REIPPPP focus on wind

As at 30 June 2019

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 Producers Procurement Programme (REIPPPP) with the focus on the contribution from wind power in particular.

The REIPPPP is located within the overall South African policy framework and notably in the:

- Respective White Papers on Energy Policy (1998) and Renewable Energy (2003);
- The Electricity Regulation Act (2006) and National Environmental Management Act (1998);
- The South African National Development Plan (NDP);
- The Integrated Energy Plan (IEP); and
- The Integrated Resource Plan (IRP) 2010 for Electricity.

Renewable Energy (RE) capacity for the programme is pursued from the different RE technologies identified in the IRP 2010, including onshore wind, solar photovoltaic (PV), concentrating solar power (CSP), biomass, biogas, landfill gas and small hydroelectric power plants. By the end of June 2019, the REIPPPP had successfully implemented seven bid windows[4] from which it procured 6 422 megawatt (MW) from 112 independent power producers (IPPs). Of these, 36 are wind IPPs contributing 3 366 MW[5].

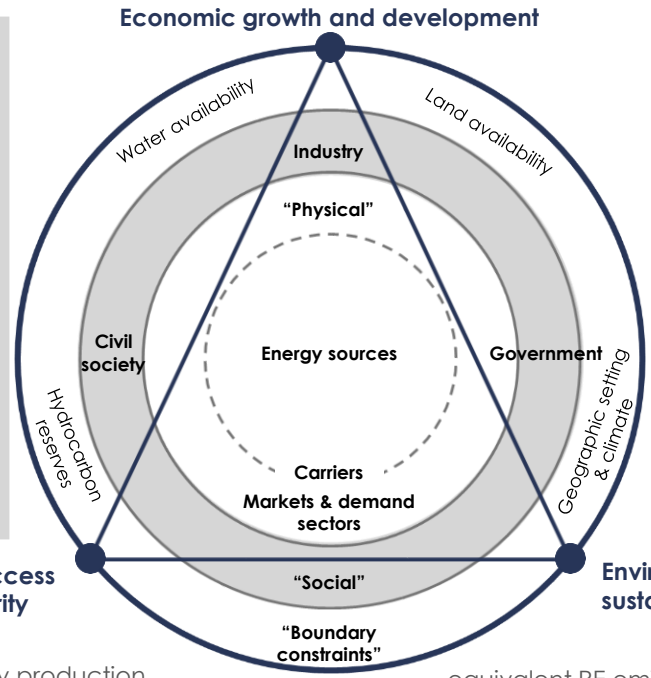
South Africa is perhaps best known for its solar resource, but the recently developed Wind Atlas has also confirmed the country's exceptional wind resources. IPPs participating in the REIPPPP have been harvesting this clean energy resource very successfully, making a significant contribution to the country's 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 – 06/2019)

38 184 GWh[2]
REIPPPP[2] Actual energy contributed to National Grid

of which
20 584 GWh[2]
Wind
(54%) contributed to the National Grid



R 80 billion
REIPPPP Total payment to all IPPs

of which
R 27.6 billion
Wind
(35%) total payments to IPP's

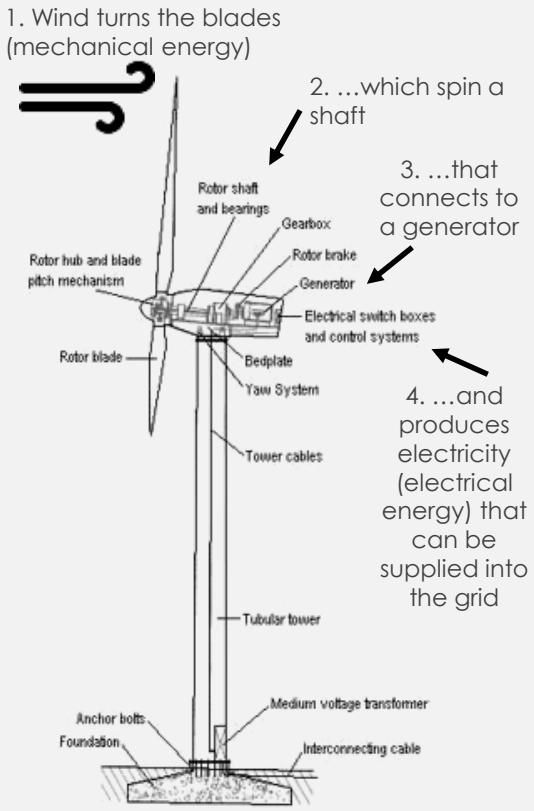
15%
of the Renewable Energy production from wind has been available[3] during peak hours (as per Megaflex tariff)

