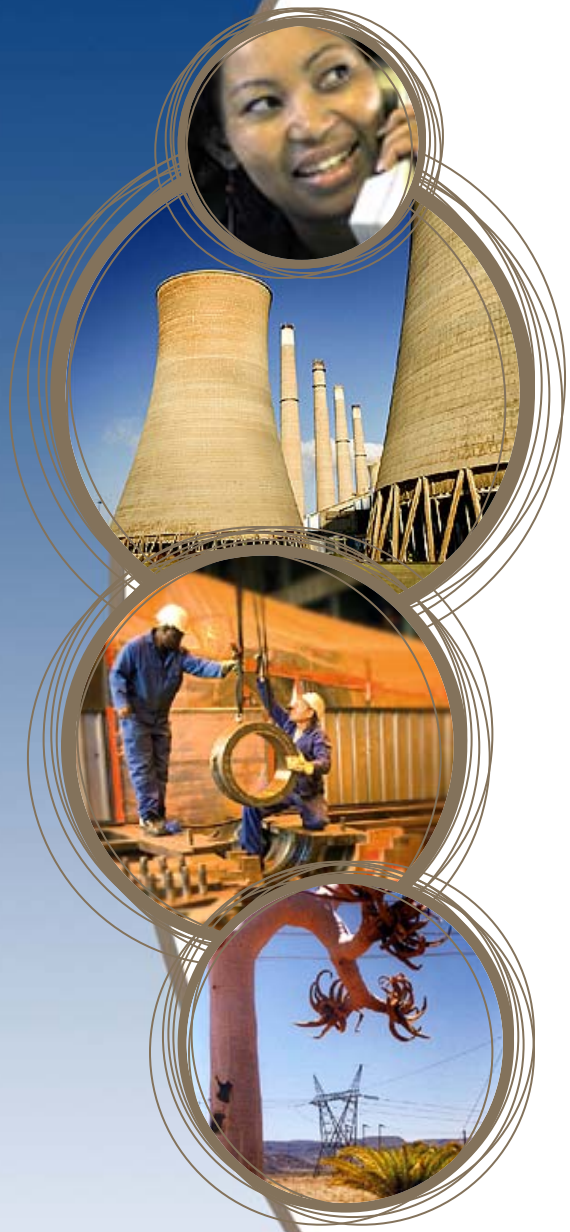


RENEWABLE ENERGY IN ESKOM

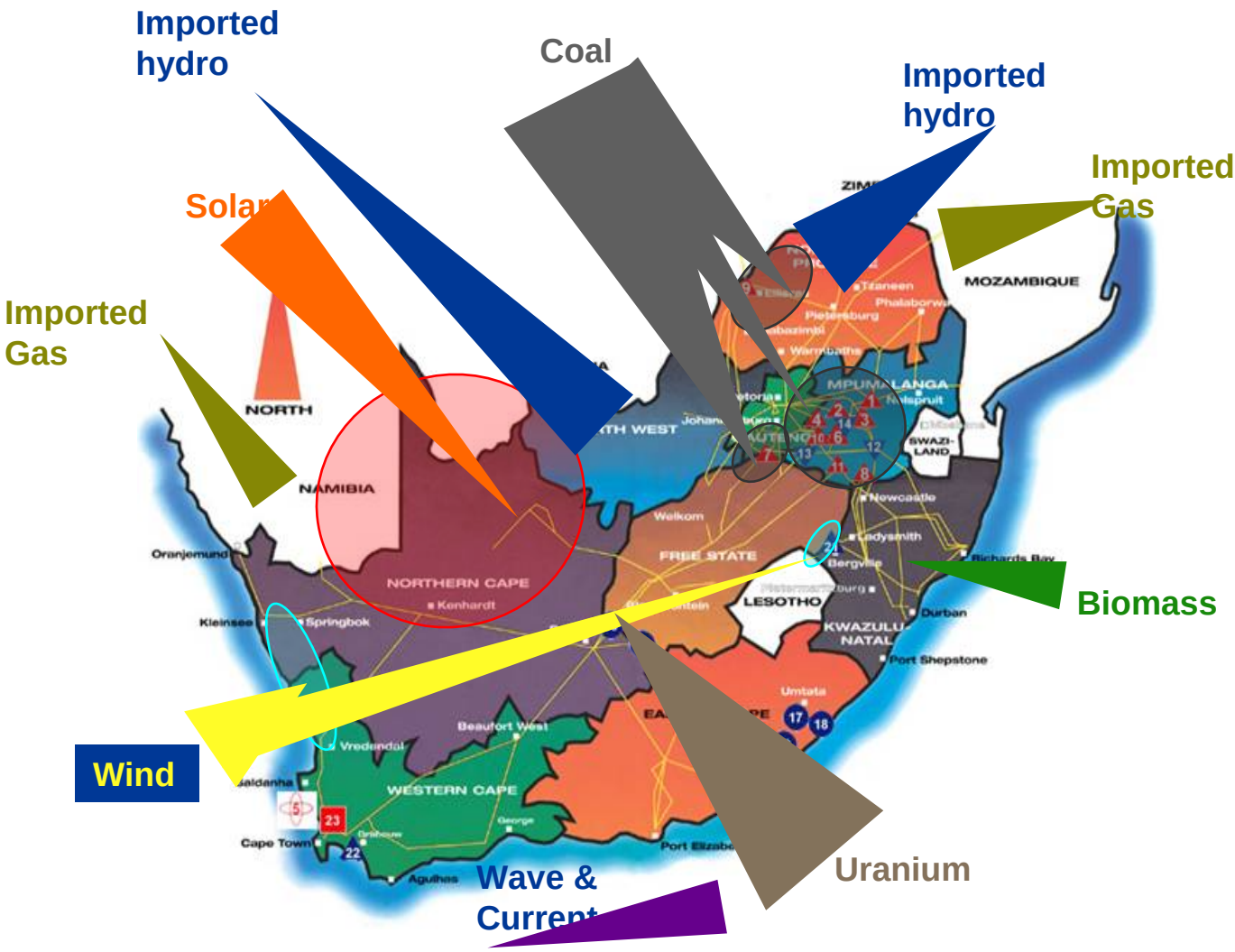
European Parliamentarians with Africa

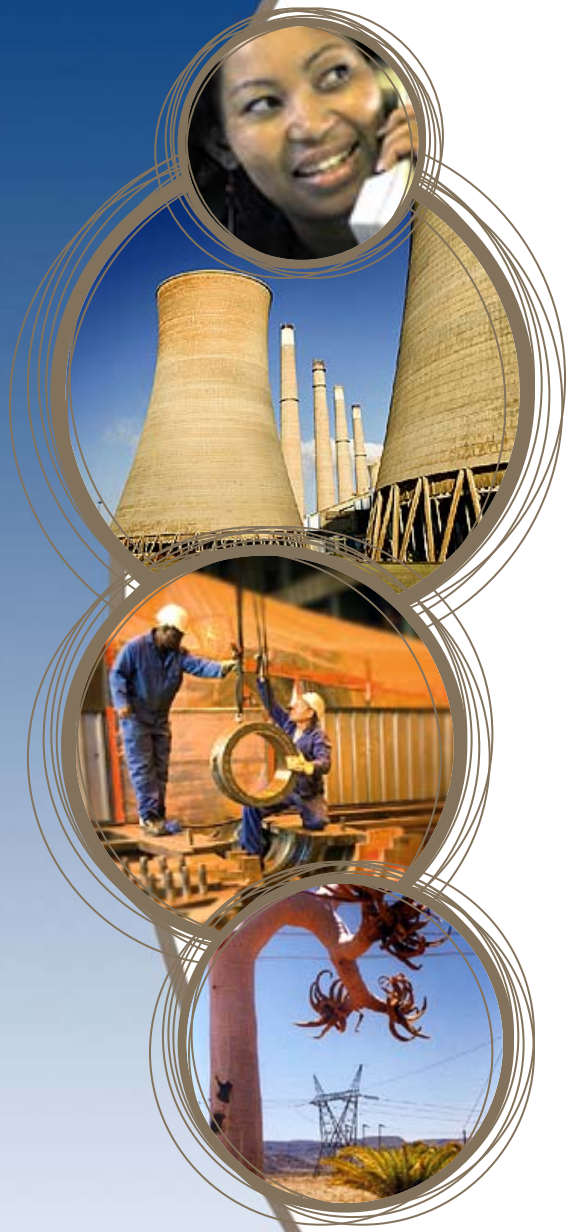
Wendy Poulton

General Manager – Sustainability and Innovation

Presentation outline

- Current share of renewable power generation in Eskom
- Possibilities for renewable power generation in SA – opportunities and challenges
- Future plans on renewable energy in Eskom





