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Why should South Africa invest in the development of renewable energy resources?

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University of Pretoria, 8 March 2012



Outline of Presentation



- Introduction to Renewable Energy in South Africa
- Current Policy and Financial Landscape for Renewable Energy
- Renewable Energy Resources and Projects in South Africa
 - Wind Energy
 - Ocean Energy
 - Solar Energy
 - Hydro Energy
- What can the contribution from Renewable Energy be?
- Why should South Africa invest in the development of these resources?
- Conclusion



Introduction



White Paper on Renewable Energy 2003

- Set target of 10 000 GWh by 2013.
- Based on 4% of total energy consumption in SA, electricity and liquid fuels.
- Primarily from biomass, solar, wind and small-scale hydro.
- Predicted role for SMMEs, IPPs and competition in energy markets.
- Drivers:
 - Environmental issues, such as pollution and exploitation of natural resources.
 - Climate Change due to CO₂ emissions from fossil fuels.
 - Energy security through diversification of supply.
 - Sustainable development.

Renewable Energy Feed-In Tariff (REFIT)

- First set of tariffs announced March 2009, wind, solar (CSP), small-scale hydro and landfill gas.
- Second set of tariffs announced November 2009, solid biomass, biogas, CSP (central receivers) and PV included.
- Attracted large number of project developers in different stages of their project development.



REFIT, Now History



Technology	REFIT	Size Constraint
REFIT Phase 1		
CSP trough with storage (6 hours)	R 2.10/kWh	
Wind	R 1.25/kWh	
Hydro	R 0.94/kWh	1 – 10 MW range only
Landfill gas	R 0.90/kWh	
REFIT Phase 2		
CSP trough without storage	R 3.14/kWh	
CSP tower with storage (6 hours)	R 2.31/kWh	
Solid biomass	R 1.18/kWh	
Biogas	R 0.96/kWh	
Large grid connected PV	R 3.94/kWh	1 MW and larger
Concentrated PV	No tariff	
Roof top PV below 1 MW	No tariff	

REFIT Status?

- **RFP Documentation** was due to be released end of March 2011.
- **PPAs** were due to be signed before December's COP 17 meeting.
- **THEN, NERSA** published a discussion document with revised (lower) REFITs!!!
- **THEN DoE/NT** announced that the REFITs were unconstitutional!
- **REBid RFP Documentation** released early August, due date 4 Nov



IRP2010, Setting the Scene



	New build options							
	Coal (PP, FBC, Imports, Clean fuels)	Nuclear	Import hydro	Gas - DCGT	Peak - DCGT	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	200	0	0	0	0	400	0	300
2015	200	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	100	300
2019	0	0	0	237	0	400	100	300
2020	0	0	0	237	0	400	100	300
2021	200	0	0	237	0	400	100	300
2022	200	0	1 137	0	805	400	100	300
2023	200	1 800	1 137	0	805	400	100	300
2024	200	1 800	753	0	0	400	100	300

- **Wind:** 800 MW (2010-2013) 2 400 MW (2014 – 2019)
- **CSP:** 200 MW (2014-2015) 400 MW (2016 – 2019)
- **Solar PV:** 2 400 MW (2012 – 2019)

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REIPPPP Tariffs



Technology	Allocation* [MW]	Size Limits [MW]	Commercial Energy Rate*
Onshore Wind	1 850	1 - 140	R 1 150/MWh
Concentrated solar power	200	1 - 100	R 2 850/MWh
Solar photovoltaic	1 450	1 - 75	R 2 850/MWh
Biomass	12.5	1 - 10	R 1 070/MWh
Biogas	12.5	1 - 10	R 800/MWh
Landfill gas	25	1 - 10	R 600/MWh
Small hydro (≤10MW)	75	1 - 10	R1 030/MWh
Small projects utilising any of onshore wind, solar photovoltaic, biomass or biogas technologies which have a maximum installed capacity of 5 MW	100	< 5	Not specified