38.8 Mtons CO_2
equivalent RE emissions reduction achieved relative to Eskom generated power (20.9 Mtons CO_2 from wind projects)

Note 1. Source: World Economic Forum – Global Energy Architecture Performance Index Report (2013). **Note 2.** Actual energy supplied to the grid. Energy (and carbon emissions) figures understated. Latest quarterly figures not received from some IPPs. **Note 3.** 15% since first operational wind IPP. Percentage figure correct as at end June 2016 as updated figures not available. **Note 4.** BW1, BW2, BW3, BW3.5, BW4 and smalls BW1 (1S2) and BW2 (2S2). **Note 5.** Includes 2 smalls projects with a capacity of 9 MW.

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.



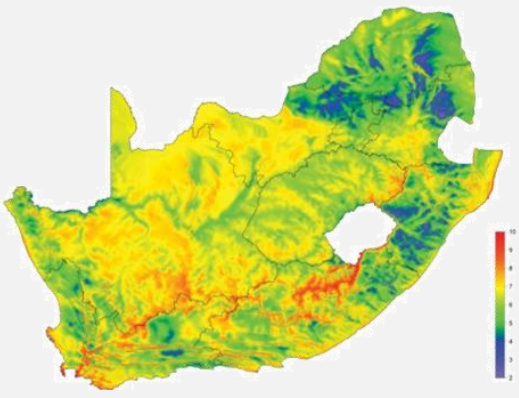
Wind resource potential in South Africa

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 3 000 km coastline.

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

Wind Atlas of South Africa (WASA), large scale high resolution wind resource map

The first phase of the project (focusing on Western Cape, parts of the Eastern Cape and Northern Cape Provinces) 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 have proven invaluable for wind power development, confirming that traditional climatology and global models underestimated resource potential in the country by as much as 5%.



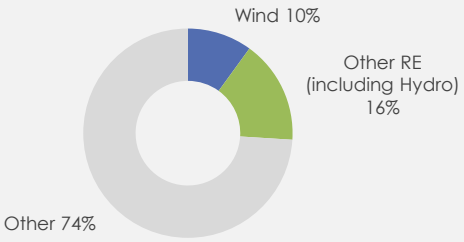
Mean wind speed (ms-1) @ 100m WAsP modelled, 250 m resolution

During the second phase, WASA 2, five additional wind measurement stations were installed in the remaining parts of the Eastern Cape, and was extended to include Kwazulu Natal and the Free State Provinces. WASA 2 commenced in March 2013 and concluded in 2018.

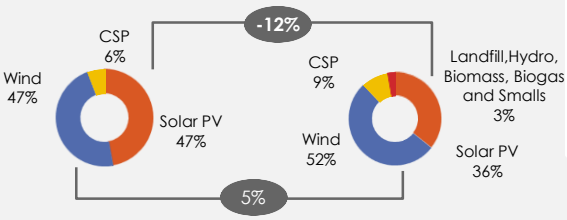
Four (4) additional measurement stations were erected in beginning of September 2018 in the Northern Cape Province under WASA 3. The measurements results of WASA 1-3, which cover an estimated 75% of South Africa's land cover will be used to extrapolate the prevailing wind conditions for the rest of South Africa.

