# REIPPPP focus on wind

As at 30 September 2018

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 September 2018, 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].

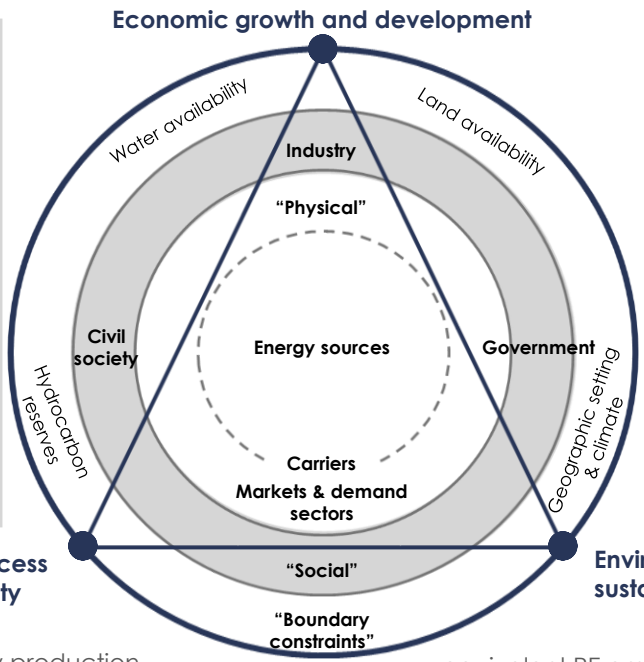
South Africa is perhaps best known for its solar resource, but the recently developed Wind Atlas has also confirmed the country's exceptional wind resources. IPPs participating in the REIPPPP have been harvesting this clean energy resource very successfully, making a significant contribution to the country's 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 – 09/2017)

**29 229 GWh[2]**
***REIPPPP***[2] Actual energy contributed to National Grid

of which
**15 468 GWh[2]**
**Wind**
***(53%) contributed to the National Grid***




**R 60.8 billion**
***REIPPPP*** Total payment to all IPPs

of which
**R 20.6 billion**
**Wind**
**(34%) total payments to IPP's**

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

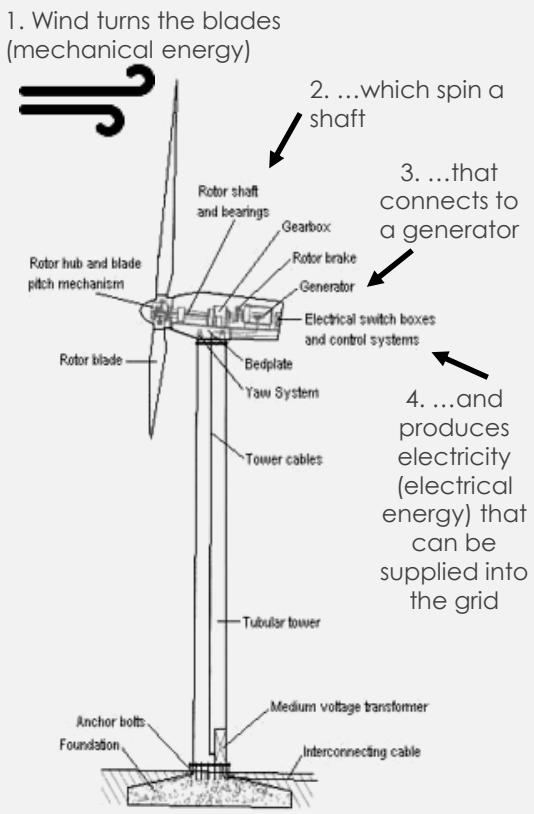
**29.7 Mtons $CO_2$**
equivalent RE emissions reduction achieved relative to Eskom generated power (15.7 Mtons $CO_2$ from wind projects)

**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.

**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 3 000 km coastline.

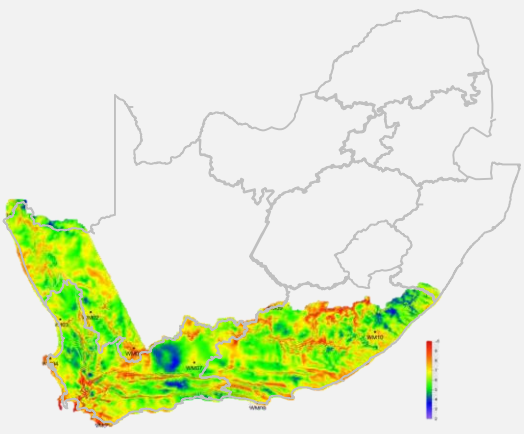
The country's wind resource has been comprehensively mapped in a **publicly available Wind Atlas** to support planning and wind power development.