* Commercial Energy Rate is seen as an upper bound of the tariffs that will be paid for the electricity from renewable energy technologies

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REIPPPP Allocations in First Round



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Round 1, December 2011:

- Onshore Wind: 634 MW of 1 850 MW
- Solar PV 631.5 MW of 1 450 MW
- Solar CSP 150 MW of 200 MW*
1.4 GW

Next Rounds Submission Dates: 5 March 2012
20 August 2012
Q1 2013
Q3 2013

* CSP allocation could be increased before third window, needs a determination by the Minister of Energy

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What is the cost of electricity in SA?



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c/kWh	Domestic Block 1	Domestic Block 2	Domestic Block 3	Domestic Block 4	Commercial Prepaid	Commercial	Industrial
RED 1	57-64	63-68	83-88	99-104	106-111	106-111	106-111
RED 2	57-64	63-68	83-88	100-105	105-110	105-110	108-113
RED 3	57-64	63-68	83-88	99-104	106-111	106-111	108-113
RED 4	57-64	62-67	82-87	98-103	105-110	105-110	108-113
RED 5	57-64	63-68	83-88	99-104	106-111	105-110	106-111
RED 6	57-64	62-67	82-87	98-103	106-111	106-111	108-113

Table 5: Benchmarks: 2011/12 at 16.03 % guideline increase

Source: NERSA MYPD Announcement 2010

Eskom 2011/2012 Tarrifs:

- Eskom Homelight: R 1.13 – R 1.46/kWh (Excl VAT)
- Eskom Megaflex: R 0.21 – R 2.01/kWh (plus other charges)
- Eskom Businessrate: R 0.68/kWh (plus other charges)
(Another 25% on its way in 2012)

REIPPPP:

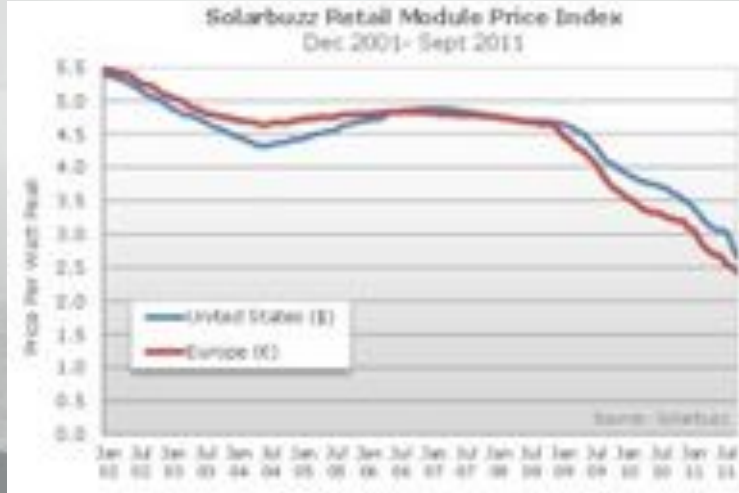
Wind < R 1.15/kWh; Solar < R 2.85/kWh; Small-Hydro < R 1.03/kWh

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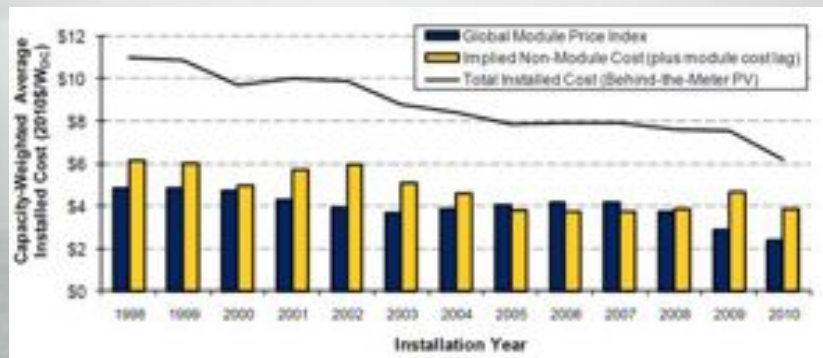
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What is the cost of electricity from PV?

