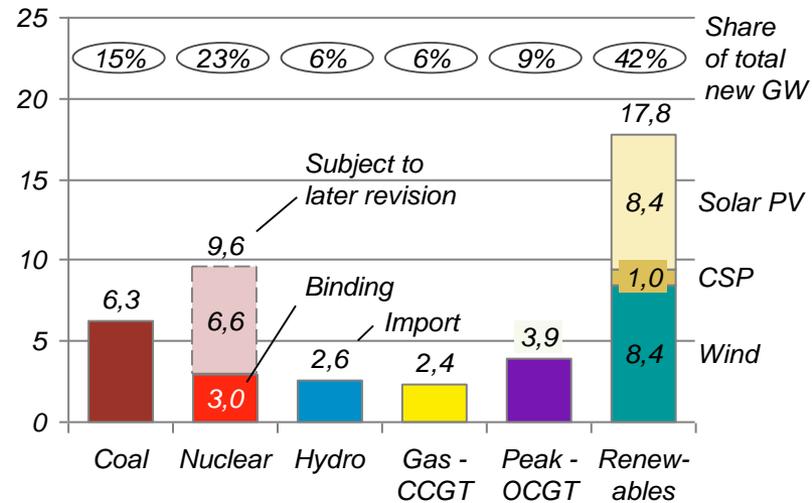
## Before consultation process: Revised Balanced Scenario (RBS)

## After consultation process: Policy-Adjusted IRP

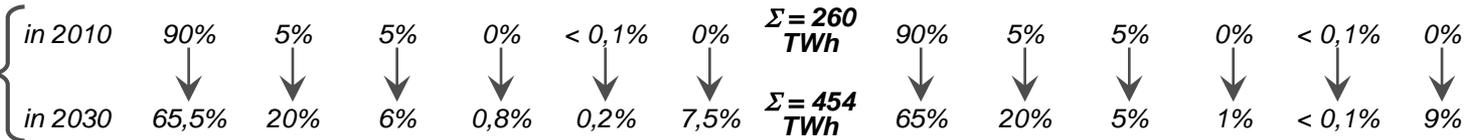
Total additional new capacity  
(without committed) until 2030 in GW



Total additional new capacity  
(without committed) until 2030 in GW



Energy share

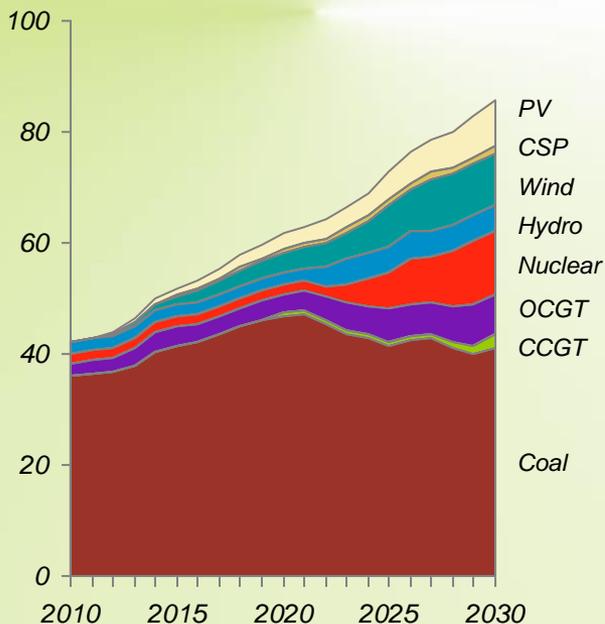


# Carbon intensity reduced by ~34% while coal and nuclear are still the backbone of the energy supply

How the Policy-adjusted IRP would affect the mix of power generation by 2030

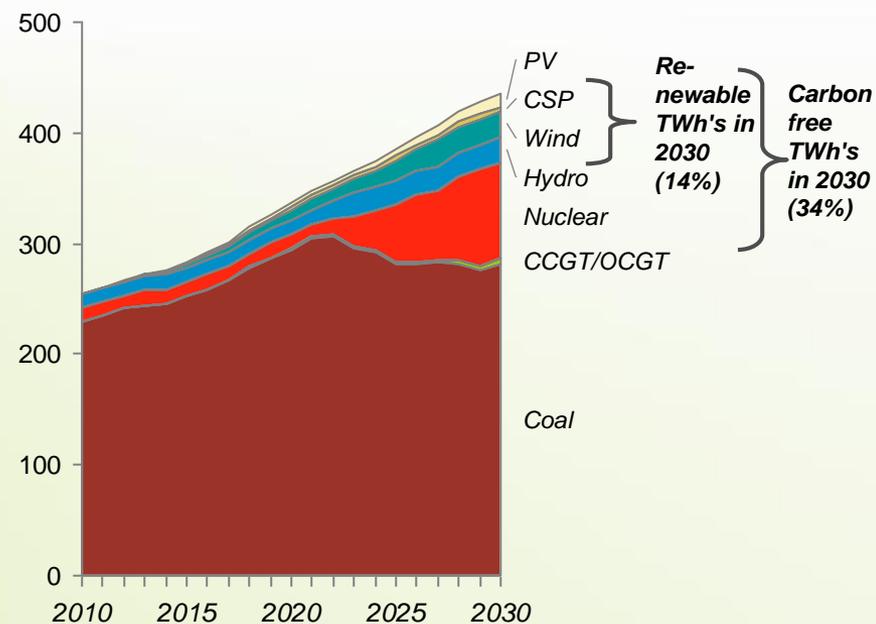
## Sources of energy supply

Capacity installed EoY in GW<sup>1</sup>



## Energy mix

Electric energy supplied in TWh p.a.