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 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%.

**Pretoria is South Africa's least windy city, with the lowest recorded wind speeds, while Port Elizabeth is the windiest city in the country when taking into account the percentage of wind-free days, wind speed and the frequency of strong winds.**

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 were installed and operation commenced in October 2015.

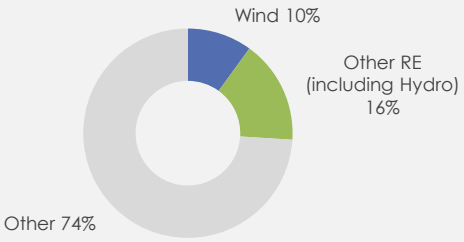
**Wind Atlas of South Africa** (WASA), large scale high resolution wind resource map



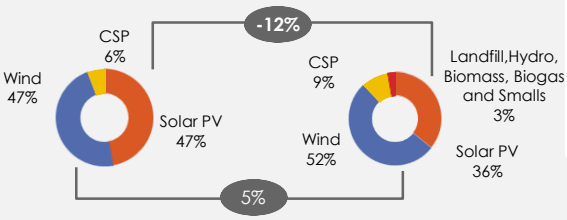
Mean wind speed (ms-1) @ 100m WAsP modelled, 250 m resolution

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

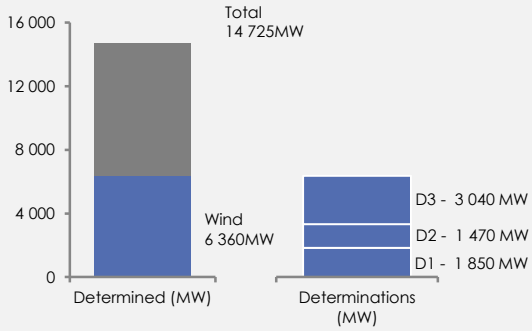
## IRP 2010, 2030 electricity mix
Technology capacity share (%)



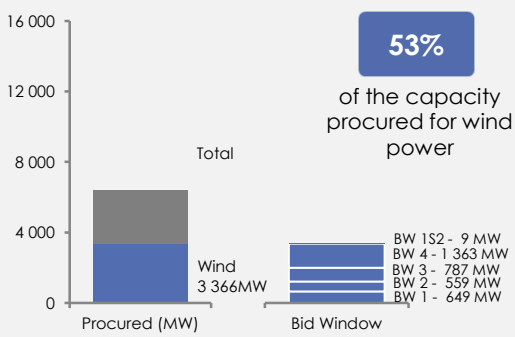

## Technology capacity share
Planned versus procured (%)




## Capacity determined[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.

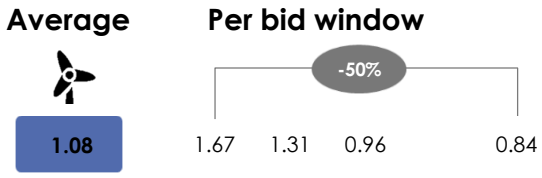
The Minister of Energy has to date determined 6 360 MW of wind power to be procured from Independent Power Producers, targeting full operation by 2025. The determinations have thereby already given effect to 69% of the capacity planned for 2030.

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.

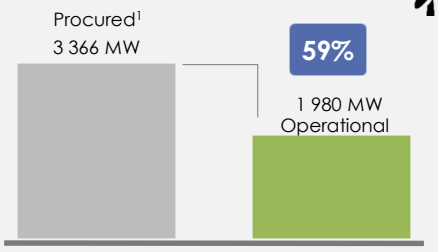
## Average wind energy tariffs[1]
R/kWh




The price for wind power has dropped by 50% to R0.84/kWh (in April 2018 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 (2018). **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 September 2018, 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 September 2018, 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 September 2018) the operational wind projects have reduced $CO_2$ emissions by 5.6 Mtons (already 56% of the total 12.1 Mtons annual P50 projection for wind IPPs).

