



This report was  
made possible  
with the support of



WWF NEDBANK  
**GREEN  
TRUST**

**REPORT**

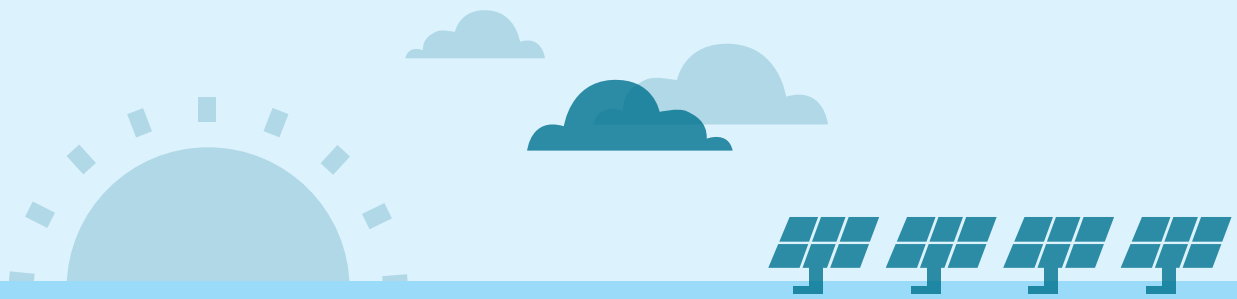
ZA

**2017**

**ENERGY**

# Renewable Energy: Facts and Futures

The energy future we want



WWF is one of the world's largest and most experienced independent conservation organisations, with over 6 million supporters and a global network in over 100 countries.

WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

Authors: Louise Scholtz and Khodani Muluadzi (WWF); Karin Kritzing and Mbali Mabaso (Stellenbosch University, CRSES); Stephen Forder (Energy Blog)

Contributors: Saliem Fakir (WWF); Gaylor Montmasson-Clair (TIPS); Justin Smith (Woolworths); Tasneem Essop (Energy Democracy Initiative); Leonie Joubert (freelance editor)

Design: Design for development, [www.d4d.co.za](http://www.d4d.co.za)

Front cover photo: Woolworths

Citation: WWF, 2017. Renewable Energy: Facts and Futures

Available online at: [www.wwf.org.za/renewable-energy-facts-and-futures](http://www.wwf.org.za/renewable-energy-facts-and-futures)

©Text 2017 WWF-SA All rights reserved

**[wwf.org.za](http://wwf.org.za)**



# CONTENTS

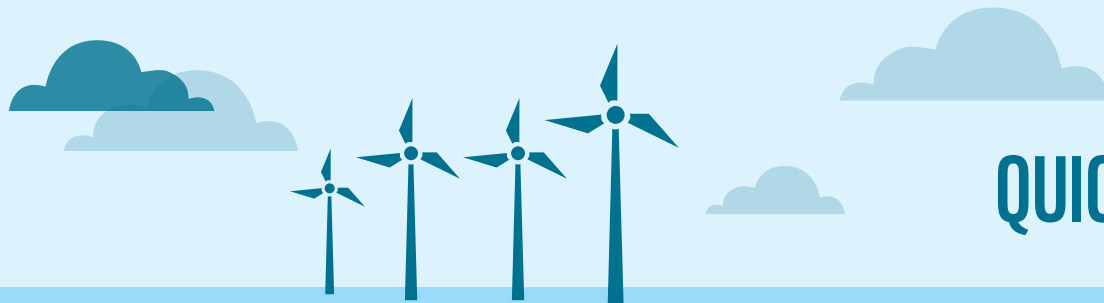
|                                                                                      |           |
|--------------------------------------------------------------------------------------|-----------|
| <b>ABBREVIATIONS AND ACRONYMS</b>                                                    | <b>4</b>  |
| <b>QUICK FACTS</b>                                                                   | <b>5</b>  |
| <b>CONTEXT</b>                                                                       | <b>7</b>  |
| <b>1. RENEWABLE ENERGY: WHAT MAKES IT A CRITICAL RESOURCE?</b>                       | <b>8</b>  |
| 1.1 Introduction                                                                     | 8         |
| 1.2 An abundant resource                                                             | 8         |
| 1.3 Early policy successes                                                           | 10        |
| Renewable energy technologies                                                        | 11        |
| <b>2. ESKOM vs RE AND THE SWAY OF HISTORY</b>                                        | <b>15</b> |
| 2.1 Introduction                                                                     | 15        |
| 2.2 The years of plenty                                                              | 15        |
| 2.3 The years of scarcity                                                            | 16        |
| 2.4 The emergence of renewable energy                                                | 16        |
| Think piece: Rethinking the role of coal                                             | 17        |
| <b>3. PUTTING RE POLICY INTO ACTION</b>                                              | <b>19</b> |
| 3.1 Introduction                                                                     | 19        |
| 3.2 The Integrated Resource Plan                                                     | 19        |
| 3.3 The future: the IRP re-optimised                                                 | 21        |
| 3.4 Other key policies and legislation                                               | 22        |
| 3.5 Government mandates                                                              | 23        |
| Think piece: Electricity supply in South Africa: Path dependency or decarbonisation? | 25        |
| <b>4. REI4P SUCCESSSES AND CHALLENGES</b>                                            | <b>26</b> |
| 4.1 Introduction                                                                     | 26        |
| 4.2 Overview of key outcomes to date                                                 | 27        |
| 4.3 Future challenges                                                                | 29        |
| <b>5. THE ROOFTOP PV REVOLUTION</b>                                                  | <b>32</b> |
| 5.1 Introduction                                                                     | 32        |
| 5.2 Increased uptake                                                                 | 33        |
| 5.3 The business case                                                                | 34        |
| 5.4 Challenges for municipalities                                                    | 35        |
| Think piece: A private sector perspective: Good for business, good for the climate   | 37        |
| <b>6. GOING FORWARD</b>                                                              | <b>38</b> |
| Think piece: A just transition to a renewable energy future in South Africa          | 40        |
| <b>BIBLIOGRAPHY</b>                                                                  | <b>42</b> |