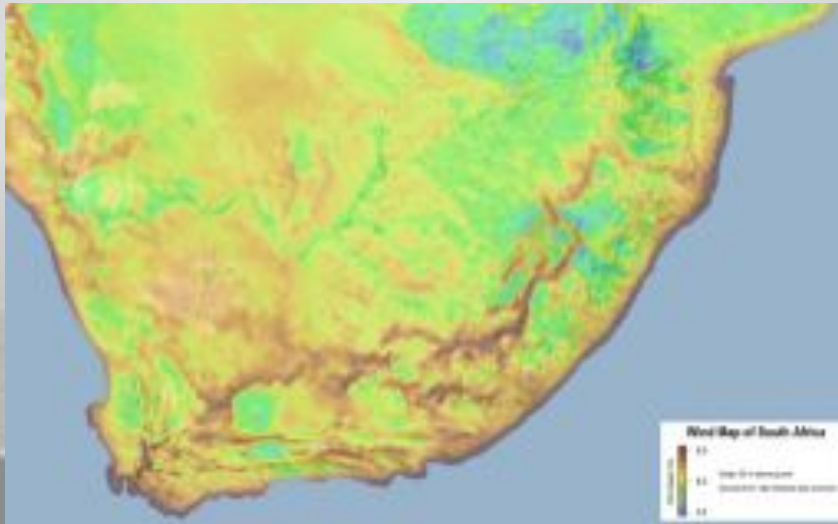


What is the cost of electricity from PV?





Wind Energy Resource



Source: firstlook.3tier.com/wind

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Wind Energy Projects



Klipheuwel, Eskom Demonstration

- Wind turbines
 - Vesta V47 660 kW
 - Vestas V66 1 750 kW
 - Jeumont J48 750 kW

Darling Wind Farm, Darlipp

- Four 1,3 MW Führländer wind turbines
- Installed February-March 2008
- Commissioned May 2008
- Official "Switch-On", 23 May 2008
- Expected capacity factor > 30% (23-24%)

Sere, Eskom Wind Energy Facility, near Lutzville on West Coast

- Up to 100 wind turbines, first phase 100 MW, second phase 100 MW
- Funded by French Development Bank, African Development Bank and World Bank loans
- Funding secured, soon out on tender, again

Latest Development

- Coega 1,8 MW Vestas turbine

IPP Projects Under Development

- More than 4 GW currently under development by various project developers 634 MW REIPPPP allocation in first round



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Wave Energy Resource



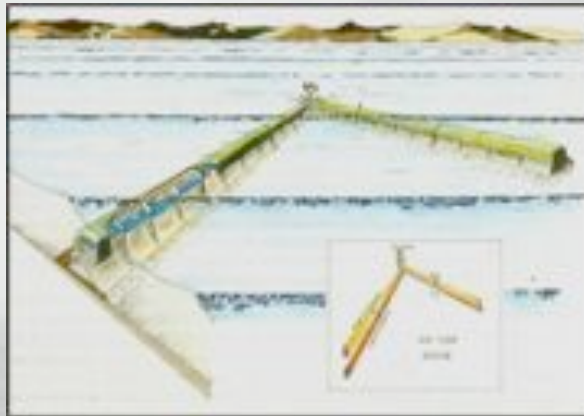
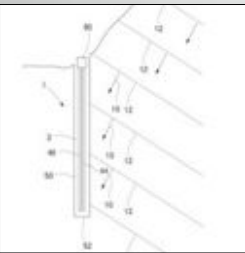
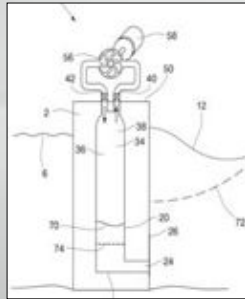
Source: Joubert (2008)

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Wave Energy Projects



Stellenbosch Wave Energy Converter (SWEC), ongoing research project. ShoreSWEC is a SWEC build into a breakwater.