**Realised (12 month period)**


5.6 Mtons $CO_2$

**Carbon emission reductions ITD**

**29.7**
Mton $CO_2$

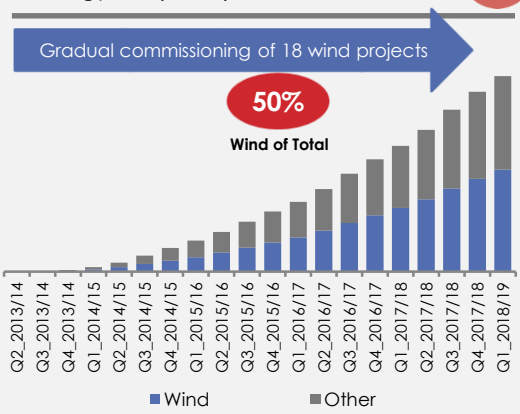
of which
**15.7 Mtons $CO_2$**
from wind power

Since the first REIPP started commercial operation at the end of 2013, 29 229 GWh have been generated, reducing carbon emissions by 29.7 Mtons. Of this, wind projects have contributed 15 468 GWh and reduced carbon emissions by 15.7 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

**29 229 GWh**

of which

**15 468 GWh** from wind power

## Energy supplied

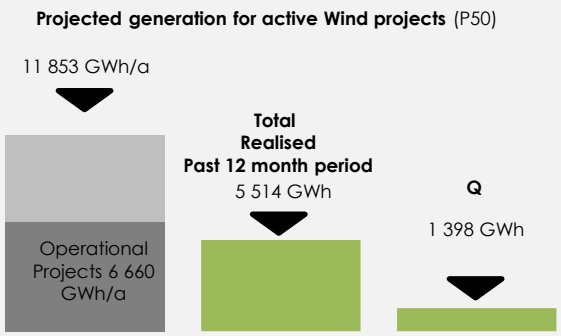
The first REIPP reached COD, supplying power to the grid, in November 2013. Since inception[1], 29 229 GWh of energy has been generated by renewable energy sources from the 62 projects that are operational.

Wind power is contributing 15 468 GWh – more than half of all renewable energy produced to date[2]. Of this energy, 1 398 GWh[3] was generated during this reporting quarter (July to September 2018).

The energy generated over the last 12 months (September 2017 to September 2018), from limited operations by the 22 projects that have reached COD, was 5 514 GWh[3].

## Energy supplied to the grid

Energy generated (GWh)[3]

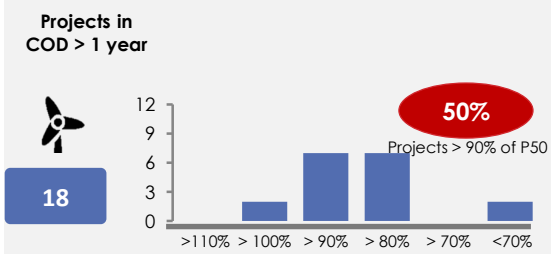



This 5 514 GWh[3] represents 83%[4] of the annual projected energy production by all the operational Wind IPPs (P50[1] for the 22 operational IPPs is 6 660 GWh).

Eighteen (18) projects, using onshore wind technology, have been operational for more than 1 year. These IPPs have generated 4 063 GWh[3] over the past 12 month period, which falls short of their total P50[5] projections, of 4 799 GWh, by 15%.

## Achievement of P50[1] projections

No. of projects




Individually, two (2) of these 18 wind projects (28%) have exceeded their P50[5] projections, while 50% of the IPPs achieved greater than 90% of their P50[5] projections. Nine (9) 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 September 2018. **Note 3.** Energy figure understated. Latest quarterly figures not received from some IPP's. To be corrected next reporting period. **Note 4.** Not all plants were operational for a year and 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)

