REIPPPP focus on wind

Quarter 1 | 2015/16 (April – June 2015)

energy
Department:
Energy
REPUBLIC OF SOUTH AFRICA

national treasury
Department:
National Treasury
REPUBLIC OF SOUTH AFRICA

DBSA
Development Bank
of Southern Africa

Purpose and outline of this report

The purpose of this report is to provide a high level "at a glance" overview of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) with the focus on the contribution from wind power in particular.

The REIPPP Programme is located within the overall South African policy framework, notably the:

- Respective White Papers on Energy Policy (1998) and Renewable Energy (2003);
- The South African National Development Plan (NDP);
- The Integrated Energy Plan (IEP); and
- The Integrated Resource Plan (IRP) for Electricity;

RE capacity for the programme is pursued from the different RE technologies identified in the IRP 2010 including onshore wind, solar PV, solar CSP, biomass, biogas, landfill gas, and small hydro. By mid 2015 the REIPPPP had successfully implemented five bid windows from which it procured 6 327 MW from 92 independent power producers (IPPs). Of these, 34 are wind IPPs contributing 3 357 MW.

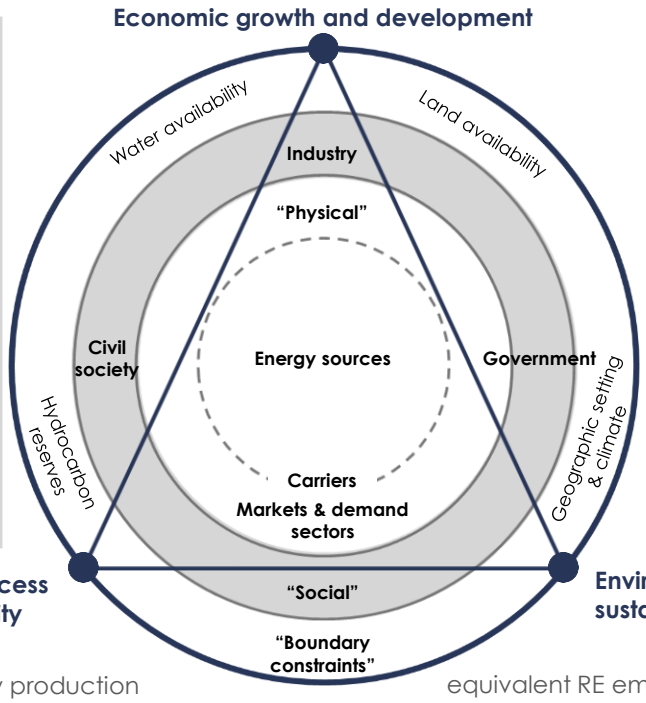
South Africa is perhaps best known for its solar resource, but the recently developed Wind Atlas has confirmed the country's exceptional wind resources. IPPs participating in the REIPPPP have been harvesting this clean energy resource very successfully, making a significant contribution to the country's energy needs, economic development and environmental sustainability in the process (refer the energy triangle for wind IPPs under the REIPPPP below).

This publication celebrates the contribution wind power has made and continues to make in South Africa's pursuit of a cleaner, cost effective electricity mix.

Key REIPPPP Energy Triangle[1] Facts: Wind Technology (for period 11/2013 – 06/2015)

4 294 GWh
REIPPPP[2] Actual energy contributed to National Grid

of which
1 991 GWh
Wind
(46%) contributed to the National Grid



ENERGY (P50)

Energy access and security

15%
of the Renewable Energy production from wind has been available[3] during peak hours (as per Megaflex tariff)

Environmental sustainability

4.4 Mtons CO_2
equivalent RE emissions reduction achieved relative to Eskom generated power
(2 Mtons CO_2 in Wind)

Note 1. Source: World Economic Forum – Global Energy Architecture Performance Index Report (2013). **Note 2.** Energy production (as per contracts) with a 50% probability (P50) of being achieved (refer to explanatory notes at end of this report). This figure includes energy produced by two projects in early operation. **Note 3.** 15% since first operational wind IPP.

Renewable energy procurement approach and portfolio status (as at 30 June 2015)

The development of new generation capacity is steered by South African planning and electricity policy frameworks and given effect by Ministerial determinations. The process of Ministerial determinations provides suitable process flexibility to allow adjustments to accommodate power system requirements and technology developments and price trends. Within the scope of determined capacity, each IPPPP bid round is initiated with a DoE procurement instruction detailing a capacity allocation (or cap) and targeted technology mix.