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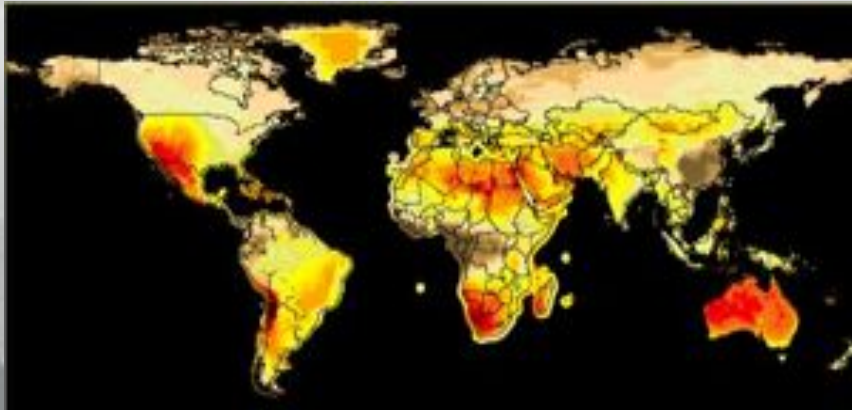
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Solar Energy Resources



Direct Normal Irradiance (DNI) solar resource worldwide



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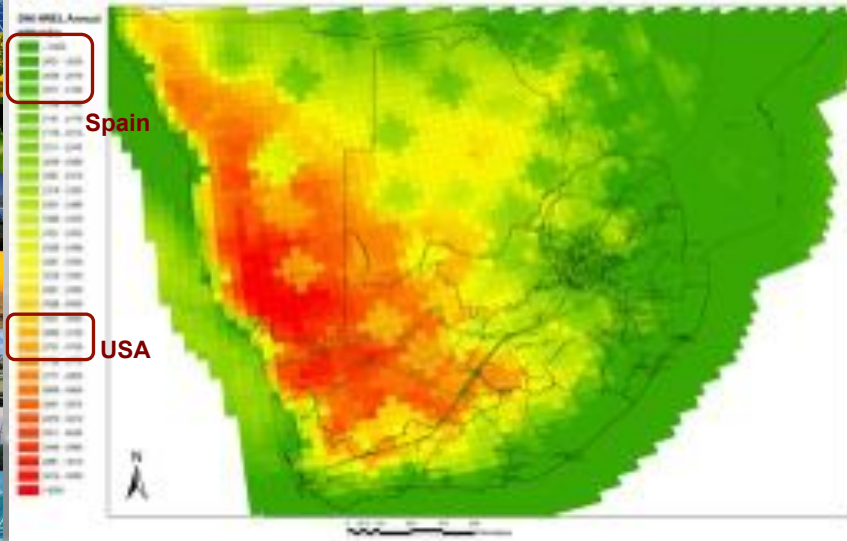
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Solar Energy Resources (2)