## ABBREVIATIONS AND ACRONYMS

|                       |                                                |                       |                                                                   |
|-----------------------|------------------------------------------------|-----------------------|-------------------------------------------------------------------|
| <b>BAU</b>            | business as usual                              | <b>MV</b>             | medium voltage                                                    |
| <b>B-BBEE</b>         | broad-based black economic empowerment         | <b>MW</b>             | Megawatt                                                          |
| <b>BEE</b>            | black economic empowerment                     | <b>MWh</b>            | Megawatt hour                                                     |
| <b>BW</b>             | bid window                                     | <b>MW<sub>p</sub></b> | Megawatt peak                                                     |
| <b>CSIR</b>           | Council for Scientific and Industrial Research | <b>NDP</b>            | National Development Plan                                         |
| <b>CSP</b>            | concentrated solar power                       | <b>NEMA</b>           | National Environmental Management Act 107 of 199                  |
| <b>DE</b>             | distributed energy                             | <b>NERSA</b>          | National Energy Regulator of South Africa                         |
| <b>DEA</b>            | Department of Environmental Affairs            | <b>NUM</b>            | National Union of Mineworkers                                     |
| <b>DG</b>             | distributed generation                         | <b>NUMSA</b>          | National Union of Metalworkers of SA                              |
| <b>DoE</b>            | Department of Energy                           | <b>PPA</b>            | power purchase agreement                                          |
| <b>DPE</b>            | Department of Public Enterprises               | <b>PV</b>             | photovoltaic                                                      |
| <b>DTI</b>            | Department of Trade and Industry               | <b>RE</b>             | renewable energy                                                  |
| <b>ERA</b>            | Electricity Regulation Act 4 of 2006           | <b>REFIT</b>          | Renewable Energy Feed-In Tariff                                   |
| <b>GW</b>             | Gigawatt                                       | <b>REI4P</b>          | Renewable Energy Independent Power Producer Procurement Programme |
| <b>INDC</b>           | Intended Nationally Determined Contribution    | <b>REIPPPP</b>        | Renewable Energy Independent Power Producer Procurement Programme |
| <b>IPPs</b>           | independent power producers                    | <b>SANEDI</b>         | South African National Energy Development Institute               |
| <b>IRP</b>            | Integrated Resource Plan                       | <b>SAWEA</b>          | South African Wind Energy Association                             |
| <b>kW</b>             | kilowatt                                       | <b>SSEG</b>           | Small Scale Embedded Generation                                   |
| <b>kWh</b>            | kilowatt hours                                 | <b>TWh</b>            | Terawatt hours                                                    |
| <b>kW<sub>p</sub></b> | kilowatt peak                                  |                       |                                                                   |
| <b>LV</b>             | low voltage                                    |                       |                                                                   |
| <b>MEC</b>            | Minerals Energy Complex                        |                       |                                                                   |

## LIST OF RELEVANT WWF-SA PUBLICATIONS

- Renewable Energy Vision 2030 – South Africa. Available at: [www.awsassets.wwf.org.za/downloads/a16369\\_wwf\\_reip\\_report\\_online.pdf](http://www.awsassets.wwf.org.za/downloads/a16369_wwf_reip_report_online.pdf).
- Feasibility of the WWF Renewable Energy Vision 2030 – South Africa. Available at: [www.wwf.org.za/media\\_room/publications/?14461/Feasibility-of-the-WWF-Renewable-Energy-Vision-2030---South-Africa](http://www.wwf.org.za/media_room/publications/?14461/Feasibility-of-the-WWF-Renewable-Energy-Vision-2030---South-Africa).
- Potential for integration of distributed solar photovoltaic systems in Drakenstein Municipality. Available at: [www.wwf.org.za/media\\_room/publications/?14841/Drakenstein-solar](http://www.wwf.org.za/media_room/publications/?14841/Drakenstein-solar).
- Concentrated Solar Power – a strategic industrial development opportunity for South Africa. Available at: [www.wwf.org.za/media\\_room/publications/?14462/Concentrated-Solar-Power---A-strategic-industrial-development-opportunity-for-South-Africa](http://www.wwf.org.za/media_room/publications/?14462/Concentrated-Solar-Power---A-strategic-industrial-development-opportunity-for-South-Africa).
- Exploring the role of retirement funds in achieving Renewable Energy Vision 2030. Available at: [www.wwf.org.za/media\\_room/publications/?14323/Exploring-the-role-of-retirement-funds-in-achieving-Renewable-Energy-Vision-2030](http://www.wwf.org.za/media_room/publications/?14323/Exploring-the-role-of-retirement-funds-in-achieving-Renewable-Energy-Vision-2030).
- A review of the local community development requirements in South Africa's renewable energy procurement. Available at: [www.wwf.org.za/media\\_room/publications/?14322/A-review-of-the-local-community-development-requirements-in-South-Africas-renewable-energy-procurement-programme](http://www.wwf.org.za/media_room/publications/?14322/A-review-of-the-local-community-development-requirements-in-South-Africas-renewable-energy-procurement-programme).
- Enabling renewable energy in South Africa: Assessing the Renewable Energy Independent Power Producer Procurement Programme. Available at: [www.wwf.org.za/media\\_room/publications/?13181/Enabling-renewable-energy-in-South-Africa-Assessing-the-renewable-energy-independent-power-producer-procurement-programme](http://www.wwf.org.za/media_room/publications/?13181/Enabling-renewable-energy-in-South-Africa-Assessing-the-renewable-energy-independent-power-producer-procurement-programme).