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CO<sub>2</sub>  
intensity

912 g/kWh

600 g/kWh

-34%

1. Pumped storage capacity of 1,4 GW in 2010 and 2,7 GW in 2030 is not included since it is a net energy user

# Long lead times for power generators & related infrastructure require timely firm commitments



	New build options							
	Coal (PF, FBC, imports, own build)	Nuclear	Import hydro	Gas – CCGT	Peak – OCGT	Wind	CSP	Solar PV
	MW	MW	MW	MW	MW	MW	MW	MW
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	300
2013	0	0	0	0	0	0	0	300
2014	500 <sup>1</sup>	0	0	0	0	400	0	300
2015	500 <sup>1</sup>	0	0	0	0	400	0	300
2016	0	0	0	0	0	400	100	300
2017	0	0	0	0	0	400	100	300
2018	0	0	0	0	0	400 <sup>4</sup>	100 <sup>4</sup>	300 <sup>4</sup>
2019	250	0	0	237 <sup>3</sup>	0	400 <sup>4</sup>	100 <sup>4</sup>	300 <sup>4</sup>
2020	250	0	0	237 <sup>3</sup>	0	400	100	300
2021	250	0	0	237 <sup>3</sup>	0	400	100	300
2022	250	0	1 143 <sup>2</sup>	0	805	400	100	300
2023	250	1 600	1 183 <sup>2</sup>	0	805	400	100	300
2024	250	1 600	283 <sup>2</sup>	0	0	800	100	300
2025	250	1 600	0	0	805	1 600	100	1 000
2026	1 000	1 600	0	0	0	400	0	500
2027	250	0	0	0	0	1 600	0	500
2028	1 000	1 600	0	474	690	0	0	500
2029	250	1 600	0	237	805	0	0	1 000
2030	1 000	0	0	948	0	0	0	1 000
Total	6 250	9 600	2 609	2 370	3 910	8 400	1 000	8 400

- Firm commitment necessary now
- Final commitment in IRP 2012

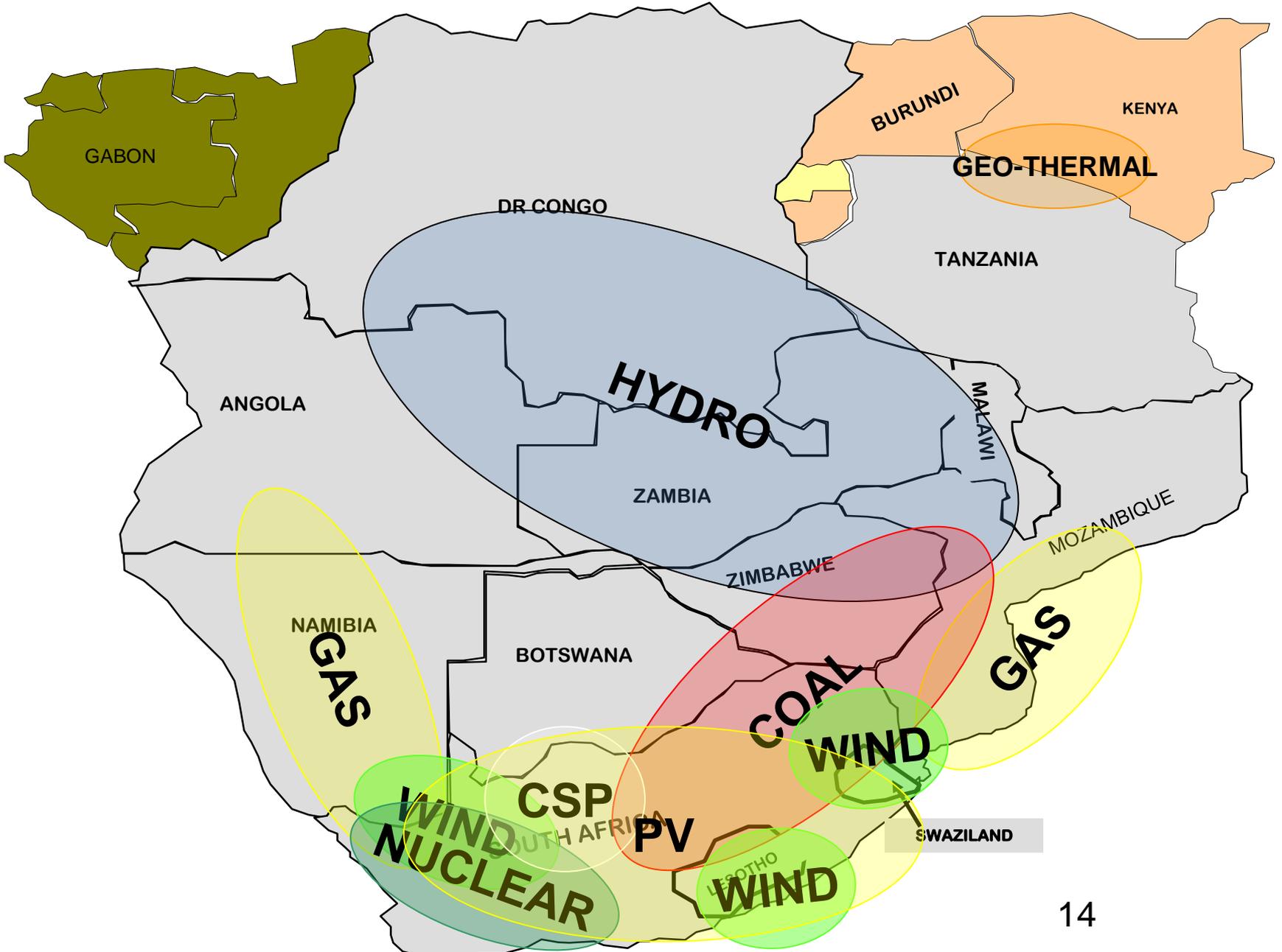


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1. Built, owned & operated by IPPs 2. Commitment necessary due to required high-voltage infrastructure, which has long lead time 3. Commitment necessary due to required gas infrastructure, which has long lead time 4. Possibly required grid upgrade has long lead time and thus makes commitment to power capacity necessary

# Potential Energy Future – 2030 Envisages More Regional Integration



# *Ministerial Determination: Legal requirements – Implementation of the IRP 2010*

The Minister has, under the Electricity Regulation Act of 2006, determined that:

- New generation capacity is required and must be generated through Renewable Energy sources
- The first required new generation capacity is 3725 MW and additional 3200 MW determination is in progress.