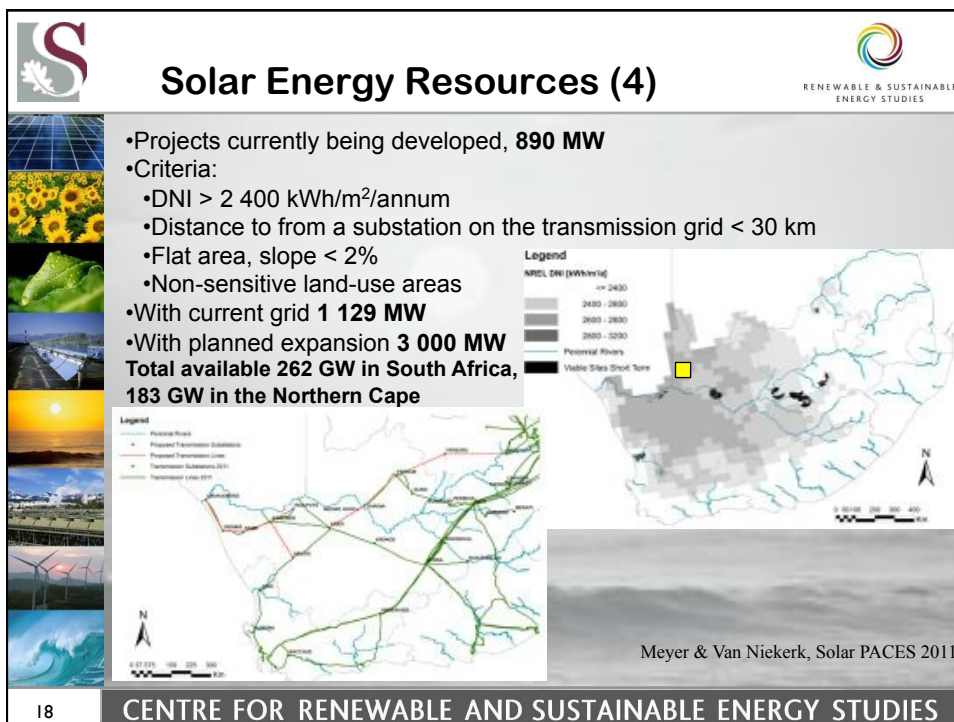
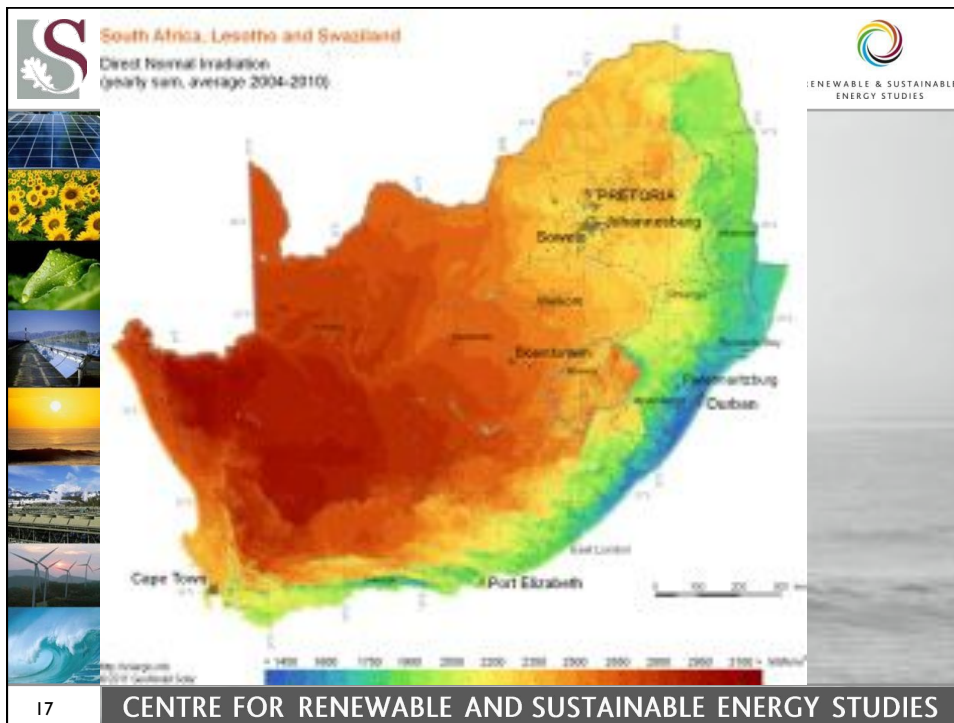