The South African government favoured a competitive tender approach that has proven to be exceptionally successful for attracting substantial private sector expertise and investment into grid-connected renewable energy at competitive prices.

Tenders are structured as a rolling bid-window programme that not only allows for continued market interest, but also for increased competitive pressure among bidders to participate and offer reduced pricing.

Bid rounds have been implemented on an annual cycle. The progress of the current RE portfolio through these key milestones in the procurement process, are reflected with milestone dates in the table below.

Since August 2011, five procurement bid windows have been completed under the REIPPPP i.e. bid windows 1, 2, 3, 3.5 and 4 (with bid window 3.5 focused exclusively on procuring concentrated solar power (CSP).

Preferred bidders for bid window 4, the most recent bid round, were announced in April 2015 with a further selection of preferred bidders from the same bid round announced in June 2015.

Carrier (Capacity determined)	Master planning	Project preparation	RFP	Bid submission	Bid announce-ment	Financial close	COD
Renewable energy (6 925 MW plus new determination of additional 6 300 MW in process)							
Bid window 1 (1 425 MW)	**IRP**	**completed**	**3 Aug 2011**	**4 Nov 2011**	**6 Dec 2011**	**5 Nov 2012**	93% COD 96% GC[1]
Bid window 2 (1 040 MW)	**IRP**	**completed**	**3 Aug 2011**	**5 Mar 2012**	**21 May 2012**	**9 May 2013**	58% COD 74% GC[1]
Bid window 3 (1 456 MW)	**IRP**	**completed**	**3 May 2013**	**19 Aug 2013**	**29 Oct 2013**	Q2 2015/16[2]	End 2016
Bid window 3.5 (200 MW CSP)	**IRP**	**completed**	**-**	**31 Mar 2014**	**15 Dec 2014**	Q2 2015/16	Mid 2018
Bid window 4 (1 121 MW)	**IRP**	**completed**	**26 May 2014**	**18 Aug 2014**	**16 Apr 2015**	Q3 2015/16	Mid 2017
Bid window Additional (1 084 MW)	**IRP**	**completed**	**26 May 2014**	**18 Aug 2014**	**7 Jun 2015**	Q4 2016/17	End 2017
Bid window Expedited (1 800 MW)	**IRP**	**completed**	**25 Jun 2015**	1 Oct 2015	Q4 2015/16	Q2 2016/17	End 2017
Bid window 5	**IRP**	**ongoing**	Q4 2015/16	Q1 2016/17	Q2 2016/17	Q4 2016/17	End 2018
Small renewables (50 MW of 200 MW)	**IRP**	**completed**	Q3 2015/16	Q3 2015/16	Q4 2015/16	Q2 2016/17	End 2017

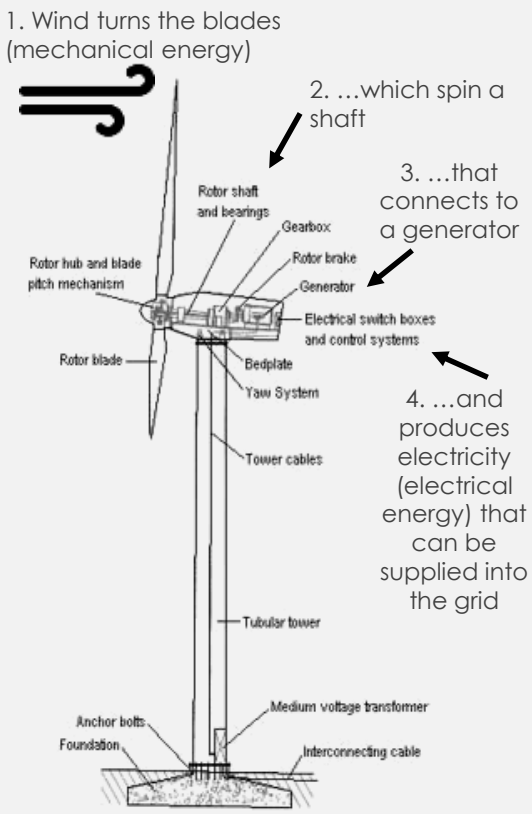
Where COD – Commercial Operation Date, FC – Financial Close; RFP – Request for Proposals; IRP – Integrated Resource Plan (*Green areas indicate milestones completed with completion dates shown. Grey areas indicate planned milestone dates.)