In terms of the Determination, the Minister allocated MW as follows:

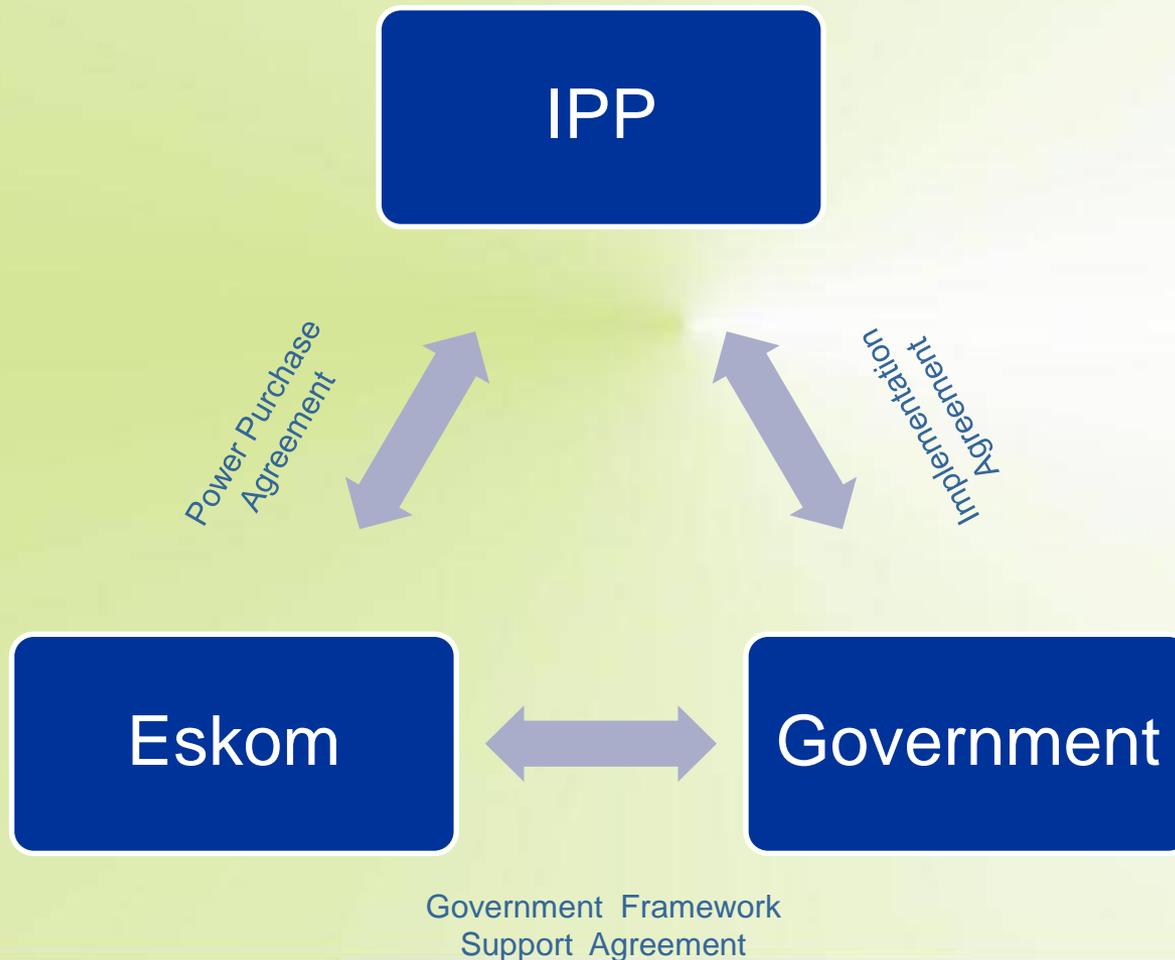
- 1850 MW for Wind
- 1450 MW for Solar Photovoltaic (Solar PV)
- 200 MW for Concentrated Solar Power (CSP)
- 12.5 MW for Biomass
- 12.5 MW for Biogas
- 25 MW for Landfill Gas
- 75 MW for Small Hydro



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# Implementation of the IRP 2010: Contractual Arrangement



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# Preferred Bidders Salient Terms Solar Photovoltaic



	Bid Window 2	Bid Window 1
<b>Price: Fully Indexed (Ave Rand per MWh)</b>	R 1 645	R 2 758
<b>MW allocation</b>	417 MW	632 MW
<b>Total Project Cost (R'million)</b>	R12 048	R21 937
<b>Local Content Value (R'million)</b>	R5 727	R6 261
<b>Local Content %</b>	47.5%	28.5%
<b>Job Creation : Construction (People)</b>	4 557	10 386
<b>Job Creation : Operations (People)</b>	194	221



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# Preferred Bidders Salient Terms Wind



	Bid Window 2	Bid Window 1
<b>Price: Fully Indexed (Ave Rand per MWh)</b>	R 897	R 1 143
<b>MW allocation</b>	563 MW	634 MW
<b>Total Project Cost (R'million)</b>	R 10 897	R 12 724
<b>Local Content Value (R'million)</b>	R 4 001	R 2 766
<b>Local Content %</b>	36.7%	21.7%
<b>Job Creation : Construction (People)</b>	1 579	1 869
<b>Job Creation : Operations (People)</b>	65	128



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# Preferred Bidders Salient Terms Small Hydro



	Bid Window 2	Bid Window 1
<b>Price: Fully Indexed (Ave Rand per MWh)</b>	R 1 030	N/A
<b>MW allocation</b>	14 MW	N/A
<b>Total Project Cost (R'million)</b>	R 631	N/A
<b>Local Content Value (R'million)</b>	R 421	N/A
<b>Local Content %</b>	66.7%	N/A
<b>Job Creation : Construction (People)</b>	261	N/A
<b>Job Creation : Operations (People)</b>	7	N/A



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# Preferred Bidder Salient Terms Concentrated Solar Power

	Bid Window 2	Bid Window 1
<b>Price: Fully Indexed (Ave Rand per MWh)</b>	R 2 512	R 2 686
<b>MW allocation</b>	50 MW	150 MW
<b>Total Project Cost (R'million)</b>	R 4 483	R 11 365
<b>Local Content Value (R'million)</b>	R 1 638	R 2 391
<b>Local Content %</b>	36.5%	21.0%
<b>Job Creation : Construction (People)</b>	662	1 165
<b>Job Creation : Operations (People)</b>	50	70