•South Africa DNI solar resource and Eskom transmission lines



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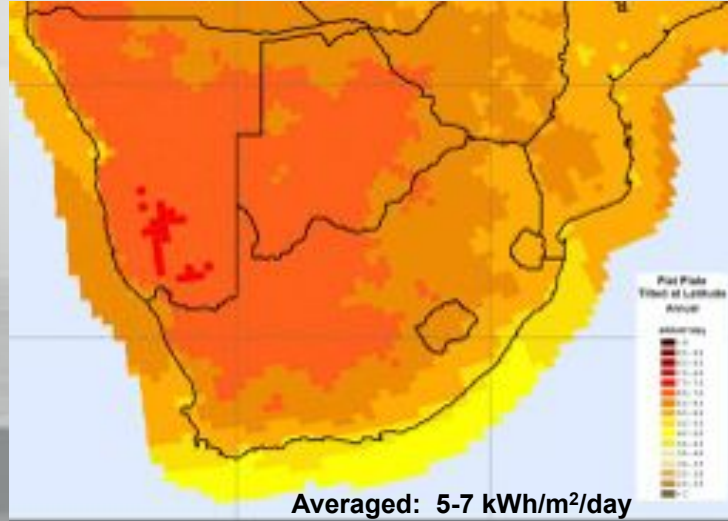




Solar Energy Resources (5)



Latitude Tilt Irradiance (LTI), used for stationary PV



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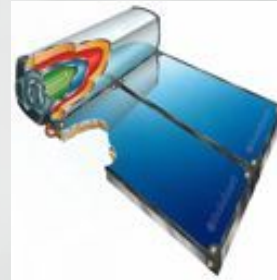


Conversion Technologies (1)



•Solar Thermal

- Solar Water Heaters
- Commercial Solar Water Heating & Cooling
- Easy implementable technology with guaranteed returns



•Solar Electricity

- Photovoltaic modules
- Concentrated Solar Power (CSP) plants
- Necessary for large scale solution to energy crises



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Conversion Technologies (2)



Parabolic Troughs



Linear Fresnel Reflectors



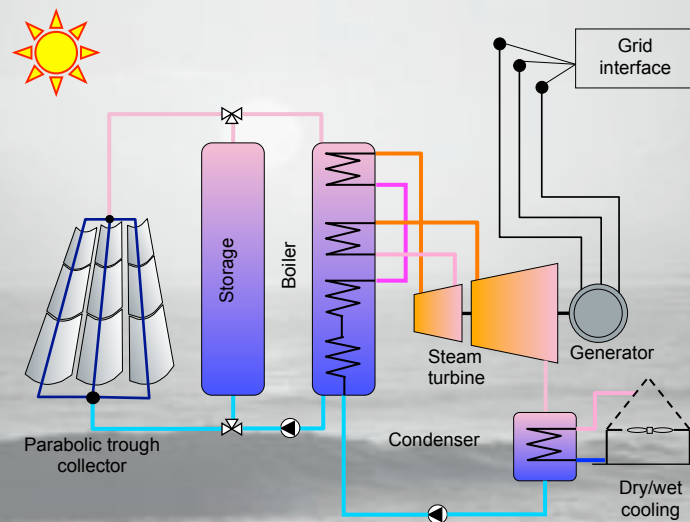
Central Receivers

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Conversion Technologies (3)



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CSP Projects in South Africa