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

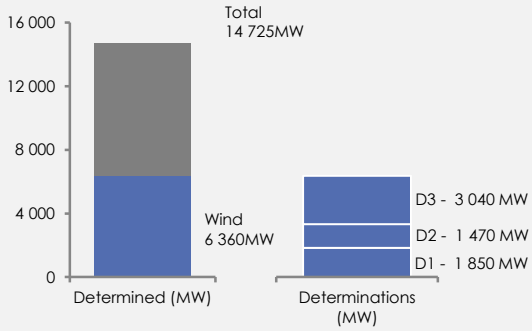
IRP 2010, 2030 electricity mix
Technology capacity share (%)



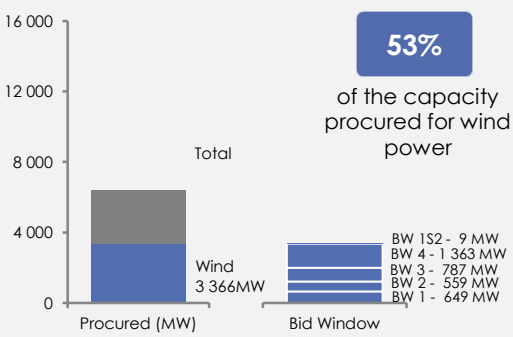
Technology capacity share
Planned versus procured (%)



Capacity determined[3]
Wind as share of total determined



Capacity procured[4]
Wind as share of total procured



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 9 200 MW[5] wind power to be constructed between 2010 and 2030.

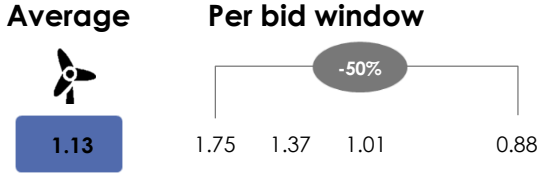
The Minister of Energy has to date determined 6 360 MW of wind power to be procured from Independent Power Producers, targeting full operation by 2025. The determinations have thereby already given effect to 69% of the capacity planned for 2030.

Wind power has taken a slightly larger share of the planned procured RE portfolio than expected. Currently, wind represents 52%[2] of the RE technology mix, i.e. exceeding plans by 5%. Technology price developments and steep downward price trends contributed to make wind even more competitive. The slight divergence from the IRP 2010 is informed by technology, price and system requirements and follows from the four ministerial determinations made to date.

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 electrical energy intersects.

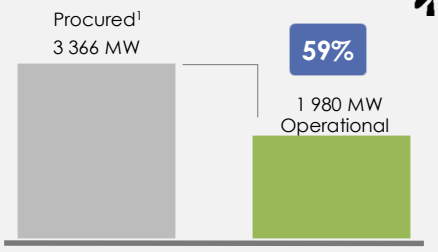
Average wind energy tariffs[1]
R/kWh



The price for wind power has dropped by 50% to R0.88/kWh (in April 2019 terms), with the BW4 price directly comparable with the per kWh price of new coal-based electrical generation.

Note 1. Fully indexed price, inflation adjusted (2019). **Note 2.** Numbers rounded. **Note 3.** Determined wind capacity excludes contribution from smalls projects . **Note 4.** Procured capacity includes contribution from smalls projects – 2 projects with a capacity of 9MW. **Note 5.** Includes 8 400 MW new build, 700 MW committed build and 100 MW from Eskom's Sere wind farm.

Procured[1] vs operational
Wind capacity (MW)



3 366 Megawatts from **36** IPP projects

3.6 million households

Wind power procured

By the end of June 2019, 3 366 MW[1] of wind power had successfully been procured under South Africa's REIPPPP.

The South African portfolio includes some of the largest wind power plants in the world, with the average project size for the 36 wind IPPs being 93.5 MW. The collective wind capacity will deliver an annual projected energy output of 11 886 GWh[3]. This is enough to power 3.6 million households[2] annually.

By the end of June 2019, 22 wind IPPs had started commercial operation, contributing 1 980 MW capacity to the national power system.

Contributing to cleaner energy

The power generated by renewable energy sources contributes to the national objectives for a cleaner energy mix. The 112 IPP projects that have already been procured are expected to reduce the CO_2 emissions annually by 20.5 Mtons (using P50[3] figures). Of this, the 36 wind IPPs are projected to contribute a reduction of 12.1 Mtons CO_2 (59%).