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# Preferred Bidders

## Job creation per Province



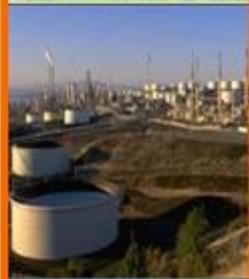
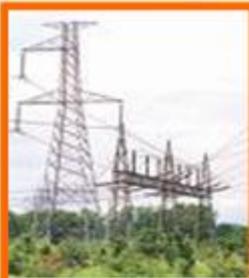
Description	Jobs during construction period	Jobs during operations period
	BW2	BW1
Eastern Cape Province	1 026	64
Free State Province	140	32
Limpopo Province	0	0
Northern Cape Province	4 709	151
North-West Province	0	0
Western Cape Province	1 184	81
<b>TOTAL</b>	<b>7 059</b>	<b>328</b>



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# Analysis of MW allocation and remaining MW



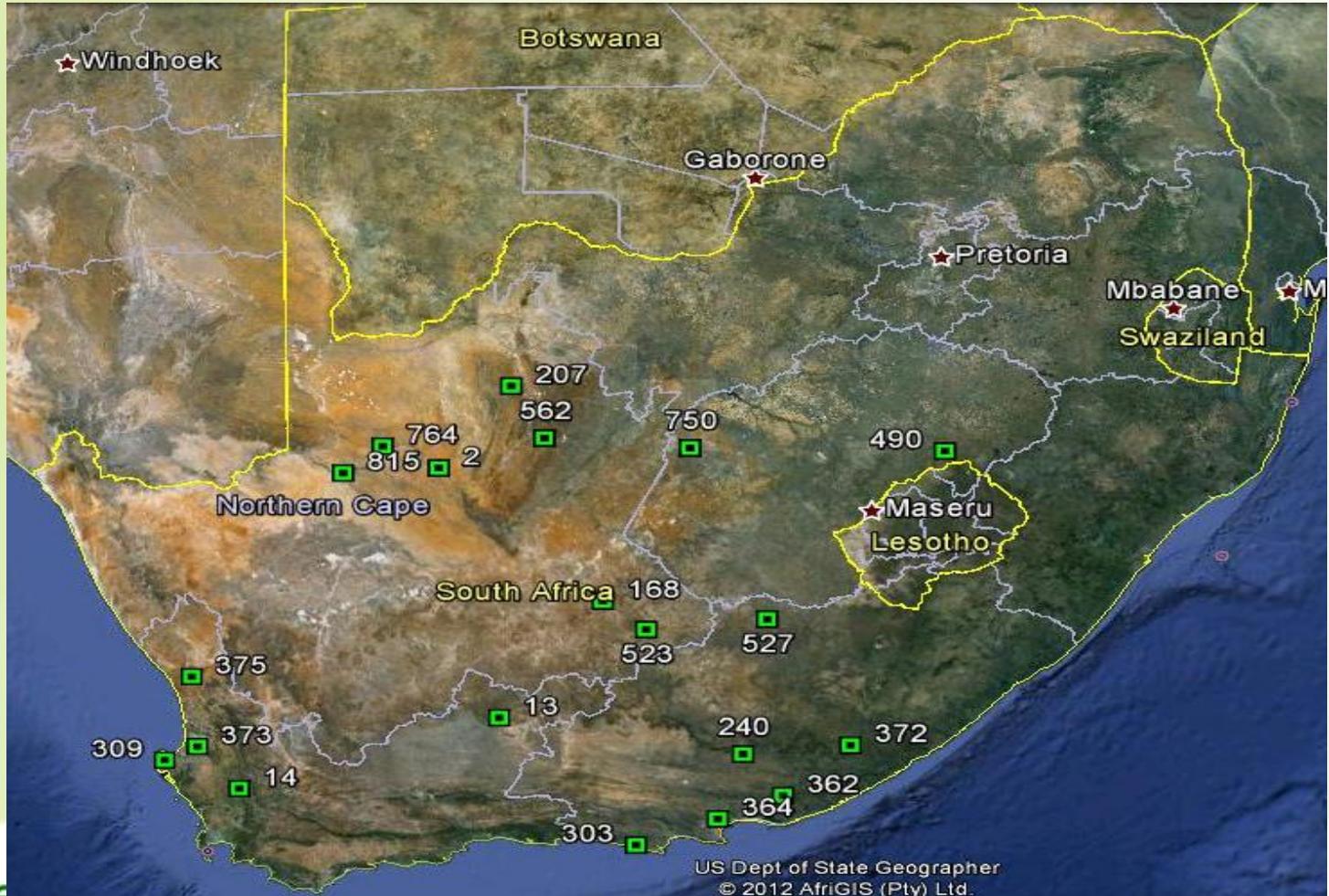
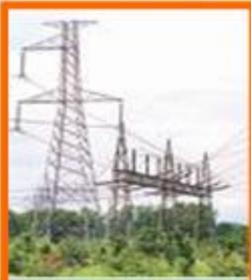
Technology	MW allocation in accordance with the Determination	MW capacity allocated in the First Bid Submission Phase	MW capacity allocated in the Second Bid Submission Phase	MW capacity for allocation in future Bid Submission Phases
Onshore wind	1 850.0 MW	634.0 MW	562.5 MW	653.5 MW
Solar photovoltaic	1 450.0 MW	631.5 MW	417.1 MW	401.4 MW
Concentrated solar power	200.0 MW	150.0 MW	50.0 MW	0.0 MW
Small hydro ( $\leq 10$ MW)	75.0 MW	0.0 MW	14.3 MW	60.7 MW
Landfill gas	25.0 MW	0.0 MW	0.0 MW	25.0 MW
Biomass	12.5 MW	0.0 MW	0.0 MW	12.5 MW
Biogas	12.5 MW	0.0 MW	0.0 MW	12.5 MW
<b>Total</b>	<b>3 625.0 MW</b>	<b>1 415.5 MW</b>	<b>1 043.9 MW</b>	<b>1 165.6 MW</b>



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# Preferred Bidders Geographic Distribution



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# ***RE Development in the Pipeline***

- In 2010, South Africa explored the possibility of developing Solar Parks across the Country – Solar Park Corridor Development Initiative
- A prefeasibility study was conducted by the Clinton Climate Initiative on behalf of the Department of Energy in 2009 October to May 2010 and Cabinet approval to proceed with Feasibility studies.
- Northern Cape Province was confirmed on the top list of the solar resource
- The prefeasibility study in Northern Cape confirmed a potential of 5000 MW.
- Since then various technical studies are in progress in Northern Cape Province, namely, Overall comprehensive feasibility study including Environmental Impact studies, Geotechnical studies.
- The Solar Park Initiative follows a Corridor Development Approach.