Current share of renewable power generation in Eskom

Current share of renewable power generation in Eskom

By energy*

Electricity production by own stations

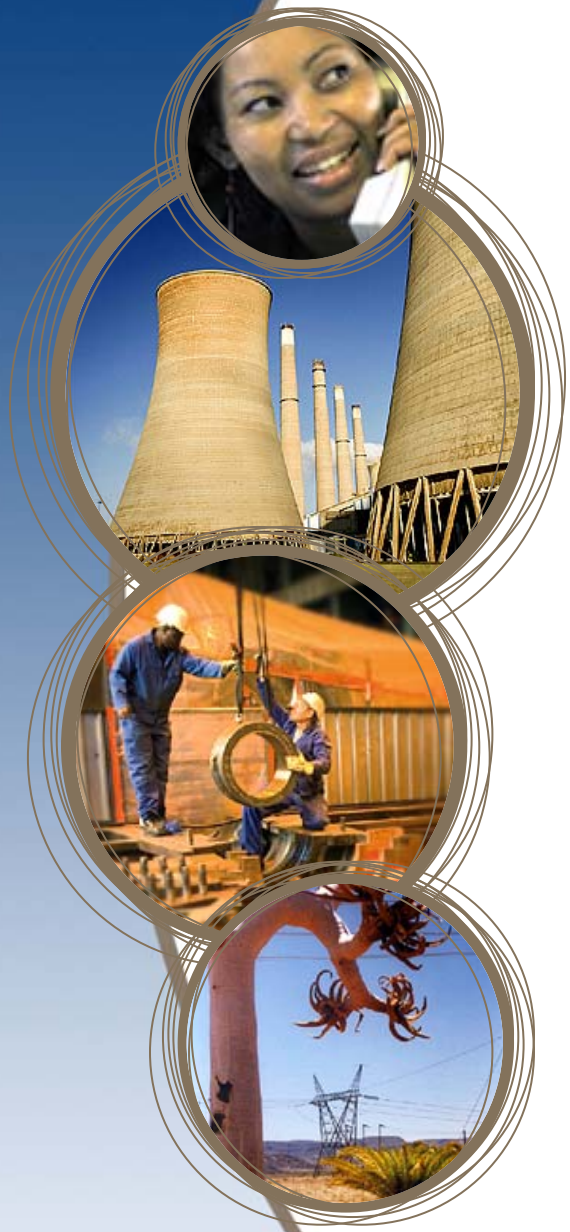
	2010	2009	2008	2007	2006
Coal-fired (GWh)	215 940	211 941	222 908	215 211	206 606
Hydro-electric (GWh)	1 274	1 082	751	2 443	1 141
Pumped storage (GWh)	2 742	2 772	2 979	2 947	2 867
Gas turbine (GWh)	49	143	1 153	62	78
Nuclear (GWh)	12 806	13 004	11 317	11 780	11 293
Wind energy (GWh)[3]	1	2	1	2	3
Total production (GWh)	232 812	228 944	239 109	232 445	221 988
Electricity purchased by Eskom					
• Foreign imports (GWh)[4]	10 047	9 162	10 998	10 624	9 318
• Local IPP and co-generation, (GWh)	0	0	0	0	0
Reserve margin (including imports) (%)	16,4	10,6	5,6	7,8	12,7
Demand-side management Savings (MW)	372[RA]	916[RA]	650	170	72

By power generation*

Power station net maximum capacity (own)

	2010	2009	2008	2007	2006
Coal-fired (MW)	34 658	34 294	33 566	33 036	32 256
Hydro-electric (MW)	600	600	600	600	600
Pumped storage (MW)	1 400	1 400	1 400	1 400	1 400
Gas turbine (MW)	2 409	2 409	1 378	925	342
Nuclear (MW)	1 800	1 800	1 800	1 800	1 800
Wind energy (MW)	3	3	3	3	3
Total production (MW)	40 870	40 506	38 747	37 764	36 401

*Reference: Eskom 2009/2010 annual report



Possibilities for renewable power generation in South Africa – opportunities and challenges

Possibilities for renewable power generation in SA

ENERGY TYPE	ESTIMATED TOTAL ENERGY POTENTIAL
Wind Energy	3 GW
Hydropower	7154 MW
Solar Energy	64.6GW
Wave Energy	56800 MW
Ocean Currents	2000 MW
Solid Waste	40.5PJ per annum
Sewage Derived Methane	1.13PJ per annum
Biomass	Bagasse: 210 GWh per annum Fuelwood & Pulp: 12167 GWh per annum Manure: 5612 GWh per annum