# QUICK FACTS

## RENEWABLE ENERGY

Renewable energy is the energy that is derived from a limitless source, in contrast to fossil fuels, which are derived from a finite source.

Types of renewables include solar energy (power from the sun), wind energy, tidal energy (power from the seas) and geothermal energy (power in the form of heat from within the earth).

In 2016, newly installed renewable power capacity set new records with 161 GW added, increasing the global total by almost 9% relative to 2015.

Solar PV was the star performer in 2016, accounting for around 47% of the total additions – the equivalent of more than 31 000 panels installed hourly – followed by wind power at 34% and hydropower at 15.5%.

In 2016 the world added more renewable power capacity annually than it added (net) capacity from all fossil fuels combined.

For the fifth consecutive year, investment in new renewable power capacity (including all hydropower) was roughly double the investment in fossil-fuel generating capacity, reaching \$249.8 billion.

2016 was the third year in a row where global energy-related CO<sub>2</sub> emissions from fossil fuels and industry remained stable despite a 3% growth in the global economy and an increased demand for energy.

In 2016 South Africa was ranked first for its addition in concentrated solar power.

By the end of 2015, renewable capacity in place was enough to supply an estimated 23.7% of global electricity, with hydropower providing about 16.6%.

Wind power was the most cost-effective option for new grid-based power in 2015 in South Africa.

South Africa is the first country on the African continent to achieve 1 GW of solar PV and helped to push the continent's wind power capacity above the 3 GW mark.

## THE REI4P

The Renewable Energy Independent Power Producer Procurement Programme (REI4P) has attracted R195 billion in large investments to South Africa, 25% of which came from foreign investors and R31.6 billion from South Africa's development finance institutions and state-owned enterprises.

Renewable energy contributed a total net benefit of R4 billion (or R2 per kWh of renewable energy) to the South African economy in 2014 and 2015 through avoided costs.

It is reported that in a three-year period the REI4P created 26 790 jobs for South Africans, mostly during the construction and operations phases of the plants (IPP Office, 2016).

R65.5 billion has been procured from B-BBEE firms for the REI4P projects that have signed up and R32.1 billion has been spent on local content.

31% shares of the procured REI4P projects are held by black South Africans, of which 31% are held by local communities.

By 2016, the REI4P had already successfully procured 43% or 6 376 MW of generation capacity since 2011.

Sources: [www.ren21.net/wp-content/uploads/2017/06/GSR2017\\_Highlights\\_FINAL.pdf](http://www.ren21.net/wp-content/uploads/2017/06/GSR2017_Highlights_FINAL.pdf); IPP Office, 2016

## RENEWABLE ENERGY WORKING FOR WOMEN

*A new hydro power plant on the Orange River creates employment in communities around Kakamas in the Northern Cape.*

'My day-to-day job is becoming more like running the plant,' electrician Vania Heyns says, laughing.

She is one of the electricians at the Kakamas Hydro Electric Power (KHEP) plant on the outskirts of this remote Northern Cape town, and her boss, Johan Benade, agrees that she pretty much runs the show. Vania's knowledge of the community means that she's ideally placed to also co-ordinate the plant's social and enterprise development work. Since KHEP's revenues started flowing in 2015, the plant has supported various projects, including helping a local school and two day-care centres for the elderly and disabled, providing them with things like computers for learning, office equipment, furniture and cooking facilities.

Born and bred in the Northern Cape, Vania understands why it is difficult for micro-enterprises here to be viable.

'When people start a business here, the money they make today is the money they are going to use to feed themselves tonight,' she says, describing how vulnerable small businesses can be.

The 10 MW KHEP plant is one of the 96 renewable energy power plants commissioned by the Department of Energy since 2011, as part of its utility-scale Renewable Energy Independent Power Producer Procurement Programme. Through the REIP, the state has outsourced some of its energy infrastructure needs to the private sector. One of the stipulations in the contract between the state and the private firms is that they will invest a percentage of the revenue they earn from selling power to the grid, into development initiatives in communities living within 50 km of each plant. This work spans the 20-year period of the contract in this public-private partnership.