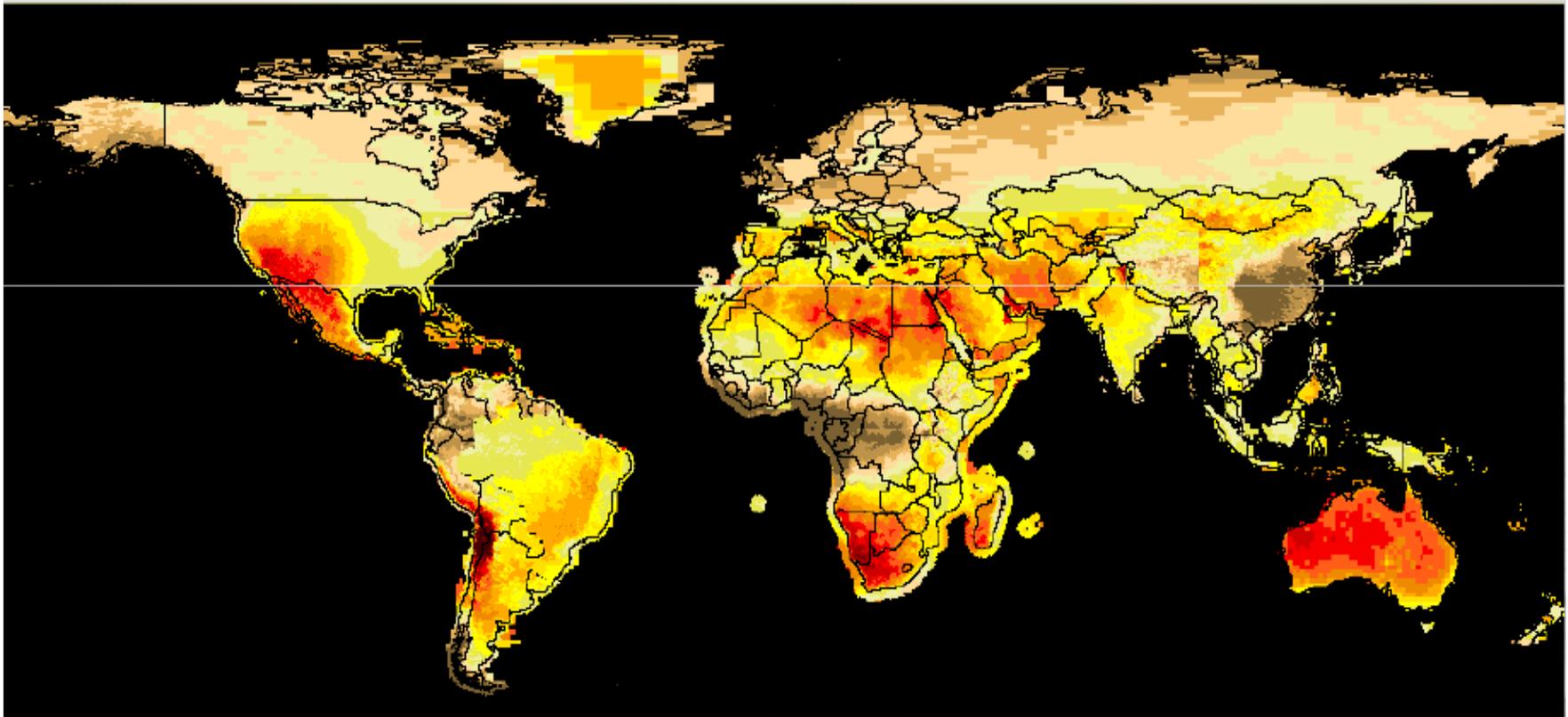


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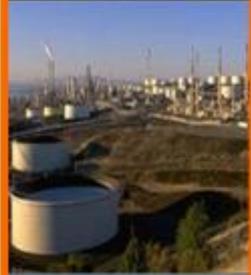
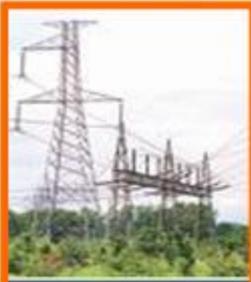
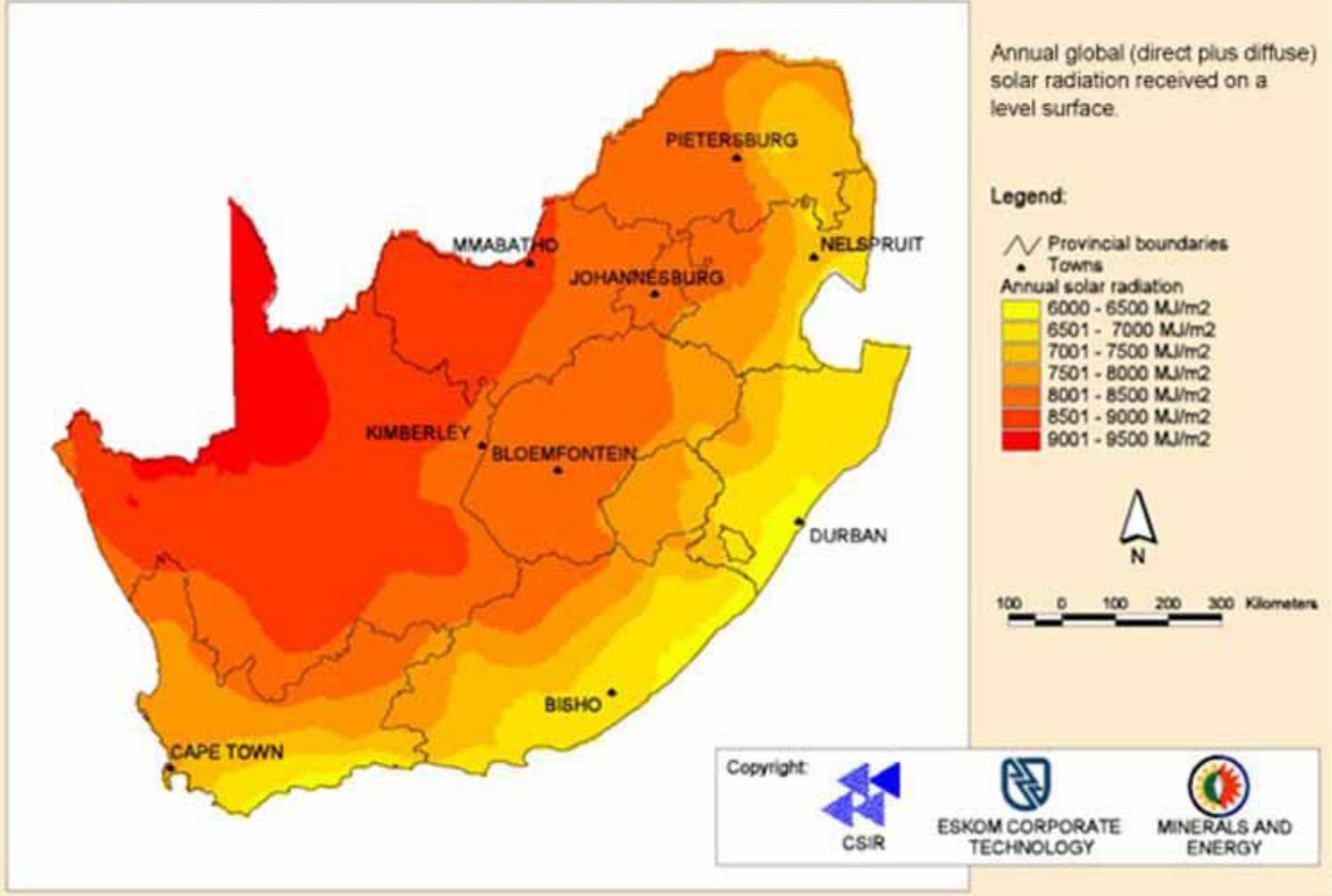
# *Solar Resource Potential Worldwide*

Direct Normal Irradiance (DNI) solar resource worldwide