Note 1. GC – Grid connected. **Note 2.** 15 of the 17 projects have signed on 11 December 2014 and 1 signed in August 2015. One IPPs still needs to sign to finalise financial close.

Wind technology basics

A wind turbine is a rotary device that extracts energy from the wind. The wind turns the blades (mechanical energy), which spin a shaft that connects to a generator and produces electricity (electrical energy). The mechanical energy can be used directly by machinery or the energy can be converted to electricity.

Many wind turbines built together is called a wind farm.



Wind resource potential in South Africa

Wind power was anticipated by both the IRP and independent researchers as the technology most likely to contribute significantly to the South African energy mix because of technology maturity and established global capacity. South Africa furthermore offers exceptional wind resource potential throughout most of the country, but particularly along our extended 3,000km coastline.

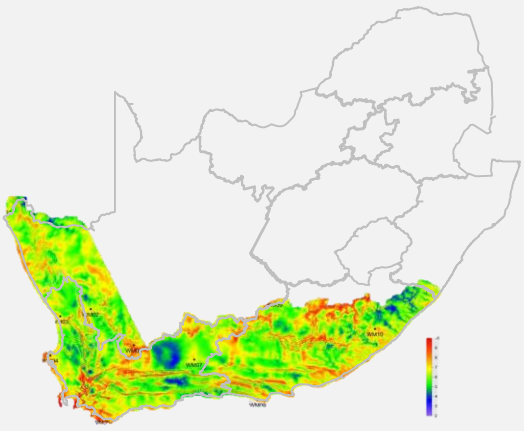
The country's wind resource has been comprehensively mapped in a **publicly available Wind Atlas** to support planning and wind power development.

The first phase of the project (focusing on coastal regions) was initiated in June 2009 and concluded in April 2014, delivering a large-scale, high-resolution, measurement-based, verified numerical Wind Atlas for South Africa that is publicly available, free of charge, for planning and development of wind farms and off-grid electrification. The level of accuracy and granularity of the data has proven invaluable for wind power development, confirming that traditional climatology and global models underestimated resource potential in the country by as much as 5%.

Pretoria is South Africa's least windy city, with the lowest recorded wind speeds.

The next phase will focus on expanding the Wind Atlas to incorporate the rest of the country. Through WASA 2, an additional five wind measurements masts are being installed, with operation to commence by October 2015.

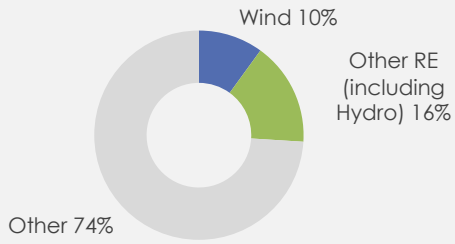
Wind Atlas of South Africa (WASA), Large Scale High Resolution Wind Resource map



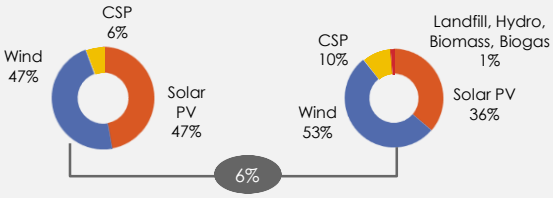
Mean wind speed (ms-1) @ 100m WAsP modelled, 250 m resolution

www
wasaproject.info or
wasa.csir.co.za

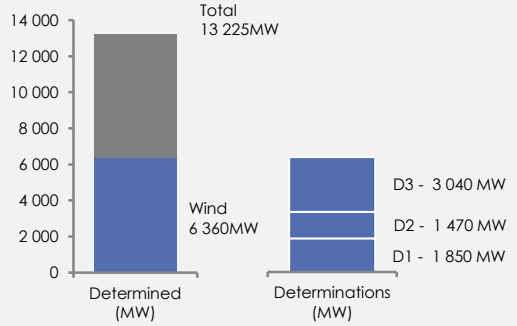
IRP 2010, 2030 electricity mix
Technology capacity share (%)