Source: DME, 2003 Whitepaper on Renewable Energy

Technology Status and Application

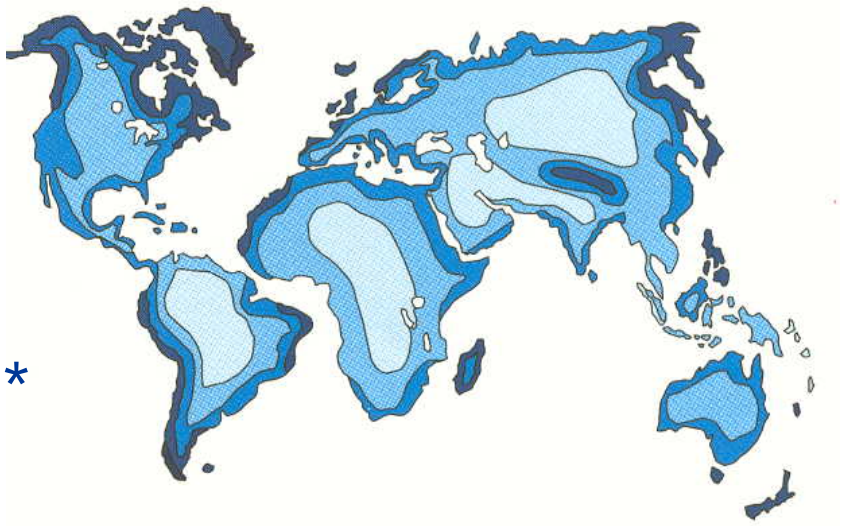
RENEWABLE ENERGY OPTIONS			
Commercial	Near or early commercial (Proven)	Pre-commercial	Research
Wind	**CSP - Tower**	**Ocean wave**	**Ocean Current**
CSP - Trough	**CPV**		**Solar Chimney**
Hydro	**Biomass co-firing**		
Biomass - Wood			
Biomass - Bagasse			
Biomass - Landfill gas			
Biomass - MSW			
Biomass - Other			
PV			
Tidal			

>20 MW per site PROVEN OPTIONS - SA RELEVANT

Commercial	**Pre-commercial (proven)**
Wind	CSP - Tower
CSP - Trough	CPV
Biomass - Bagasse	
Biomass - Wood waste	
Biomass - MSW	
PV	

Strategic fit:
Baseload?
Mid-merit?
Peaking?

Resource Availability - Wind Energy Resource



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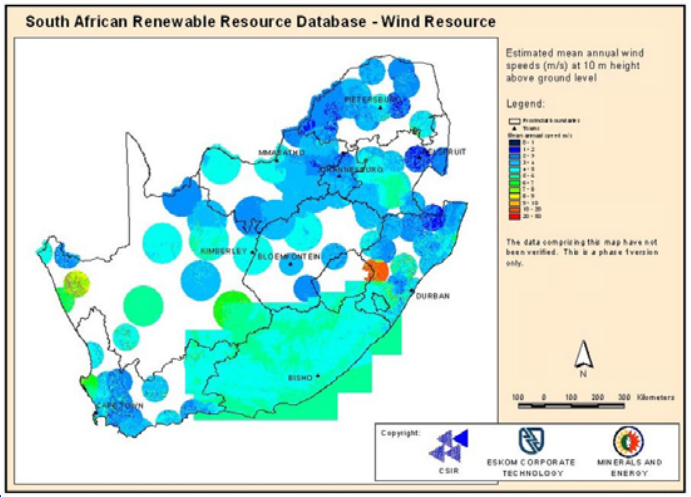


** Ref. NASA*

National Resource

- The wind resource can be described as moderate with the East and West Coast regions having an avg. resource of app. 4 to 6m/s per annum @ a height of 10m or 6 to 8 m/s @ 50m.

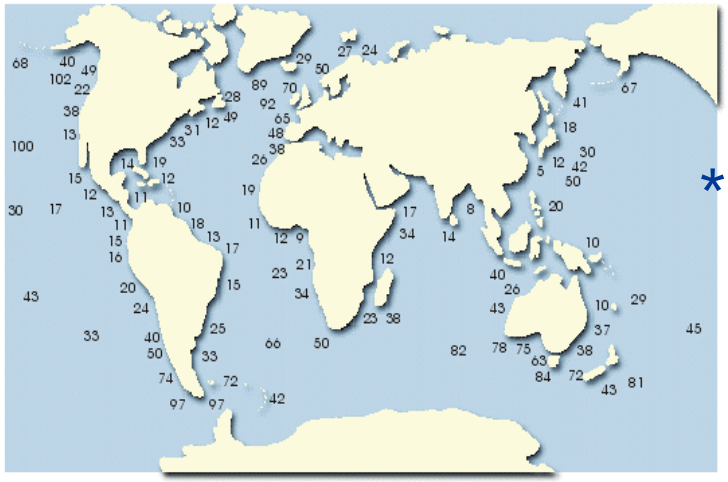
- The wind is extremely seasonal and varied, resulting in relatively low avg. capacity factors between 15 and 25%, though higher capacity factor sites exist.