Eskom, 100 MWe, CSP northwest of Upington

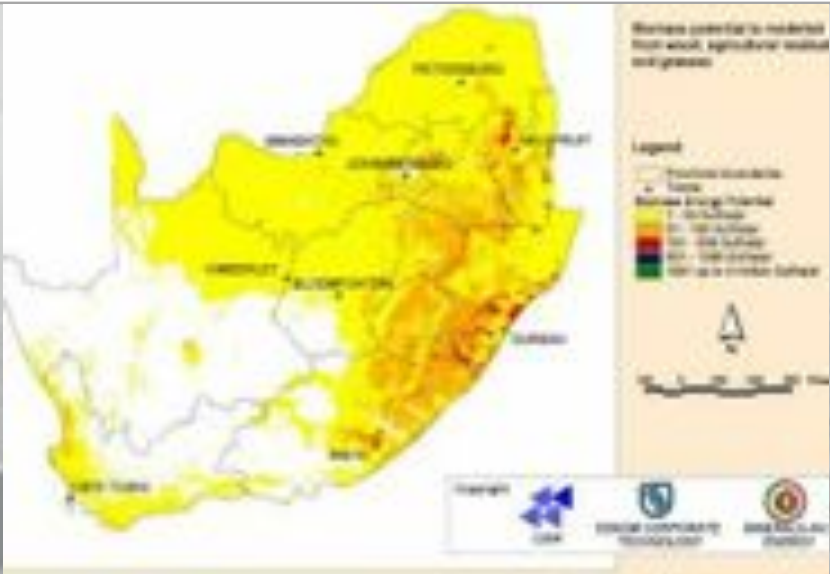
- Receiver – 540MW(t)
- Energy storage – 14 (now 3?) hours, Salt volume of 25,000 ton
- Plant capacity – 100MW(e), generating 24 hours over summer solstice
- Load factor – 68%
- Construction will take 3 years. Plant can be operational by 2016.
- World Bank funding secured for the project.

IPP Projects

- 100 MW, near Pofadder in the Northern Cape by KaXu (Though);
- 50 MW near Upington in Northern Cape, Khi Solar One (Central Receiver)
- 75 MW, near Groblershoop in the Northern Cape by Solafrica Thermal Energy;
- 100 MW, near Kathu in the Northern Cape by Renewable Energy Investments South Africa (REISA)
- 125 MW, near Upington in the Northern Cape by Ilangaethu Solar Power;
- 100 MW, near Kimberley in the Northern Cape by Afri-Devo;
- 30 MW, near Daniëlskuil in the Northern Cape by Afri-Devo; and
- 100 MW, near De Aar in the Northern Cape by African Clean Energy Developments, (ACED).



Bio-Energy





Hydro Energy



- Existing:
 - Hydroelectric power stations at Gariep (360 MW) and Vanderkloof (240 MW)
 - Caharo Bassa in Mozambique (2 000 MW)
 - Kunene river in Namibia/Angola
- Energy Storage:
 - Steenbras (180 MW), Palmiet (400 MW) and Drakensberg (1 000 MW)
 - New Ingula (1 333 MW) and Project Lima (on hold)
- Micro and Small Hydro:
 - Small installations, < 100 kW
 - Run-of-river systems
 - Small Hydro, e.g. Bethlehem Hydro, 7 MW
- Future:
 - Inga in the DRC, Grand Inga 40 GW (Eskom's current installed capacity)



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What can Renewable Energy contribute? (1)



- Clean Energy
- Quick Implementation
- Energy Security
- Jobs, jobs, jobs
- New Manufacturing Industry
- Electricity at lower cost?

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What can Renewable Energy contribute? (2)



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- **Clean Energy**

- SA energy sector is very carbon intensive
- Electricity from coal - 90%
- Large % (25?) of liquid fuel also from coal
- While we have access to abundant renewable energy resources

- **Quick Implementation**

- Wind farms can be built in 1-2 years
- Feasible to get wind farm project from idea to generation in less than four years
- PV probably faster
- CSP will take longer



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What can Renewable Energy contribute? (3)



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- **Energy Security**

- Diversity of resources assists with managing intermittency of renewable energy
- Internationally (and nationally?) imposed carbon taxes may increase the price of electricity and influence the competitiveness of our industry
- As renewable energy is distributed and also more prevalent in the southern and western parts of the country it should increase security of supply, at least here in the Western Cape