# Introduction: South Africa's Solar Resource

South African Renewable Energy Resource Database - Annual Solar Radiation

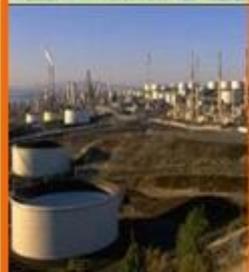
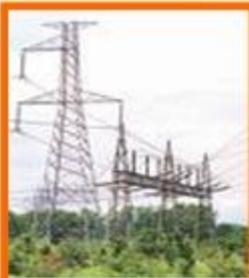
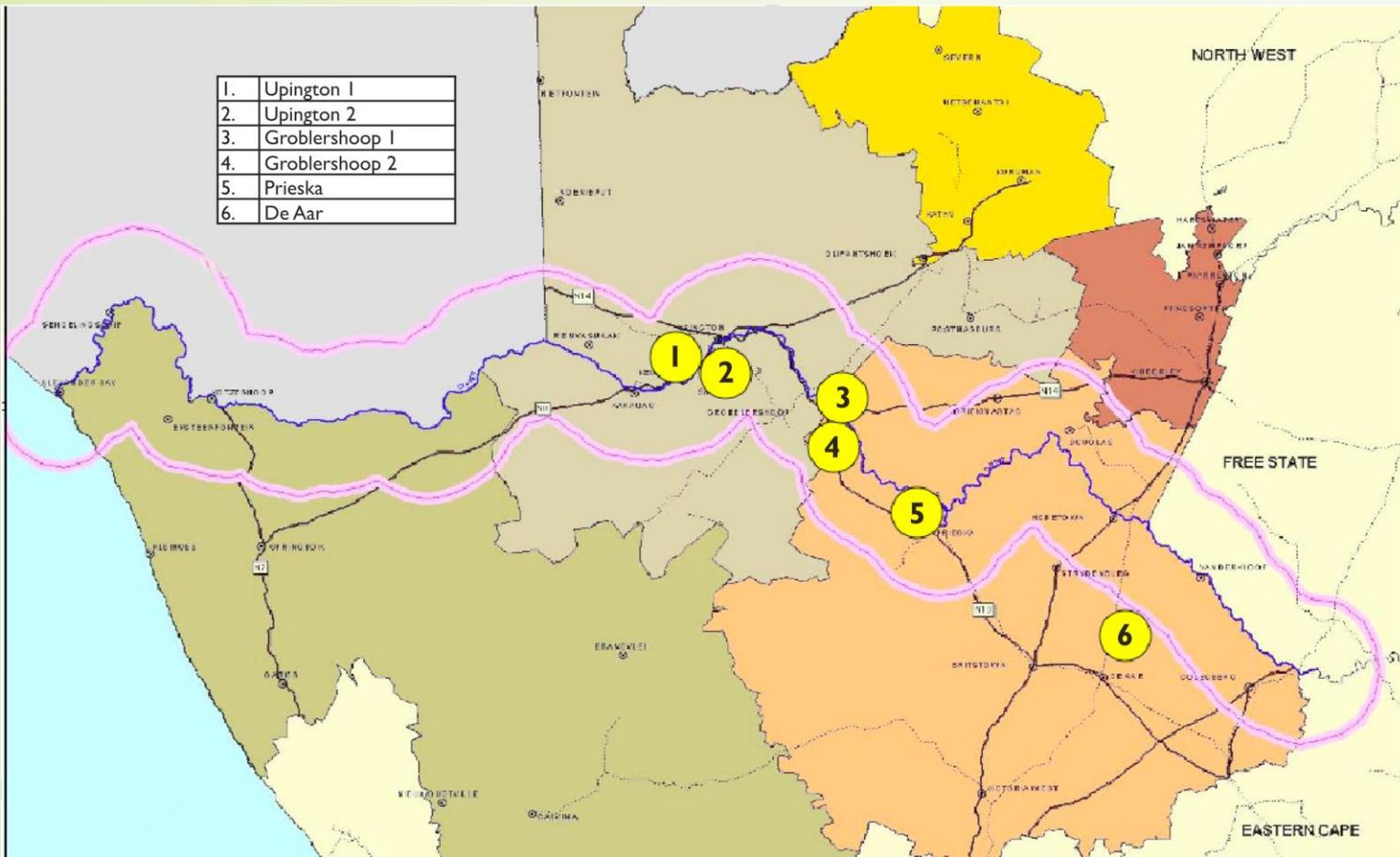