Wind Solving the intermittency issues

- Wind-generated power is a variable resource, and the amount of electricity produced at any given point in time by a given plant will depend on wind speeds (among other factors).
- If wind speed is too low (less than about 2.5m/s) then the wind turbines will not be able to generate electricity, and if it is too high (more than about 25m/s) the turbines will have to be shut down to avoid damage.
- While the output from a single turbine can vary greatly and rapidly as local wind speeds vary
- Capacity Factor: Wind power typically has a capacity factor of 20-40%.
- Dispatchability: Low

- Technological solutions to mitigate large scale wind energy type intermittency exist such as increased interconnection (into the National Grid). As more turbines are connected over larger and larger areas, the average power output becomes less variable.
- In the case of wind power, operational reserve, by existing base load stations, is the additional generating reserve needed to ensure that differences between forecast and actual volumes of wind generation and demand can be met.
- Battery storage is expensive but other storage options are considered

Resource Availability - Ocean Energy Resource

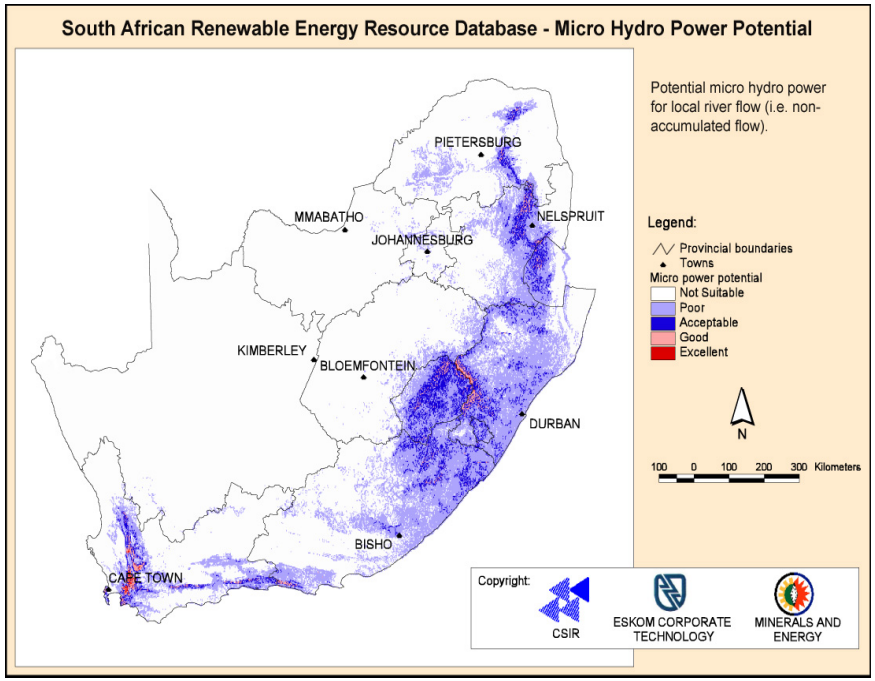


*

- **RSA - Good wave potential along certain coastal areas, comparable to international high-resource areas.**
- **The highest wave power potential, kW/m, occurs off-shore.**
- **The highest wave power generation occurs during the austral winter months, i.e. June, July and August**
- **The largest wave power yield (between 20 and 35 kW/m) is concentrated along the South and South East/ West coast.**
- **Significant energy source in the form of the Agulhas current.**
- **Initial findings indicate a significant resource capable of delivering capacities in the GW range**
- **Ocean currents measured ranged from 1-2 m/s2.**
- **Limited tidal resource.**