# CONTEXT

**Worldwide there is an energy transition under way with countries moving away from fossil-fuel generated electricity to renewable energy sources.**

*“The world now adds more renewable power capacity every year than it adds in net new capacity from all fossil fuels combined.”*

The world now adds more renewable power capacity every year than it adds in net new capacity from all fossil fuels combined (REN21, 2017). Although this shift is underpinned by the need to ensure future energy security, it is given momentum by the realisation that replacing fossil fuels with renewable energy is one of the most effective measures to reduce greenhouse gases (GHGs) and mitigate climate change.

For the third year in a row in 2016, economic growth was decoupled from the growth in CO<sub>2</sub> emissions. This was largely owing to the combined growth in renewable energy capacity and a decline in coal consumption (REN21, 2017). A further leading impetus is the decreasing cost of renewable energy technology, particularly wind and photovoltaics (PV), which make renewables increasingly cost competitive with electricity generated from fossil fuels (REN21, 2017).

South Africa's dependence on coal to generate about 90% of our electricity has made it the biggest carbon emitter in Africa (Baker, 2016). The Department of Energy (DoE) states that, at present the electricity sector is responsible for 45% of the country's greenhouse gas emissions. Reducing the dependence on coal for electricity generation and increasing the percentage of renewables in the energy mix are low-hanging fruits ripe for the picking.

South Africa is in the fortunate position that it has an abundance of renewable energy resources, particularly solar and wind. In addition, these resources are complementary in nature, which means a power generation system with a high degree of renewables is possible (Gauchè et al., 2015). South Africa should therefore think long and hard about the feasibility of investing in expensive new nuclear power to provide for base-load electricity when the wind is not blowing and the sun is not shining.

**R195 BILLION**  
ATTRACTED INTO  
SOUTH AFRICA

**26 790**  
JOBS CREATED

Through the Renewable Energy Independent Power Producer Procurement Programme (REI4P), South Africa has also demonstrated that it can successfully and rapidly implement a large-scale, world-class renewable energy programme. The REI4P not only addresses energy security and the reduction of greenhouse gas emissions but also includes a number of socio-economic prescriptions to ensure local community ownership and socio-economic development in the vicinity of the renewable energy power plants. Through local content stipulations, the programme has also managed to provide the market for a number of renewable energy manufacturing facilities. The REI4P constitutes a public-private initiative on a massive and unprecedented scale, attracting R195 billion into the country and creating 26 790 jobs in construction and maintenance of plants (IPP Office, 2016).

The private sector, both at household and industry level, is the primary force behind embedded generation developments, in essence PV installed on rooftops. This positive development, however, presents a challenge to municipalities that have to manage a future decrease in revenue from electricity sales. Municipalities are responding to the changing landscape and many have implemented guidelines and feed-in tariffs for privately owned PV systems to feed excess electricity into the grid. In addition, some of the metros and large municipalities are exploring options to procure power from sources other than Eskom, such as independent power producers (IPPs). The major challenge in this regard is the present regulatory environment that does not allow municipalities to procure from sources other than Eskom (Montmasson-Clair et al., 2017).

However, the South African renewable energy landscape is in danger of being derailed by vested interests, like Eskom's refusal to sign off-take agreements with IPPs, mobilisation around coal and coal mining in particular, and the inclusion of expensive new nuclear capacity and retention of coal-fired capacity in the Draft Integrated Resource Plan 2016.

WWF-SA argues that South Africa should rather build on the early success of the REI4P by extending the programme beyond the initial five bid windows, which will demonstrate the government's long-term commitment to the roll-out of renewables. Choosing this route will provide South Africa with clean, affordable energy, avoid perpetuating coal-generated electricity that is highly carbon intensive and polluting, and obviate investment in expensive nuclear power plants that are not necessary.

# 1. RENEWABLE ENERGY: WHAT MAKES IT A CRITICAL RESOURCE?

Apart from its many socio-economic benefits, renewable energy is a critical part of reducing global carbon emissions and setting us on a path to a low-carbon economy.

## 1.1 INTRODUCTION

South Africa was one of the first developing countries to pledge emissions reductions – despite not being obliged to do so – when, in 2010, it set emissions reduction targets of 34% by 2020 and 42% by 2025 below an unspecified ‘business as usual’ level (Fakir, 2015).

Reducing South Africa’s dependence on coal for generating electricity and increasing the percentage of renewable energy sources in the country’s energy mix is a so-called ‘low-hanging fruit’ – a goal that can most easily be achieved. The potential of renewable energy sources to mitigate climate change was highlighted in the National Climate Change Response White Paper, which pointed out the investment in renewable energy programmes as one of the most promising options of climate change mitigation in the electricity sector (DEA, 2015).

## 1.2 AN ABUNDANT RESOURCE

South Africa is endowed with some of the best solar and wind resources in the world. In terms of South Africa’s theoretical **wind potential**, research from the Council for Scientific and Industrial Research (CSIR) suggests that to generate the equivalent of South Africa’s current yearly electrical energy demand of 250 terawatt hours (TWh), only 0.6% of the available South African land mass would have to be dedicated to wind farms with a cumulative installed capacity of approximately 75 GW. In addition, the total technical theoretical potential for wind power in South Africa, if wind farms were to be installed all across the country except in exclusion zones such as national parks and settled areas, amounts to 6 700 GW. This wind fleet would be large enough to supply the entire world’s electricity demand (CSIR in Forder, 2016). Figure 1.1 illustrates the technical theoretical potential for wind power in the southern parts of the country. Red indicates the highest and blue the lowest mean wind speed.