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# Targeted potential Sites

- Potential sites are marked with yellow below:

1.	Upington 1
2.	Upington 2
3.	Groblershoop 1
4.	Groblershoop 2
5.	Prieska
6.	De Aar



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# Generation Connection Capacity Assessment of the 2012 Transmission Network (GCCAT – 2012) Report

- Eskom released commissioned a Generation Connection Capacity Assessment of the Transmission Network , 2012
- The study confirmed connectivity potential starting from 2012 in three provinces, that is Western Cape, Eastern Cape and Northern Cape.
- Table 2 below provides a summary of the estimated System N-1 generation capacity for the three Zones in the Cape provinces.

## System N-1 Generation Connection Capacities

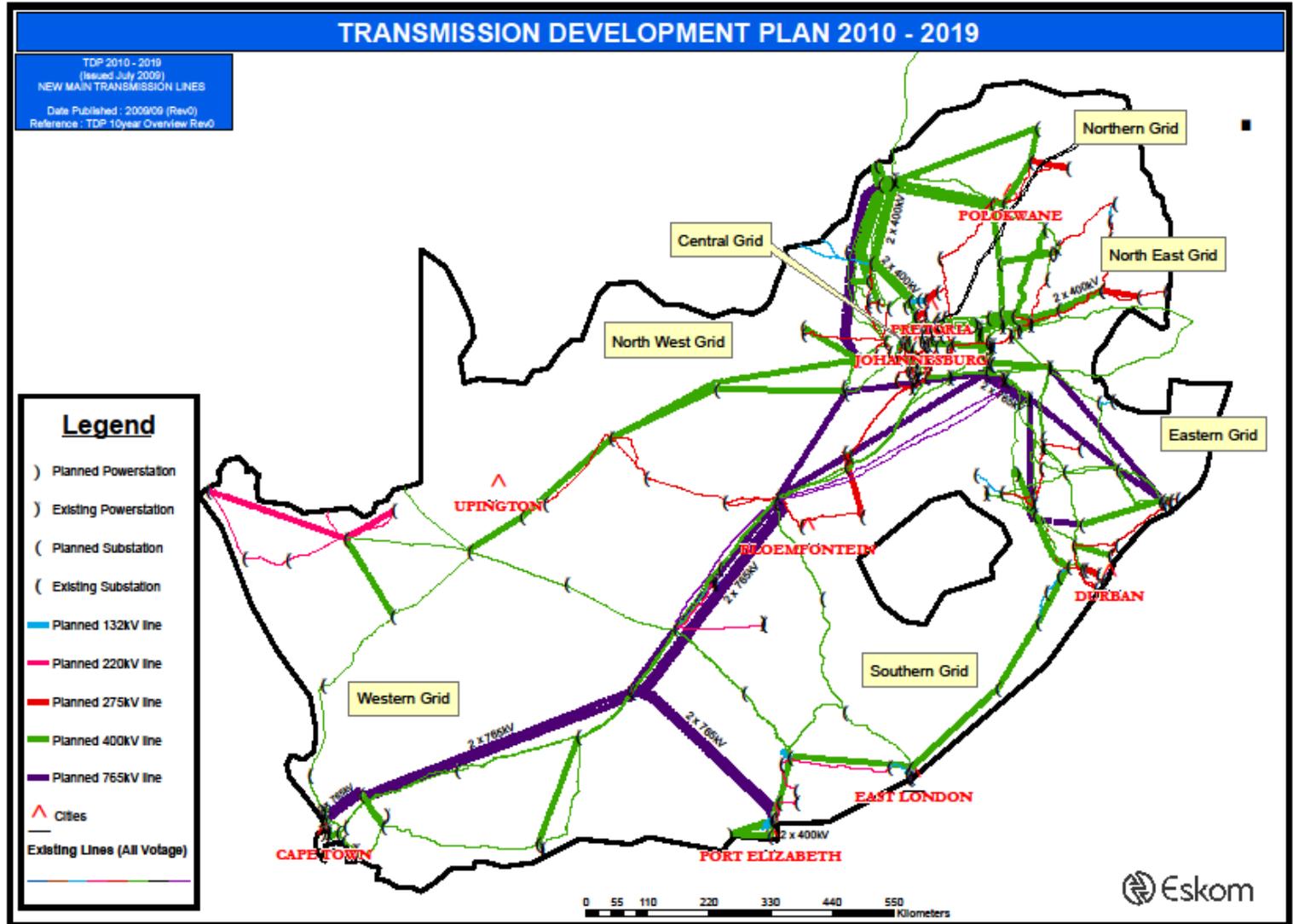
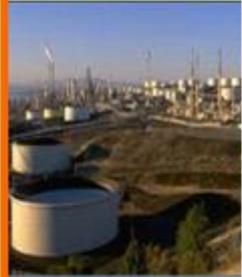
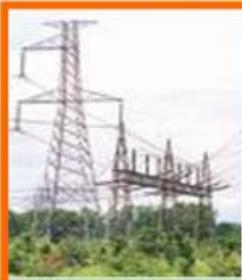
Area	Level 1	Level 2
Western Cape	2 988 MW	4 100 MW
Eastern Cape	1 042 MW	1 600 MW
Northern Cape	129 MW	1000 MW
Total	4 159 MW	6 700 MW