** Ref. Ocean Power Delivery*

Micro-Hydro Resource*



Installed Capacity

(small/mini/micro and pico hydropower) 33.92MW

Potential for development*

Firmly established 69MW, additional long-term 94MW

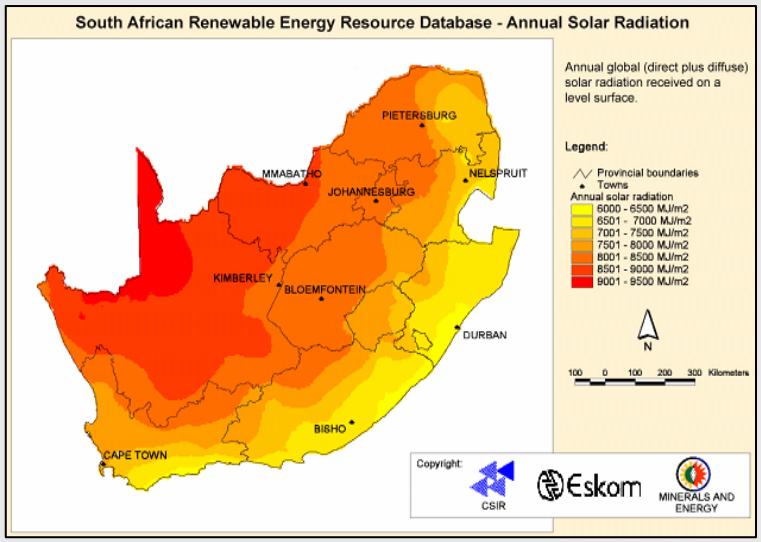
Main opportunities exist for mini and micro systems (<1MW), decreasing has the size increases (small and large).

**Ref. RSA Renewable Energy White Paper*

Strategic Drivers for Solar Power

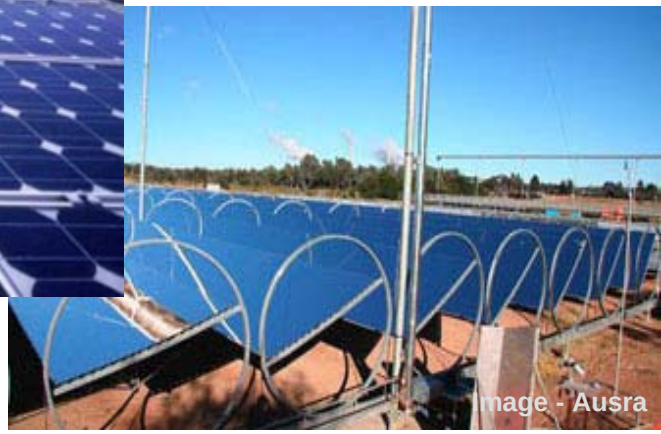
- Solar energy a significant resource in South Africa
- Solar power could potentially have a significant impact on a supply-side base load generation
- The potential supply of dispatchable power in future is in the GW range
- Energy storage an option
- Positive impacts on local industry and GDP growth
- Local green job and skills base

South Africa's Solar Irradiation levels is amongst the best in the world



South Africa experiences some of the highest levels of solar radiation in the world.
The average daily solar radiation in South Africa varies between 4.5 and 6.5 kWh/m2 (16 and 23 MJ/m2), with excellent areas such as Upington - 8.17 kWh/m2/day.