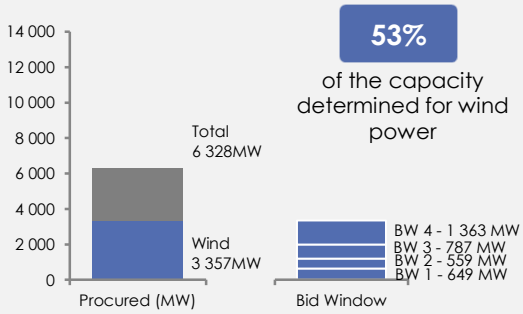
Technology capacity share
Planned versus procured (%)



Capacity determined
Wind as share of total determined



Capacity procured
Wind as share of total determined



53%
of the capacity determined for wind power

Wind power in South Africa's electricity plan to 2030

In terms of South Africa's Integrated Resource Plan, wind power is expected to contribute 10% towards the country's power capacity by 2030. This will require 9 200MW wind power to be constructed between 2010 and 2030.

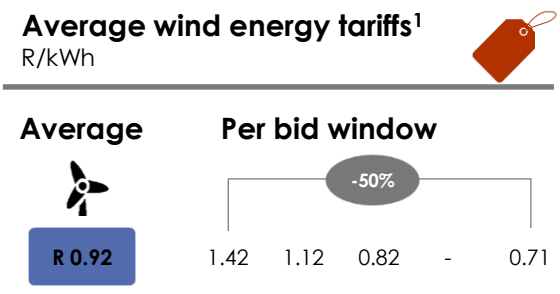
By August 2015, the Minister of Energy had determined 6 360MW of wind power to be procured from Independent Power Producers, targeting full operation by 2025. The determinations have thereby already given effect to 69% of the capacity planned for 2030,

Wind power has taken a slightly larger share of the planned procured RE portfolio than expected. Currently, wind represents 53% of the RE technology mix, i.e. exceeding plans by 6%. Technology price developments and steep downward price trends contributed to make wind ever more competitive. The slight divergence from the IRP 2010 is informed by technology, price and system requirements and follows from the three ministerial determinations in 2010, 2011 and 2015.

Offering an increasingly cost competitive energy alternative

In line with international experience, the price of renewable energy is increasingly cost competitive with conventional power sources. The REIPPPP has effectively captured this global downward trend with prices decreasing in every bid window (BW). Energy procured by the REIPPPP is progressively more cost effective and rapidly approaching a point where the wholesale pricing for new coal- and renewable-generated energy intersects.

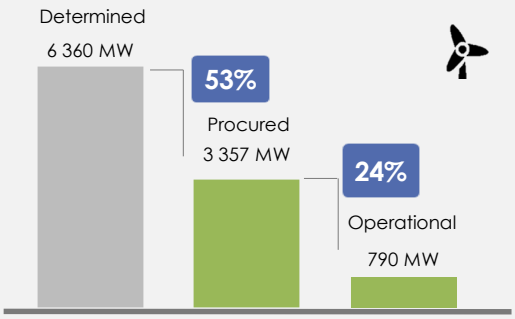
Average wind energy tariffs[1]
R/kWh



The price for wind power has dropped by 50% to R0.71/kWh, with the BW4 price directly comparable with the per kWh price of new coal generation.

Note 1. Fully indexed price, inflation adjusted (2015).

Procured vs determined
Capacity Per technology (MW)



3 357 Megawatts from **34** IPP projects

3.6 million households

Carbon emission reductions
Projected using P50 (Mton CO_2)

Projected (P50)

12.0
Mton CO_2 / annum

Wind contribution to total

Carbon emission reductions ITD

4.4
Mton CO_2

of which

2 Mtons CO_2
from wind power

Wind power procured

By mid 2015, 3 357MW of wind power had successfully been procured under South Africa's REIPPPP. Effectively therefore, 53% of the capacity determined by the Minster for wind power have already been procured.

The South African portfolio includes some of the largest wind power plants in the world, with the average project size for the 34 wind IPPs being 98.74MW. The collective wind capacity will deliver an annual projected energy output of 11 796GWh. This is enough to power 3.6 million households[1] annually

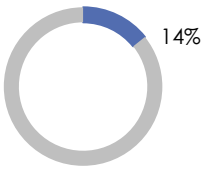
By mid 2015, 10 wind IPPs had started commercial operation, contributing 790MW capacity to the national power system. This is equivalent in terms of installed capacity to the first unit from Medupi that was commissioned in August 2015 (794MW).