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# South Africa Transmission Infrastructure



# ***South African Wind Energy Programme (SAWEP)***

- In 2009 South Africa embarked on an exercise through the South African Wind Energy Programme (SAWEP), a programme funded by Global Environmental Facility with UNDP as the Executing Agent to update our wind atlas.
- This was a 4 year project covering three provinces, namely Northern Cape, Western Cape and Eastern Cape and ten (10) wind measurement masts and data collection systems were installed in selected areas of these 3 provinces.
- The purpose of the project was to provide accurate measurements and data for modeling of the wind resource in order to assist planners, the power sector and wind developers to identify sites with sufficient wind resources to set up their wind power generation facilities.
- In March 2012, South Africa launched its first Verified Numerical Wind Atlas South Africa based on full year of assessment (i.e. since September 2010 - 2011)



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# South African Wind Energy Programme (SAWEP)

- The project also has five working packages that also culminate into a wind atlas and database for South Africa.
- The wind resource assessment was done using:
  - Meso-scale modeling which was originally used for numerical weather prediction and has now been refined and uses a variety of global, geophysical and meteorological databases;
  - Micro scale modeling;
  - Undertaking site visits to determine actual wind measurements;
  - Application of the numerical wind atlas; and
  - Estimation of extreme wind climate in the selected areas.



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# South African Wind Energy Programme (SAWEP)

- WASA has produced at least one-year's worth of Quality Assured and checked wind energy data that are graphically displayed online and can be downloaded on the following websites:
  - <http://www.wasa.csir.co.za> (online graphs)
  - <http://wasadata.csir.co.za/wasa1/WASAData> (download)
  - <http://www.wasaproject.info/> (SANEDI WASA website)
- The user statistics indicates that the numbers are growing:

Date	Number of registered users	Countries	Downloads	Number of Data Downloads
Mar 2012	444	37	16136	380
Dec 2012	1099	47	28463	783
Jan 2013	1112	50	29440	792
Mar 2013	1206	53	33225	854

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# Wind Atlas of South Africa (WASA)

- The outputs from WASA will also help developers in planning and project preparation of bankable projects, siting of turbines as well as siting of wind farms).
- This WASA project also aims to build local capacity in wind resource assessment through the involvement and participation of the South African Weather Service (SAWS), University of Cape Town (UCT), and the Centre for Scientific and Industrial Research (CSIR) and RISO DTU with the South African National Energy Development Institute (SANEDI) managing the WASA team.
- South Africa is amongst the countries participating in the Clean Energy Ministerial's Global Wind and Solar Atlas Initiative led by IRENA;
- Phase 2 of the WASA is currently in progress through funding support from the Government of Denmark and is focusing on the 3 provinces, that is, Eastern Cape, Kwa Zulu Natal and some parts of Free State Province between 2013 – 2015.
- **South Africa is amongst the countries participating in the Global Wind and Solar Atlas led by IRENA;**



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# ***Solar Energy Technology Road Map (SETRM)***

- In June 2011, the South Africa Government signed an MoU with the International Energy Agency (IEA)
- Through this collaboration, the Departments of Energy and Science & Technology are developing a Solar Energy Technology Road Map (SETRM).
- Since 2012, both Departments engaged with various experts in the sector for the planning and preparation of this Solar Energy Technology Road Map.
- This included setting a vision in an effort to define the desired pathway for this technology deployment and long terms goals of the roadmap;
- The key area of focus for the SETRM is the integration of solar technology into the South African energy mix through 2030 and 2050.
- Within the broad solar energy sector, the South Africa SETRM is focusing on four sub-sectors, that is, Solar Photovoltaic (PV & CPV); Concentrated Solar Power; Solar Heating and Cooling (with a particular emphasis on solar water heating also referred to Solar Thermal) and High Temperature Solar Energy (Current & Future



# Bioenergy in South Africa

- Within the family of bioenergies, liquid biofuels are topical on South Africa's developmental agenda due to the inherent attributes such as high labour intensity, potential balance of payments savings, diversification of the country's transport fuels mix, etc. The country is fairly well-endowment with bioenergy feedstock; however exploitation thereof remains less optimal.
- The table below depicts a non-exhaustive list of research projects in progress:

Project	Focus
Commercial Production of Cellulosic Ethanol in Southern Africa	Development and application of advanced, second generation technology for the production of bio-ethanol from waste-based fibrous plant residues produced by milling and/or fermentation
Makana Mobile Bioethanol System	Use of small-scale farmers to produce sugar beet feedstock for bioethanol production
Microalgae biomass to biofuel/bioenergy via direct liquefaction of biomass	Photo bioreactors used to grow algae at optimum levels by using autotrophic and heterotrophic methods whereby nutrients are recovered and recycled within the system

# *Small scale hydro*

- The South Africa Government through the Departments of Energy, Water Affairs and National Treasury is currently finalising a feasibility study for small scale hydro for 21 National Water Resource Infrastructure (i.e. Dams);
- All the 21 dams falls within the NWRI under the Department of Water Affairs.
- Once completed, this will inform the procurement of small scale hydro Independent Power Producers programme



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# Conclusion

- The South Africa Government remains committed to:
- Ensure security of energy resources, and pursuing an energy mix that includes clean and renewable resources to meet the needs of our fast growing economy, without compromising our commitment to sustainable development.
- Put in place clear programme of incentives for investment, as well as the development of the requisite human resource capacity to take full advantage of the opportunities presented due to the growth in this sector
- Acknowledges that many of the building blocks to support the scale up of RE and EE initiatives exist today and effort therefore should be concentrated on regrouping these building blocks and ensuring the right level of coordination between public and private sector finance to maximize the available financial resources.
- Putting all the necessary institutional structures and governance tools in place.



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# THANK YOU

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