Solar technology options

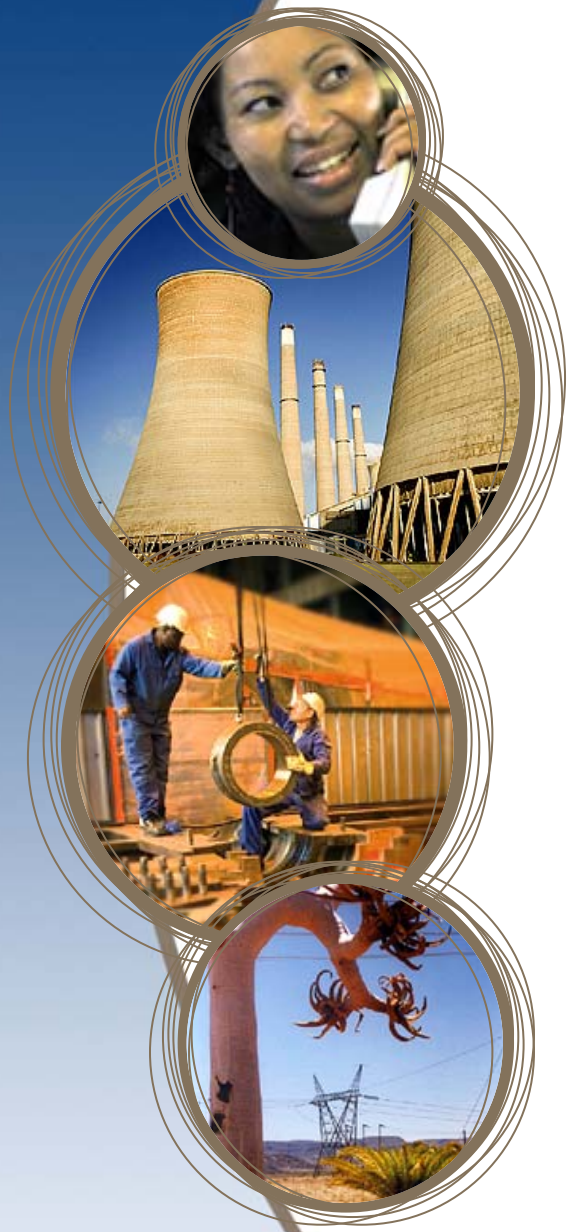


Technology Basics

- CSP technologies use large sun-tracking mirrors to concentrate the solar radiation and to heat a working fluid.
- The working fluid is then used to generate steam, which powers a turbine and generates electricity.

SOLAR Solving the intermittency challenge

- Solar power is generated by using the energy in the sun either directly (PV panels, SWH) or indirectly (CSP- heats salts or water to turn a turbine)
- Solar power is a very predicable intermittent energy source: whilst the sun's energy is not available all the time, we can predict it to a very good degree of accuracy
- Solar power output varies throughout the day and through the seasons, and is affected by cloud cover
- The extent to which the intermittency of solar-generated electricity is an issue will depend to some extent on the degree to which the generation profile of solar corresponds to demand



Future plans on renewable energy in Eskom

IPP's and REFIT

- Introduction of private sector generation has multiple benefits:
  - Diversification of supply and nature of energy production
  - Introduction of new skills and capital
  - Reduction of funding burden on Government
  - Benchmarking of performance and pricing
  - Reduction of borrowing requirement of Eskom

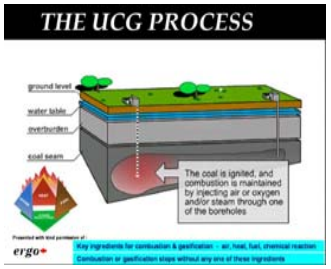
- Eskom is committed to facilitate the entry of independent power producers and will collaborate with Government, NERSA and developers of projects to ensure this happens.

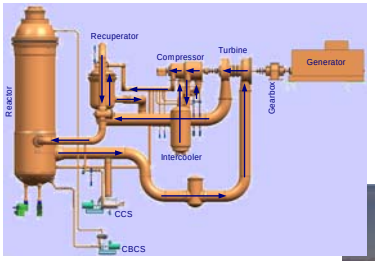
- Government is working on the enabling environment for IPPs using the Inter-ministerial Committee on Energy process.

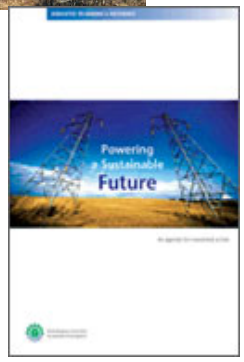
- Eskom has already signed agreements with some IPPs in the last 6 months and will continue to do so within the framework of the Integrated Resources Plan and the tariff determination for MYPD2.

Eskom's 6 point plan on climate change

- **Diversification** of the generation mix to lower carbon emitting technologies
- **Energy efficiency** measures to reduce demand and greenhouse gas and other emissions
- **Innovation** through research, demonstration and development
- **Investment** through carbon market mechanisms
- **Adaptation** to the negative impacts of climate change
- **Progress** through advocacy, partnerships and collaboration