**209.4**

Rand billion

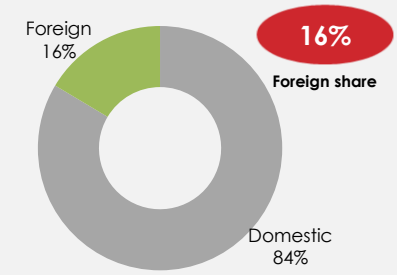
Committed (**total project costs[1]**) for IPP development in BW 1, 2, 3, 3.5, 4, 1S2 & 2S2

of which

**R80.6 billion** from wind power

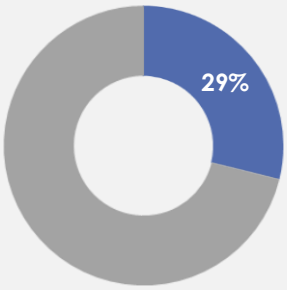
## Foreign equity and financing share

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




## Shareholding by black South Africans

Active projects[3,5]




## 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 R209.4 billion of which R80.6 billion is for onshore wind IPPs.

The expected project value[2] for these wind IPPs is R58.5 billion and, at end September 2018, R28.8 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

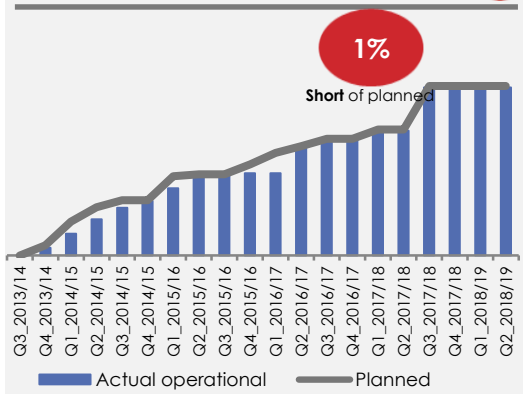
South African (local) equity shareholding across BW1 to BW4, 1S2 and 2S2 equates to 48% (R11.1 billion) of total equity (R23.2 billion). Black South Africans own, on average, a 29% share of wind projects that have reached financial close[5]. Eight (8) of the 12 BW4 wind projects that recently reached financial close are excluded from this reporting, as actual figures achieved will only be available from the next reporting cycle.

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

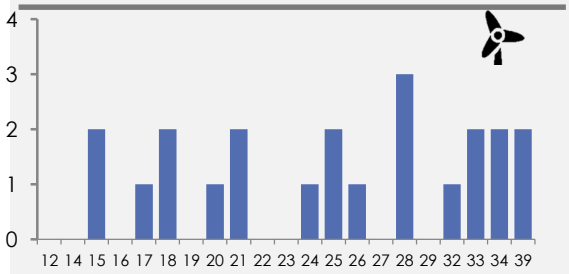
Black people in local communities also hold ownership in the IPP projects operating in or nearby their vicinities. On average, black people in local communities own 12% of IPPs at financial close.

**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.** 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 (25 of 26 projects) BW4. **Note 4.** Projects for BW3, BW3.5 and BW4 (one project each), 1S2 and 2S2 have not yet reached financial close. **Note 5.** Achievements are available for only 8 of 12 BW4 wind projects that recently reached financial close. Target achievements for the rest of the BW4 wind projects will only be reported on in the next quarter when actuals are available.

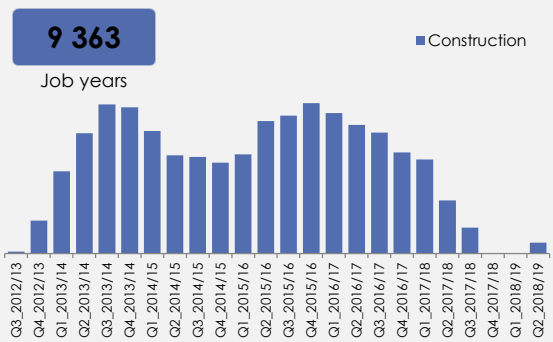
**REIPPPP operational capacity**
Capacity (MW)



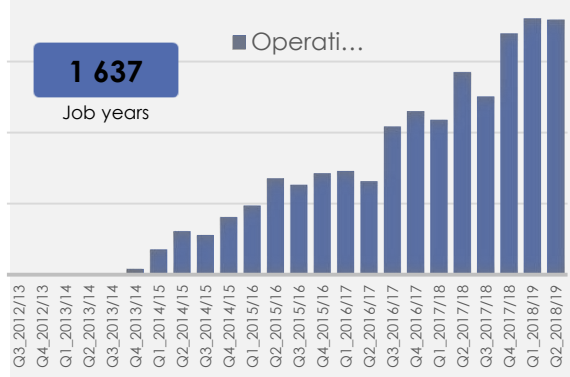

**Distribution of lead times**
Construction (in months) for completed projects




**Employment opportunities**
Actual (Job years) (active projects[1])




**Operations employment**
Actual (Job years) (active projects[1])




## Wind power delivering capacity quickly

By the end September 2018, 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 September 2018.