Carbon emission reductions
Projected using P50 (Mton CO_2)

Projected (P50)

12.1
Mton CO_2 / annum

Wind contribution to total

Over the past 12 month period alone (ending June 2019) the operational wind projects have reduced CO_2 emissions by 6.4 Mtons (already 53% of the total 12.1 Mtons annual P50 projection for wind IPPs).

Realised (12 month period)

6.4 Mtons CO_2

Carbon emission reductions ITD

38.8
Mton CO_2

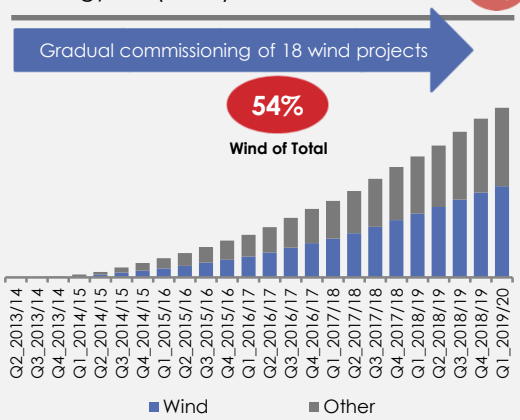
of which
20.9 Mtons CO_2
from wind power

Since the first REIPP started commercial operation at the end of 2013, 38 184 GWh have been generated, reducing carbon emissions by 38.8 Mtons. Of this, wind projects have contributed 20 584 GWh and reduced carbon emissions by 20.9 Mtons.

Note 1. Procured capacity includes 9 MW procured by smalls projects in smalls BW1 (1S2). **Note 2.** Based on an annual usage for an average South African home of 3 319 kWh. **Note 3.** Projected annual energy contribution – P50 refers to probabilities for annual energy production which are expressed as P values. A P50 figure is the level of generation that is forecasted to be exceeded in 50% of years over a 10 year (or sometimes 20 year) period.

REIPPPP energy generation

Energy ITD (GWh)



Energy Generation ITD

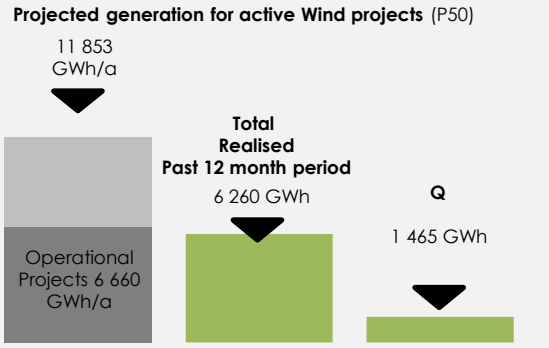
38 184 GWh

of which

20 584 GWh from wind power

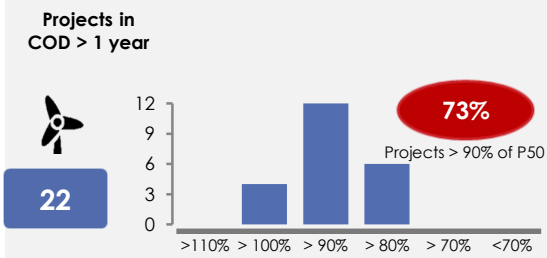
Energy supplied to the grid

Energy generated (GWh)[3]



Achievement of P50[1] projections

No. of projects



Energy supplied

The first REIPP reached COD, supplying power to the grid, in November 2013. Since inception[1], 38 184 GWh of energy has been generated by renewable energy sources from the 64 projects that are operational.

Wind power is contributing 20 584 GWh – more than half of all renewable energy produced to date[2]. Of this energy, 1 465 GWh[3] was generated during this reporting quarter (April to June 2019).

The energy generated over the last 12 months (June 2018 to June 2019), from limited operations by the 22 projects that have reached COD, was 6 260 GWh[3].

This 6 260 GWh[3] represents 94%[4] of the annual projected energy production by all the operational Wind IPPs (P50[1] for the 22 operational IPPs is 6 660 GWh). All these 22 projects have been operational for more than 1 year.