Contributing to cleaner energy

The power generated by renewable energy sources contribute to the country objectives for a cleaner energy mix. The total 92 IPP projects that have already been procured are expected to reduce the CO_2 emissions annually by 19.6 Mtons (using P50 figures). Of this, the 34 wind IPPs are projected to contribute 12.0 Mtons CO_2 (60%).

Since the first REIPP started commercial operation at the end of 2013, 4.3GWh have been generated reducing carbon emissions by 4.4 Mtons. Towards this total emission reductions, wind contributed 2 Mtons CO_2.

Realised (12 month period)



1.7 Mton CO_2

Over the past 12 month period alone (ending June 2015) the operational wind projects have reduced CO_2 emissions by 1.7 Mtons (already 14% of the total annual P50 projection for wind IPPs).

Note 1. Based on an annual usage for an average South African home of 3 319 kWh

Committed investments

Bid window 1, 2, 3,3.5 & 4(Rand billion)

192.6

Rand billion

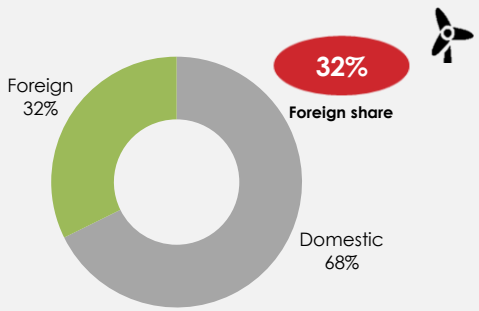
Committed (**total project costs[1]**) for IPP development in BW 1, 2, 3, 3.5 & 4

of which

R73.4 billion from wind power

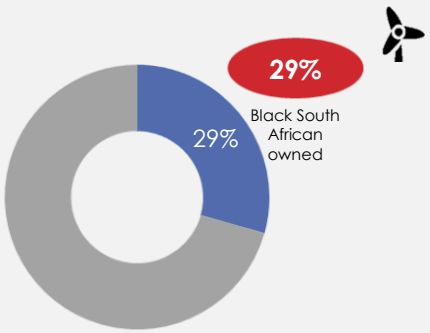
Foreign equity and financing share

Bid window 1, 2, 3, 3.5 & 4 (percentage)



Shareholding by black South Africans

Bid window 1,2 & 3[4]



Investment attracted for wind power

Wind IPPs have attracted significant investment in the development of the REIPPs into the country. The total investment (total project costs[1]), of all projects under construction and projects in the process of closure (BW3, 4, BW3.5 and BW4) is R192.6 billion of which R73.4 billion is for onshore wind IPPs.

The expected project value[2] for these wind IPPs is R57.4 billion and at end September 2015, R14.0 billion had actually been spent.

Wind IPPs have attracted R23.7billion in foreign investment and financing in the five bid windows (BW1 – BW4). Foreign equity in wind IPPs (BW1 – BW4) is R17billion, equivalent to 28% of the inward FDI attracted into South Africa during 2014 (R62 billion)[2]. Whilst retaining shareholding for South Africans is a priority, the associated influx of foreign investment and funding is also of significance to the economy. The NDP (Outcome 11) set a target of a R230 billion increase in FDI (facilitated by the dti) by 2019.

Equitable shareholding in wind IPPs

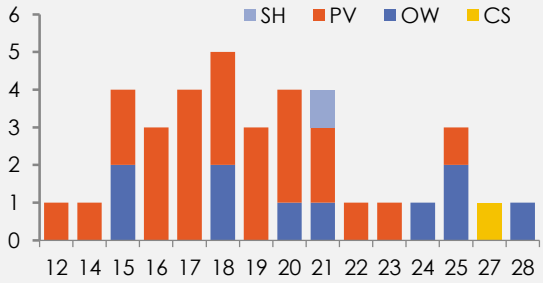
South African (local) equity shareholding across BW1 to BW4 equates to 43% (R13.2 billion) of total equity (R30.5 billion). Black South Africans own, on average, a 29% share of wind projects that have reached financial close[3]. Shareholding by black South Africans has been secured across the value chain.

Black people in local communities also hold ownership in the IPP projects operating in or nearby their vicinities. On average, black local communities own 12% of IPPs at financial close.