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 31 522 job years[2] of which 9 363 of these employment opportunities were for the construction of wind IPPs.

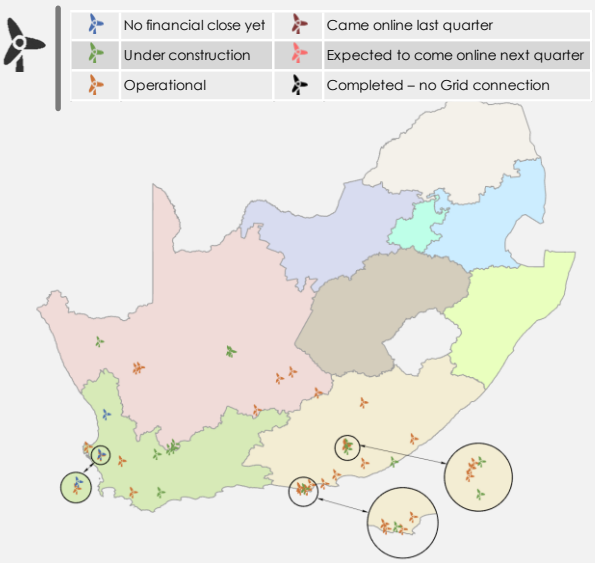
It is projected that the construction phase for all wind IPPs (BW 1 to BW4, 1S2 and 2S2) will create 11 403 job year opportunities.

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.

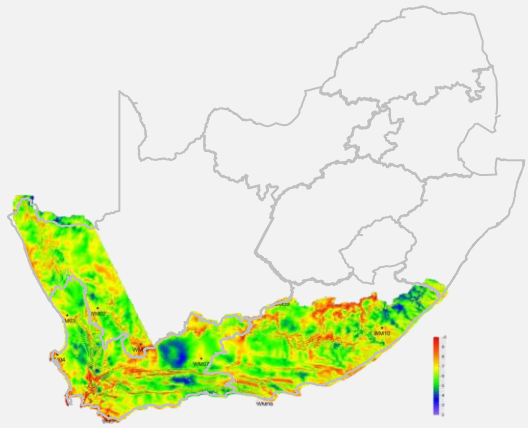
The 22 wind IPPs that have successfully reached commercial operations to date have reported 1 637 job years. Over the operational life of the full wind portfolio (BW 1 to BW4, 1S2 and 2S2), 32 138 job years are expected to be created.

**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. **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



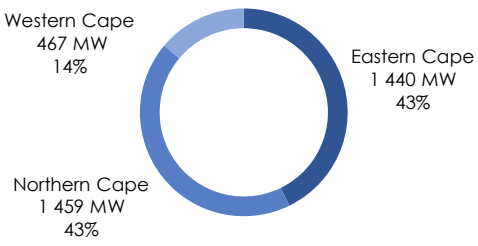

**Wind Atlas of South Africa** (WASA), Large Scale High Resolution Wind Resource map



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.

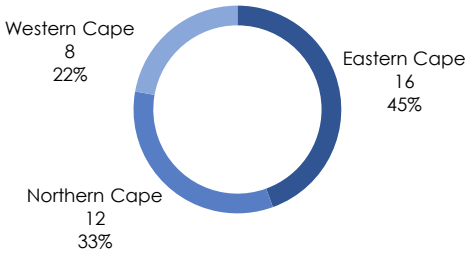
## Share of wind capacity

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] | **1 925** | 664 | 1 260 |
| **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, 1 of 2 BW3.5 projects and 25 of 26 BW 4 projects have reached financial close (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 (kWh, MWh or GWh) production / generation projected with a 50% probability that it will be achievable for the established 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 CSP (Concentrated Solar Power)

Solar PV (photovoltaic)


Wind generation


Small hydro


Biomass


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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REPUBLIC OF SOUTH AFRICA

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Department:
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