### WHAT IS RE?

Renewable energy is derived from a limitless source, whereas fossil fuels, are derived from a finite source such as coal.



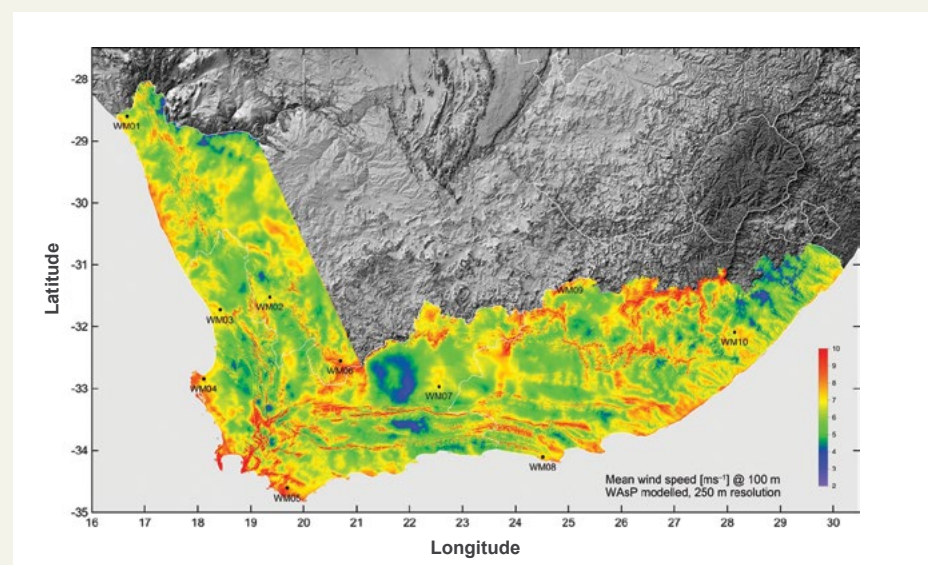
**SOLAR ENERGY**  
(power from the sun)



**WIND ENERGY**



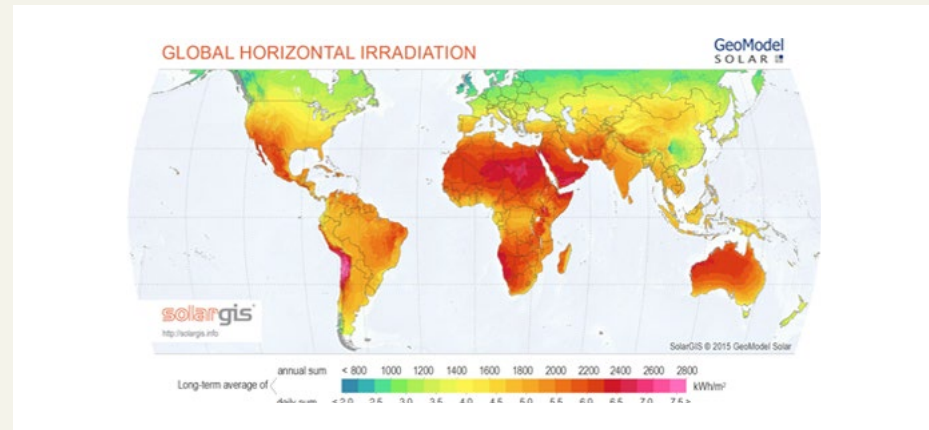
**HYDRO ENERGY**



**Figure 1.1: The technical theoretical potential for wind power in the southern parts of South Africa**

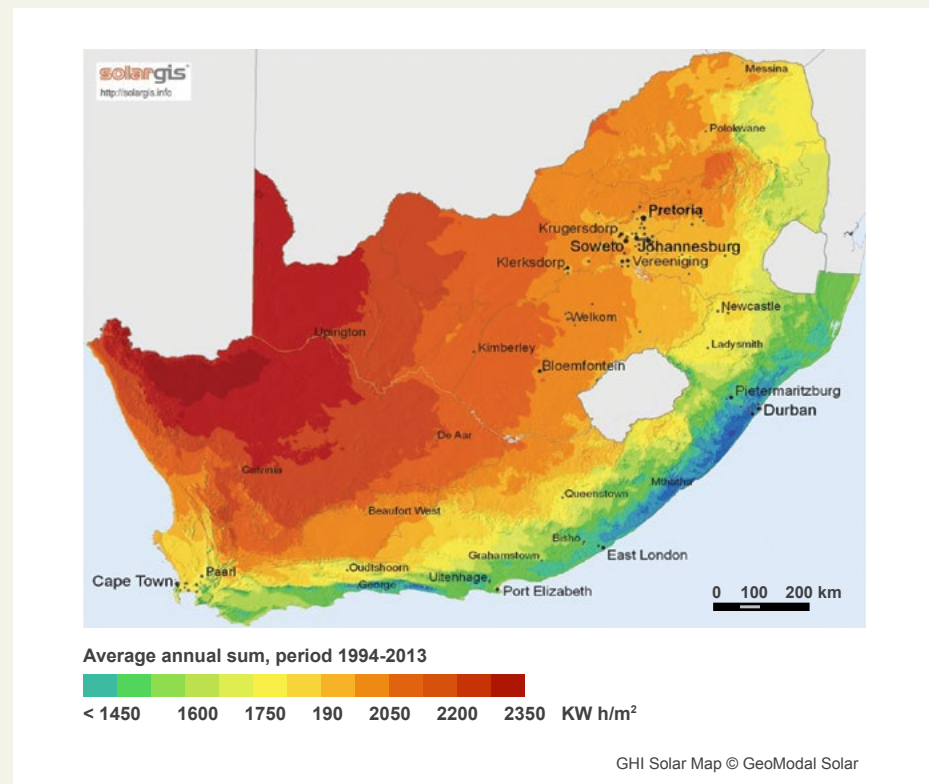
Source: [www.wasaproject.info/docs/metadataApril2014.pdf](http://www.wasaproject.info/docs/metadataApril2014.pdf)