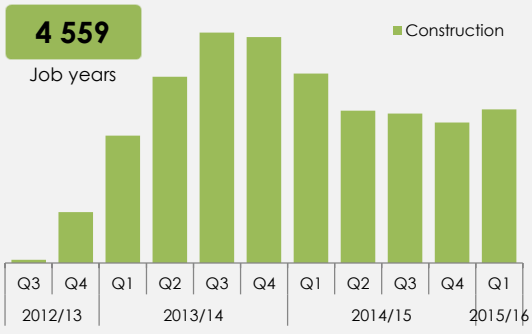
Note 1. Total Project Costs : Total capital expenditure to be incurred up to the COD by the Seller in the design, construction, development, installation and/or commissioning of the project (inclusive of VAT and revenue). **Note 2**. Project Value : capital costs and costs of services procured for the construction of the Facility only. **Note 3.** South African Reserve Bank (SARB). 2015. Quarterly Bulletin March 2015:45. Pretoria: SARB. **Note 4.** Projects in BW1 – BW3[1], since projects in BW3[1], BW3.5 and BW4 have not reached financial close yet.

REIPPPP operational capacity
Capacity (MW)

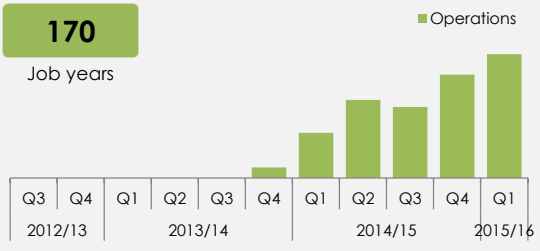
Distribution of lead times
Construction (in months) for completed projects



Employment opportunities
Actual (Job years) (BW 1,2 & 3)



Operations employment
Actual (Job years) (BW 1,2 & 3)



Wind power delivering capacity quickly

By the end of Q1 2015/16, 11 IPPs with a capacity of 935MW were scheduled to have reached commercial operations. Actual achievement has been 10 projects delivering 790 MW (85% of the scheduled plan and a shortfall of 145MW[1]).

790 Megawatts from **10** IPP projects

A few of the wind IPPs that have started operation have done so below the contracted capacity. As a result there is a 9 MW (1%) shortfall between contracted and delivered capacity for operational projects at the end of June 2015.

Average lead time for the 10 projects to reach commercial operation was 640 days (1.8 years). Lead times across the portfolio varied from 15 to 28 months.

Employment creation

During the construction of REIPPs, numerous employment opportunities are being created. The construction of the portfolio of RE projects in the first three bid windows delivered 18 195 job years[2] of which 4 559 of these employment opportunities were for the construction of wind IPPs.

It is projected that the construction phase for all wind IPP (BW 1 – 4) will create 11 354 job year opportunities. With BW3 projects only just starting construction, there are 24 projects in the construction phase and employing people. The number of employment opportunities can reasonably be expected to grow to meet and, possibly, exceed original expectations.

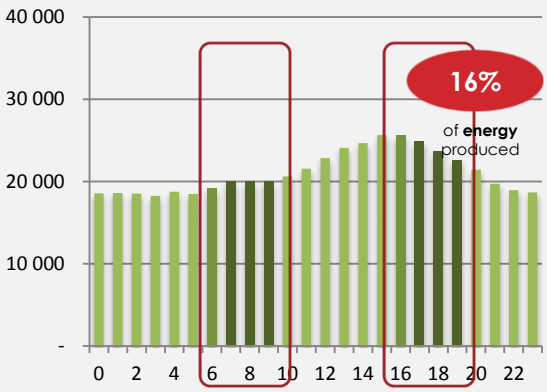
While construction jobs are demobilized when construction is complete, employment for commercial operations are fewer, but more sustainable.

The 10 wind IPPs that have successfully reached commercial operations to date have reported 170 job years. Over the operational life of the full wind portfolio (BW 1 – 4), 32 041 job years are expected to be created.

Note 1. One project experiencing construction delays and challenges related to grid compliance. **Note 2.** The equivalent of a full time employment opportunity for one person for one year.