Individually, four (4) of these 22 wind projects (18%) have exceeded their P50[5] projections, while 73% of the IPPs achieved greater than 90% of their P50[5] projections. Six (6) projects fall short of achieving greater than 90% of their P50[5] projections.

Note 1. Total renewable energy generated by IPPs since the first project became operational. **Note 2.** As at June 2019. **Note 3.** Energy figure understated. Latest quarterly figures not received from some IPP's. To be corrected next reporting period. **Note 4.** Not all IPPs provided generation data this quarter, hence the figure is understated. **Note 5**. Projected annual energy contribution.

Committed investments

Bid window 1 to 4, 1S2 & 2S2 (Rand billion)

209.7

Rand billion

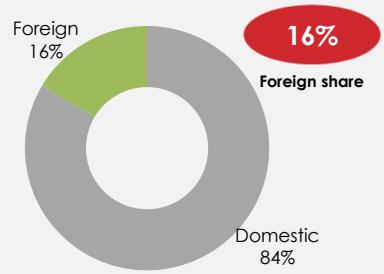
Committed (**total project costs[1]**) for IPP development in BW 1, 2, 3, 3.5, 4, 1S2 & 2S2

of which

R80.6 billion from wind power

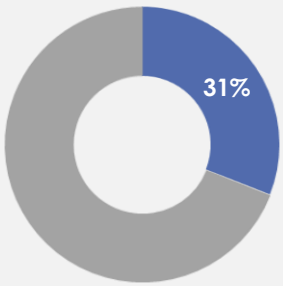
Foreign equity and financing share

Bid window 1 to 4, 1S2 & 2S2 (percentage)



Shareholding by black South Africans

Active projects[3]



Investment attracted for wind power

Wind IPPs have attracted significant investment, in the development of these projects, into the country. The total investment (total project costs[1]), of all projects under construction and projects in the process of closure[4], is R209.7 billion of which R80.6 billion is for onshore wind IPPs.

The expected project value[2] for these wind IPPs is R59.8 billion and, at end June 2019, R32.5 billion had actually been spent.

Wind IPPs have attracted R13.2 billion in foreign investment (debt and equity) in the seven bid windows (BW1 – BW4, 1S2 and 2S2), of which R12.1 billion is foreign equity. 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, 1S2 and 2S2 equates to 48% (R11.1 billion) of total equity (R23.2 billion). Black South Africans own, on average, a 31% share of wind projects that have reached financial close.

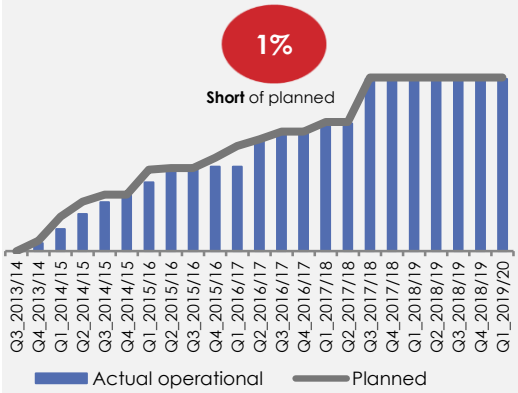
Shareholding by black South Africans has been secured across the value chain.

Black people in local communities also hold ownership in the IPP projects operating in or nearby their vicinities. On average, black people in local communities own 10% of IPPs at financial close.

Note 1. Total Project Costs means the total capital expenditure to be incurred up to the commercial operations date in the design, construction, development, installation and/or commissioning of a project, which is equal to the total debt and equity related to a project as reported at commercial close. **Note 2.** Project Value means the total project cost that involves the capital costs and costs of services procured for the construction of a project, but excludes finance charges, land costs, mobilisation fees to the operations contractor and the costs payable to the distributor, national transmission company and/or a contractor for the distribution or transmission connection works. **Note 3.** Active projects are projects currently in construction (or in operation) i.e. BW1, BW2, (16 of 17 projects) BW3, (1 of 2 projects) BW3.5 and BW4. **Note 4.** Projects for BW3 and BW3.5 (one project each), 1S2 and 2S2 have not yet reached financial close.