South Africa has some of the highest **solar irradiance** in the world and experiences some of the highest levels of yearly horizontal solar irradiation globally (Figure 1.2). The average daily solar radiation in South Africa is between 4.5 and 6.5 kWh/m<sup>2</sup>/day (Figure 1.3) compared to about 3.6 kWh/m<sup>2</sup>/day for parts of the USA, and about 2.5 kWh/m<sup>2</sup>/day for Europe and the United Kingdom (Gulati & Scholtz, 2017). When compared to industrialised countries that are using solar thermal technology on a much larger scale, even South Africa's provinces with the lowest potential have higher levels of solar irradiation than these countries. Yet South Africa lags behind countries with a lesser solar resource such as Spain and Germany in the adoption of solar energy (Sager, 2014).



Source: Solar GIS, 2016

**Figure 1.2: Global horizontal irradiation**



Source: Solar GIS, 2016



Wind power consumes no fuel and emits no air pollution, unlike fossil-fuel power sources. Wind power available in the atmosphere is much greater than current world energy consumption. Energy consumed in manufacturing a wind power plant is equal to the new energy produced by the plant within a few months of operation.  
(www.wasaproject.info)

**Figure 1.3: Global horizontal irradiation for South Africa**

In addition to the country's excellent wind and solar potential, South Africa's climatic conditions tend to result in a complementary power generation profile for wind and solar energy. Wind supply peaks in the evening and solar photovoltaic (PV) potential peaks at midday. Wind and solar output also has low seasonality, i.e. is hardly affected by the seasons. A combination of these climatic factors and the wide geographical area over which wind and solar plants can be distributed results in lower volatility and less variability and intermittency, making wind and solar energy more dependable options than in other countries, and cheaper to deploy (CSIR in Forder, 2016).

The CSIR findings also reinforce earlier findings from a modelling study by WWF (Gauchè et al., 2015), which found that a low-cost and resilient power generation system can be achieved by using a high share of renewable energy (Forder, 2016). This can be achieved through the right geographical distribution of solar and wind generation facilities and the installation of storage and flexible peaking plants that can power up at short notice ('load-following') for times of high demand.

## 1.3 EARLY POLICY SUCCESSSES

Given the abundance of South Africa's solar and wind resources, there is a compelling and strategic case for a high share of renewables in the South African electricity generation mix. The first official document to acknowledge the need to secure energy supply through diversifying energy sources was the **White Paper on Energy Policy of the Republic of South Africa (1998)**. This document acknowledged that the 'rapid development of renewable energy technologies was imminent, and that they would become cost competitive and cost effective'. This would create numerous opportunities for South Africa, which has great renewable energy potential (DoE, 2015).

This was followed by the **White Paper on the Renewable Energy Policy of the Republic of South Africa (2003)**, which dealt exclusively with renewable energy in South Africa. The aim of this document was to create conditions for the development and commercial implementation of renewable technologies. This was also the first document to refer to the procurement of renewable energy from independent power producers (IPPs) (Baker, 2016). However, while the paper set precedence for renewable energy policy in the country, it had little impact on the development of the renewable energy sector because it was only published in 2012, by which time the 2010 Integrated Resource Plan (IRP) for electricity had already been promulgated (Eberhard et al., 2014; Baker, 2016). For the first time, the IRP included renewable energy in South Africa's electricity mix – see Chapter 3 for more details.