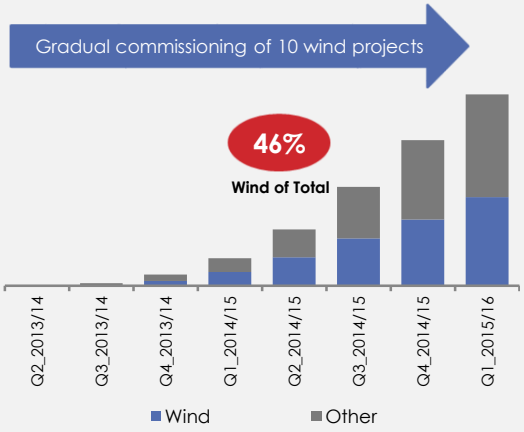
Hourly energy profile

Q1_2015/16 energy generated (GWh)[4]



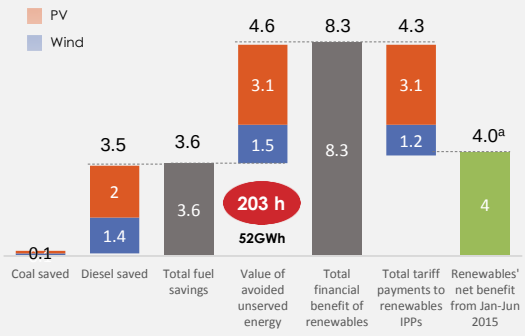
REIPPPP energy generation

Energy ITD (GWh)



Economic benefit of RE

CSIR Energy Centre analysis (R billion)



Note a. Using a COUE @ R90/kWh as per Integrated Resource Plan (IRP) in Apr-2015-Rand

Wind power contribution to the national power system

Wind and solar PV power plants have been the first power plants from the RE portfolio to start operations, steadily contributing additional capacity to the power system with each new successfully commissioned plant.

During the preceding 12 month period the 10 completed wind IPPs generated 1 682GWh of energy.

A 24 hour profile representing the energy produced by the portfolio of operational wind IPPs **during this quarter**, shows that wind contributed 16%[2] during the morning and evening system **peak periods**[3].

Contributing to system needs

Results of a CSIR Energy Centre study[1] for Jan – Jun 2015, assessed the contribution from RE technologies to the power system over the 6 month period. This independent study confirmed that wind power contributed around half of all RE produced during the period. It also found that, on average, peak production from wind generation coincided with the evening consumption peaks, reducing the need for costlier alternatives to provide for peak demand.

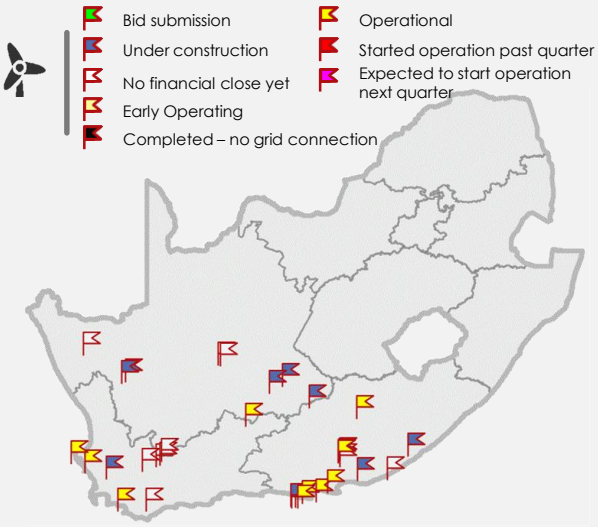
The analysis showed that RE prevented/ enabled a lower stage of load shedding for 15 days during the period. The study furthermore determined that the 2TWh generated from solar PV and wind facilities during the first six months of 2015, had contributed a net benefit for the economy of up to R4 billion. This financial benefit was calculated with consideration of:

- Fuel savings when displacing coal- and diesel-powered alternatives (points A and B).
- The economic benefit of avoiding unserved energy during severe shortfalls, i.e. where power cuts would have resulted if the RE had not been available. (point C); and
- Tariff payments made to IPPs.

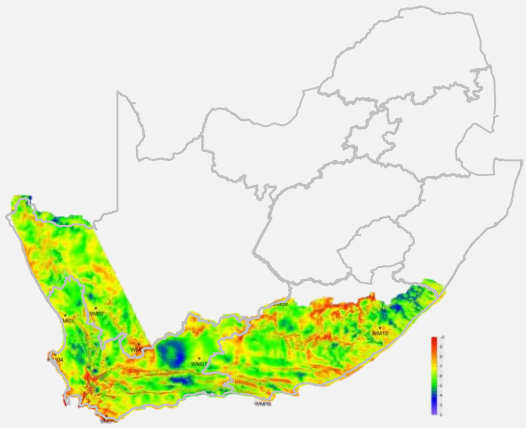
If the contribution from wind is allocated on a pro rata basis, the net benefit to the economy would be R1.1 billion in the last six months.