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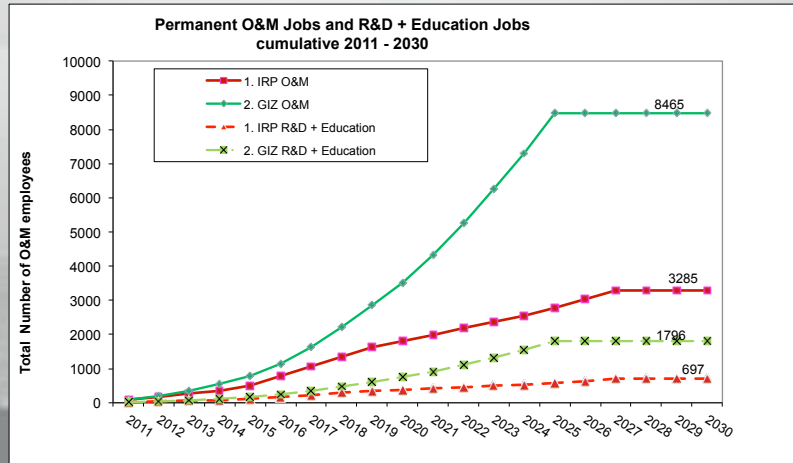
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What can Renewable Energy contribute? (4)



Jobs, Jobs, Jobs (E.g. Wind Energy)



SAWEC Study, GIZ, 2011

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What can Renewable Energy contribute? (6)



New jobs in Wind Energy, based on IRP 2010

Year	Engineers	Technicians	Skilled Worker	other	Total Staff Training
2011	52	102	112	97	364
2012	53	102	113	97	365
2013	94	169	192	156	611
2014	74	125	145	113	458
2015	173	280	331	248	1,031
2016	388	617	743	563	2,311
2017	418	651	790	586	2,445
2018	447	683	834	608	2,573
2019	497	742	914	650	2,803
2020	347	521	646	472	1,986
2021	409	598	746	529	2,282
2022	461	661	830	576	2,528
2023	533	750	948	643	2,873
2024	533	750	948	643	2,873
2025	756	1,048	1,332	886	4,023
2026	899	1,234	1,577	1,042	4,753
2027	972	1,334	1,705	1,127	5,138
2028	-	-	-	-	-
2029	-	-	-	-	-
2030	-	-	-	-	-
Average per year	418	610	759	532	

SAWEC Study, GIZ, 2011

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What can Renewable Energy contribute? (7)



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ENERGY STUDIES



• **New Manufacturing Industry**

- For Wind Energy: Towers, Blades, Power Electronics and perhaps Generators and Nacelles
- For PV Industry: Modules, Frames, Power Electronics, and in future Cells and Thin-Film Panels
- For CSP Industry: Heliostat Structures, Mirrors, some Receivers, Heat Exchangers, Pipes and Valves and perhaps Turbines and Generators

- All construction and other support services will be local stimulating manufacture as well

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Conclusions



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- South Africa has abundant renewable energy resources that can be tapped for clean energy and increase security of supply.
- South Africa has one of the best solar regimes in the world, of all the renewable energy resources it is by far the most abundant available in the country.
- Stimulating significant growth in the renewable energy sector will not only results in o&m jobs but also establish a manufacturing industry that will create even more jobs
- The manner in which the Government implements the current IRP and REIPPPP is very important to establish the credibility of SA's emerging renewable energy industry. Is it only lip-service to appease a critical world audience or is it a real commitment to clean energy?

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Conclusions



• What needs to be done?

- Current REIPPPP process should be completed with limited “issues.”
- Roll-out of the new RE IPPs should be efficient and according to plan (that is what private industry is good at.)
- IRP should be updated with the new costing information and RE targets increased, especially for CSP, to establish a RE manufacturing industry in SA.
- Local content requirements should be revisited.
- Allocations in REIPPPP should be increased, especially for CSP.
- Technology transfer and development should be continued, especially in those areas where SA has a competitive edge.
- Small scale RE should be allowed and encouraged, i.e. roof-top PV, net-metering by home-owners, etc.

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