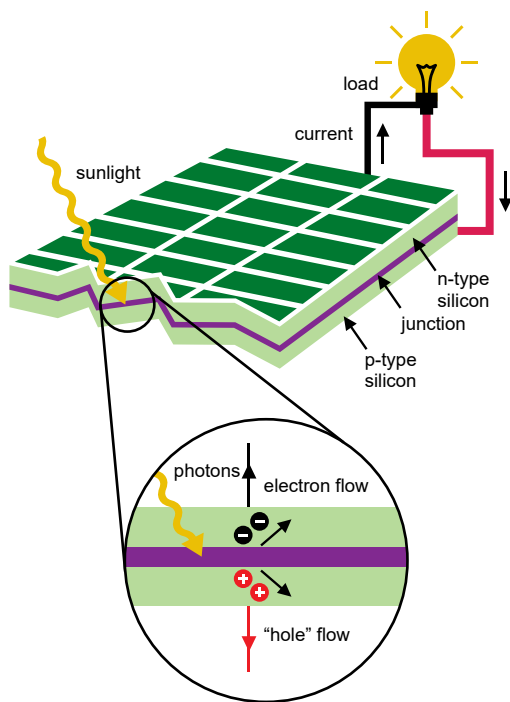
The table was now set to start procuring and integrating renewables into the South African electricity mix as a first step in decarbonising South Africa's electricity system and transitioning to a low-carbon economy. However, and as will become apparent, although the roll-out of large-scale renewables was particularly successful at the outset, it increasingly faced challenges. Many would argue that these challenges were primarily owing to South Africa's high dependence on coal, which stretched much wider than the dominant role of coal in South Africa's power generation system. The challenges were compounded by the growth and consolidation of the large and powerful state-owned and vertically integrated monopoly, Eskom (Eberhard, 2007: 215).

# RENEWABLE ENERGY TECHNOLOGIES



## CONVERTING SOLAR ENERGY (LIGHT) INTO ELECTRICITY USING PHOTOVOLTAIC SYSTEMS

Source: CRSES, 2017



Photovoltaic (PV) panels consist of two types of semiconductors: one is positively charged and the other one negatively. When the sun shines on the semiconductor, the electric field across the junction between these two layers causes an electric current. The greater the intensity of light, the greater the flow of electricity.

### Schematic of a PV system

**Small-scale PV** systems can generate electricity for households and businesses that can power all electrical appliances. These systems are normally installed on the roofs of buildings. If the system produces more electricity than needed, the excess electricity can be stored in batteries or it can be fed back into the grid (see Chapter 5).

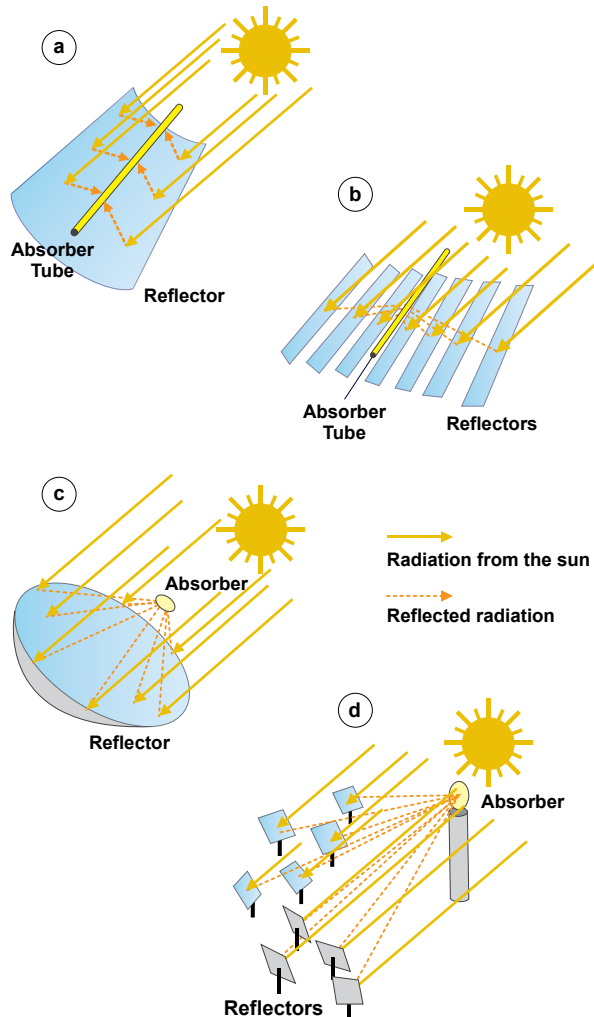
**Utility-scale PV** power plants built in terms of the REI4P consist of a large number of panels erected in areas that have good solar resources (see Figure 1.3 in Chapter 1). They feed electricity directly into the national grid at an agreed tariff and are paid by Eskom (see Chapter 4).

## CONVERTING SOLAR ENERGY (HEAT) INTO ELECTRICITY

Solar thermal power plants convert the solar heat into electricity by heating water to produce steam that feeds into turbines, which generates electricity.

The benefit of CSP plants such as the one at Bokpoort in the Northern Cape is that, unlike PV where the electricity must be used immediately, it has the ability to store electricity. The Bokpoort plant (see page 24) can store thermal energy for up to 9.3 hours, which means it can provide electricity at night. More importantly, it can feed into the grid to assist Eskom to cover the country's evening peak demand (17:00 to 21:00).