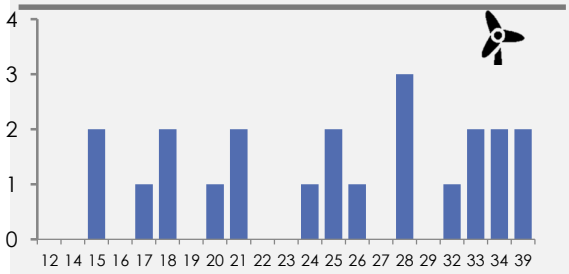
REIPPPP operational capacity

Capacity (MW)



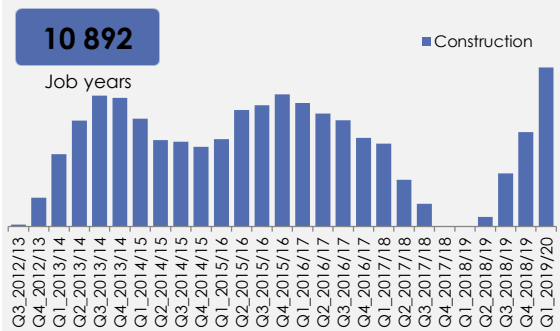
Distribution of lead times

Construction (in months) for completed projects



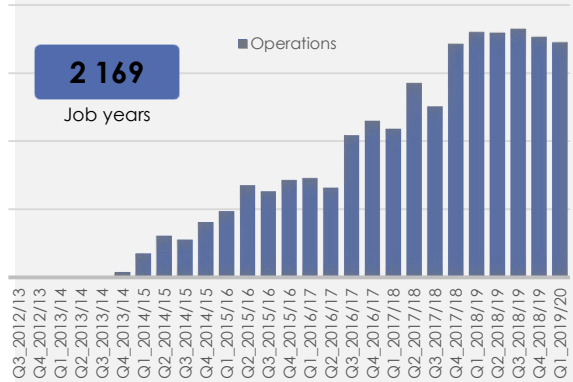
Employment opportunities

Actual (Job years) (active projects[1])



Operations employment

Actual (Job years) (active projects[1])



Wind power delivering capacity quickly

By the end June 2019, 22 IPPs with a capacity of 1 994 MW were scheduled to have reached commercial operations. However, the 22 projects achieved commercial operations, delivering 1 980 MW (99% of the scheduled plan).

1 980 Megawatts from **22** 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 15 MW (1%) shortfall[3] between contracted and delivered capacity for operational projects at the end of June 2019.

Average lead time for the 22 projects to reach commercial operation was 793 days (2.2 years). Lead times across the portfolio varied from 15 to 39 months.

Employment creation

During the construction of REIPPs, numerous employment opportunities are being created. Active RE projects (projects that have commenced construction[1]) delivered 34 664 job years[2] (for SA citizens) of which 10 892 of these employment opportunities were for the construction of wind IPPs.

It is projected that the construction phase for all wind IPPs (BW 1 to BW4, 1S2 and 2S2) will create 11 406 job year opportunities for SA citizens.

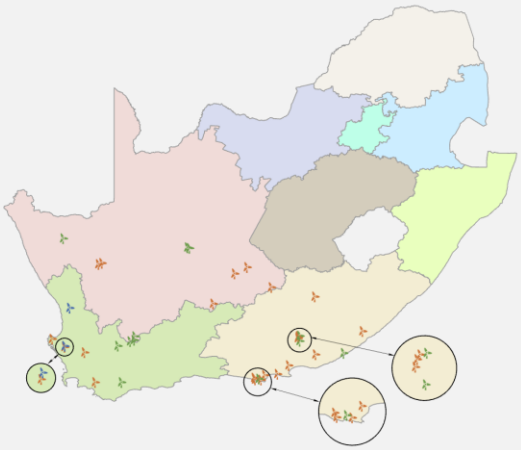
The construction phase offers a high number of opportunities over shorter durations, while the operations phase requires fewer people, but over an extended operating period.