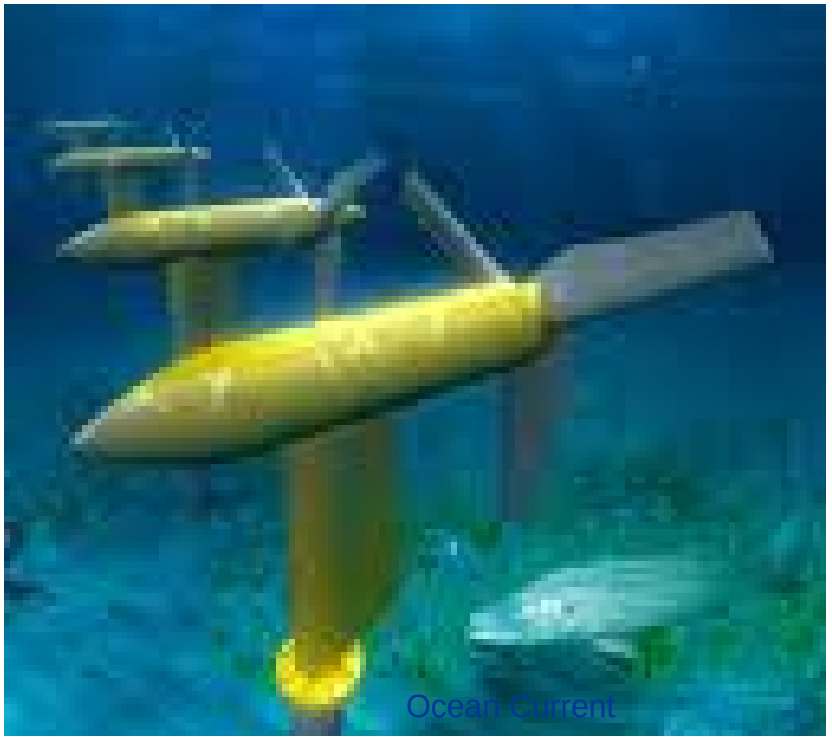
Eskom's Renewable Energy Focus

- Big Four renewable energy resources considered
  - Biomass (Co-Firing),
  - Solar (CSP),
  - Wind,
  - Ocean (Waves and Current)
- Eskom's programme seeks to find multi-MW options for grid supply
- Off-grid or stand-alone renewables is not currently part of Eskom's implementation, the exception is solar water heaters in the DSM portfolio
- Research into off-grid or stand alone options in support of national objectives
- Regional Options also considered
- Grid connection studies underway

Renewable Energy Research

Includes:

- Cofiring of Biomass in coal stations
- Municipal Solid Waste
- Continued support for solar water heaters
- Commission 100MW Solar
- Research into off-grid or stand alone options
- Site specific wind and solar resource assessments
- Potential for the retrofit of solar hybrid to coal stations



Concentrating Solar Power Central Receiver

- Application

  Grid connected supply- Eskom impact High

- Power Range

  Plant sizes of 100MW

- Footprint

  100MW would require app 4km2

- Status

  EIA complete

  Partial funding through the CTF

  Technology review underway

Commercial Wind

- Application

  Grid connected supply. Eskom impact – Medium/High

- Power Range

  Plant size - 100MW

- Footprint

  100MW would require app 20km2

- Status

  EIA complete

  Partial funding through the CTF

  Commercial stage

Biomass study

The initial uptake of biomass co-firing in Eskom is based on:

- Minimising Risks on plant availability
- Ease of Implementation
- Minimising initial Capital Cost
- Utilising fuels that meet local sustainability criteria (including social, economic and environment)

The option that best fits these requirements is expected to be co-milling or separate milling and co-injection of wood chips or pellets with coal

- Of the biomass fuels available wood based biomass have the largest growth expectation, with the main advantages being their high availability, heat content and transportability
- It is the biomass of choice for most European Utilities
- Technical risks tend to be lower than other biomass fuel sources
- **Up to 5-10% wood pellet biomass can be co-combusted without significant modifications to the existing plant**
- Biomass storage, pre-processing and handling are generally the largest costs associated with conversion into co-firing in a coal plant

Solar water heating

- Eskom has been active in the area of solar water heating for many years.
- Activities in the 90s were focussed on assessments of different systems and attempts to develop lower cost SA-based units.
- Subsequent work was aimed at understanding the requirements from the systems and the behavioural impact on the consumer – as such several pilot installations were made.
- The focus changed slightly as the SWH systems were not an attractive option to the residential consumer, given the low cost of electricity. As such, the use of SWH systems from a commercial and industrial perspective was considered.
- Current efforts are aimed at increasing the uptake significantly. Efforts are focussed not only on significantly increase the number of systems installed, but also see the accreditation of suppliers and registration of installer significantly enhanced; a key factors in enabling higher market penetration.

Funding for Renewable Energy in Eskom

- 100 MW Wind and CSP plants partly funded through the CTF
- Eskom renewable energy projects included in our tariff application
- CDM credits evaluated on all projects

Conclusions

- South Africa has significant renewable energy potential
- A number of projects are underway in Eskom
- Research focused on areas of future potential – resource and technology assessments as well as storage options
- Local content and important consideration
- Percentage of renewable energy in the mix to increase

Thank you