Note 1. CSIR, August 2015. Financial benefits of renewables in South Africa in 2015. Graphic source: http://all-free-download.com/free-vector/download/idea_concept_with_light_bulb_and_cogwheels_6815228_download.html. **Note 2.** Contribution during peak hours has increased as the wind portfolio has grown (refer 15% average since first IPP reported on page 1). **Note 3.** As defined by the Eskom Megaflex tariff. **Note 4.** For reporting quarter only.

Geographic distribution

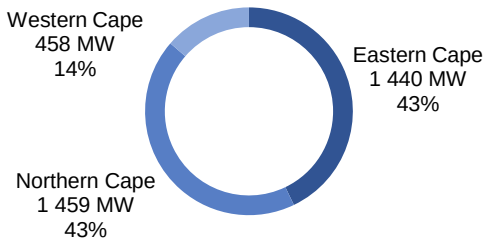


Wind Atlas of South Africa (WASA), Large Scale High Resolution Wind Resource map

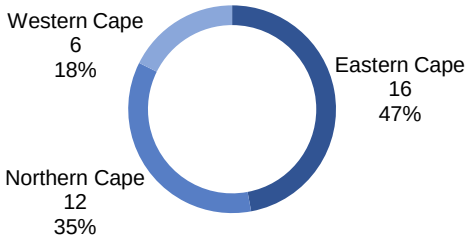


Wind IPPs are largely located along the coastal regions of the Eastern Cape and Western Cape provinces based on the strong wind flows along these shores. Surprisingly, a large share of wind IPPs are located in the Northern Cape. Northern Cape and Eastern Cape together make up 86% of the capacity with 1459MW and 1 440MW located respectively in each province. Eastern Cape has the highest number of wind projects at 16, with the Northern Cape 12 and the Western Cape 6.

Share of wind capacity
Provincial distribution of capacity (MW)



Share of wind projects
Provincial distribution of projects (#)



Province	Provincial totals		Technology share OW	Technology share Other RE
Eastern Cape	Number of projects	**17**	16	1
	Capacity procured (MW)[1]	**1 509**	1 440	70
	Capacity online[2]	**603**	533	70
Northern Cape	Number of projects	**48**	12	36
	Capacity procured (MW)[1]	**3 566**	1 459	2 107
	Capacity online[2]	**835**	74	761
Western Cape	Number of projects	**11**	6	5
	Capacity procured (MW)[1]	**592**	458	134
	Capacity online[2]	**237**	183	54
Other Provinces	Number of projects	**16**	-	16
	Capacity procured (MW)[1]	**660**	-	660
	Capacity online[2]	**186**	-	186

Note 1. Only 15 of 17 BW 3 projects have reached financial close (2 have not yet signed), BW3.5 and BW4 projects have not yet signed.
Note 2. Excluding projects in early operations.
OW – Onshore Wind, Other includes PV – Photovoltaic, BM – Biomass, LG – Landfill Gas, SH – Small Hydro, CS – Concentrated Solar

Glossary of icons

These icons are used in the document to represent the following concepts:

ENERGY (P50)

Energy (kWh, MWh or GWh) production / generation projected with a 50% probability that it will be achievable for the established capacity

CAPACITY

Generation capacity (kW, MW or GW) i.e. the rated output capability of the power plants

Investment

Job creation

Renewable energy source | technology type:

SOLAR

Solar CSP (Concentrated Solar Power)

Solar PV (photovoltaic)

WIND

Wind generation

HYDRO

Small hydro

BIO

Biomass

WASTE

Landfill gas / waste to energy

Colour convention used [RGB]

Colours used to denote technologies

Solar PV [**220** | **89** | **36**]

CSP [**245** | **149** | **1**]

Wind [**82** | **109** | **176**]

Landfill, hydro, biomass, biogas (when treated as a group e.g. IRP) [**209** | **40** | **46**]

Hydro [**151** | **167** | **208**]

Landfill [**152** | **154** | **172**]

Biogas [**180** | **179** | **146**]

Biomass [**155** | **187** | **89**]

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