The 22 wind IPPs that have successfully reached commercial operations to date have reported 2 169 job years for SA citizens. Over the operational life of the full wind portfolio (BW 1 to BW4, 1S2 and 2S2), 32 140 job years are expected to be created for SA citizens.

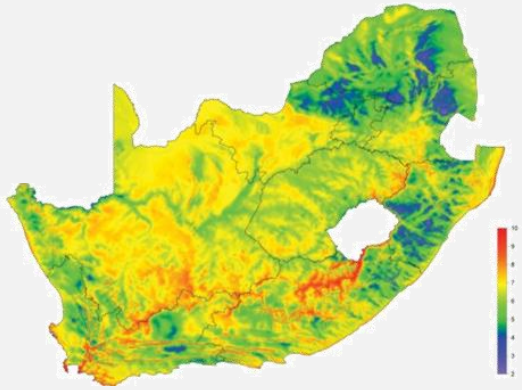
Note 1. Actuals tracked against Active projects – referring to all projects that have commenced construction i.e. currently BW1, BW2, (16 of 17 projects) BW3 and (1 of 2 projects) BW3.5 and BW4. **Note 2.** The equivalent of a full time employment opportunity for one person for one year. **Note 3.** The 22 projects planned to deliver 1 995 MW, but only achieved 1 980 MW.

Geographic distribution

No financial close yet		Came online last quarter	
Under construction		Expected to come online next quarter	
Operational		Completed – no Grid connection	



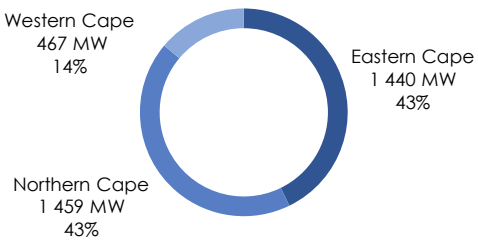
Wind Atlas of South Africa (WASA), Large Scale High Resolution Wind Resource map



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 1 459 MW and 1 440 MW located respectively in each province. The Eastern Cape has the highest number of wind projects at 16, while the Northern Cape has 12 projects and the Western Cape has 8.

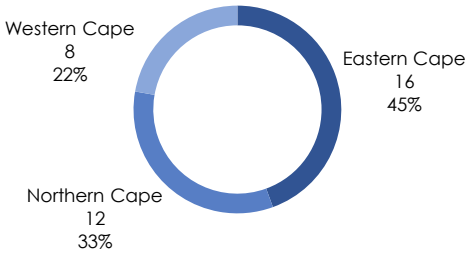
Share of wind capacity

Provincial distribution of capacity (MW)



Share of wind projects

Provincial distribution of projects (#)



Province	Provincial totals		Technology share	
			OW	Other RE
Eastern Cape	Number of projects	**17**	16	1
	Capacity procured (MW)[1]	**1 509**	1 440	70
	Capacity online (MW)[2]	**1 066**	997	70
Northern Cape	Number of projects	**59**	12	47
	Capacity procured (MW)[1]	**3 621**	1 459	2 162
	Capacity online (MW)[2]	**2 125**	664	1 460
Western Cape	Number of projects	**14**	8	6
	Capacity procured (MW)[1]	**606**	467	139
	Capacity online (MW)[2]	**452**	319	134
Other Provinces	Number of projects	**22**	0	22
	Capacity procured (MW)[1]	**685**	0	685
	Capacity online (MW)[2]	**332**	0	332

Note 1. 16 of 17 BW3 projects and 1 of 2 BW3.5 projects (the remainder have not yet signed), 1S2 and 2S2 projects have not yet signed.
Note 2. Excluding projects in early operations.
OW – Onshore Wind, Other RE 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**]

IPPPP Office Contact information

Address:
Bylsbridge Office Park, Building 9, cnr Jean and Olievenhoutbosch Ave, Centurion

Telephone: +27 (0)87 351 3000

Website: www.ipp-projects.co.za

Independent Power Producer Office

Bylsbridge Office Park, Building 9, cnr Jean and Olievenhoutbosch Ave, Centurion

Tel: +27 87 351 3000

energy
Department:
Energy
REPUBLIC OF SOUTH AFRICA

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