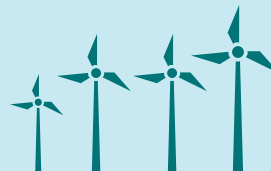
Source: CRSES, 2017



In CSP plants, solar energy is concentrated on a point or line in one of the following configurations:

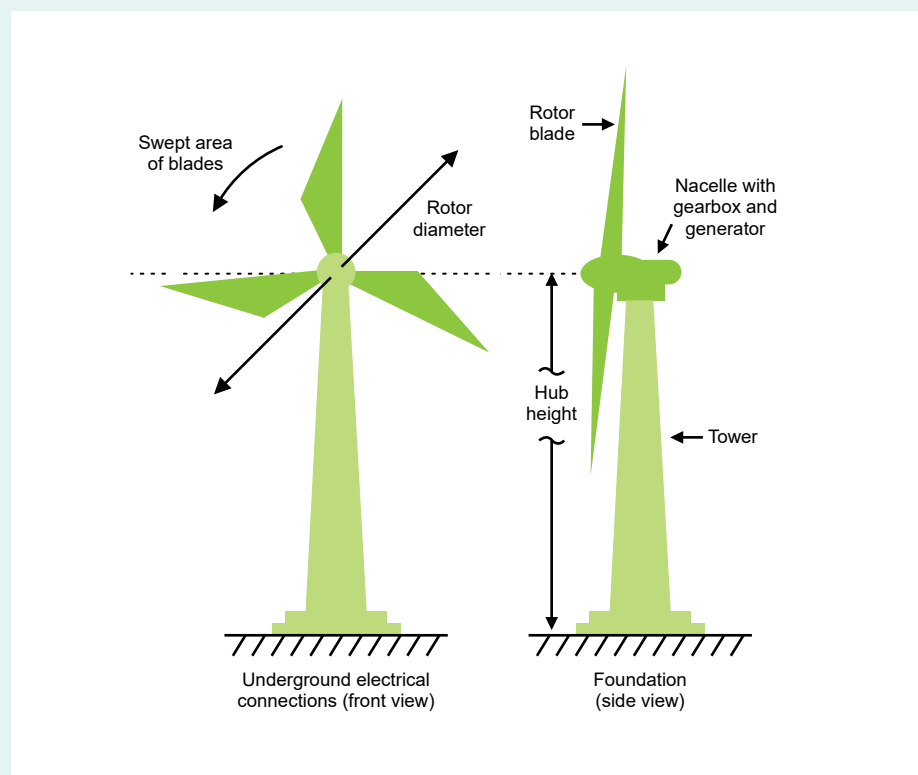
- |                       |                       |
|-----------------------|-----------------------|
| a. a parabolic trough | c. a parabolic dish   |
| b. a fresnel          | d. a central receiver |

### The different configurations for CSP receivers



## USING WIND TO GENERATE ELECTRICITY

Wind turbines use the patterns of wind direction and wind speeds to turn generators and generate electricity. They usually have two or three thin blades of up to 50 m or longer that are fixed to the top of a tower. Towers can range from quite short to very tall. Wind speed increases with height above the earth's surface owing to surface drag. Taller wind turbines utilise the higher-speed winds above the earth's surface.



Source: ESN in CRSES, 2017

### Drawing of the rotor and blade of a wind turbine

Similar to PV, smaller applications can be installed in and around structures that generate electricity for residential use (off-grid and on-grid), telecommunication towers, small businesses, farming activities and rural areas. These applications are usually installed in conjunction with battery storage systems because wind energy resources are highly inconsistent in some areas.

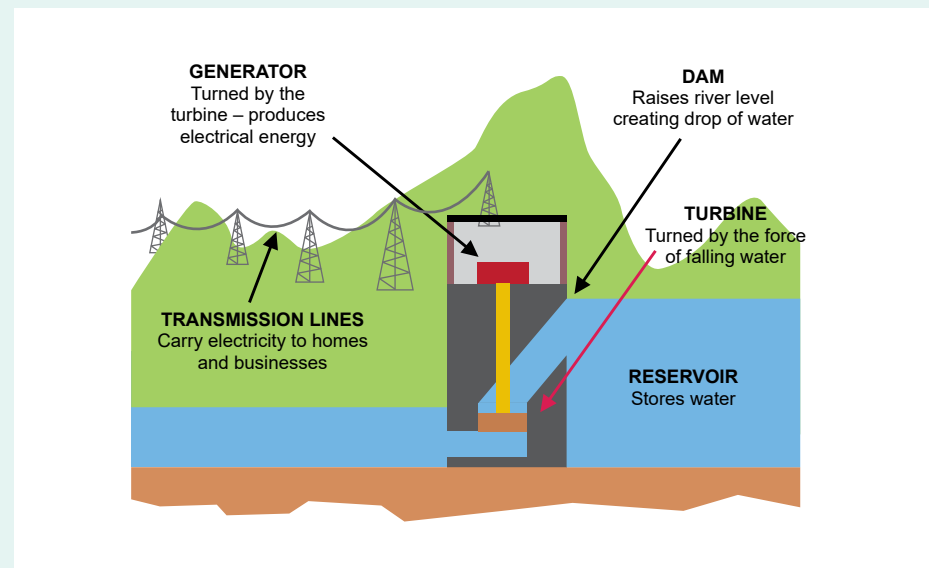
Utility-scale wind farms, like large-scale PV plants, have been erected in terms of the REI4P and feed electricity directly into the grid (see Chapter 4).

Source: All the above sourced from the website of the Centre for Renewable and Sustainable Energy Studies, University of Stellenbosch (CRSES).  
Available at: [www.crses.sun.ac.za/files/services/schools/wind\\_energy/Wind%20Energy%2017%20ppt.pdf](http://www.crses.sun.ac.za/files/services/schools/wind_energy/Wind%20Energy%2017%20ppt.pdf).



## USING WATER (HYDRO) TO GENERATE ELECTRICITY

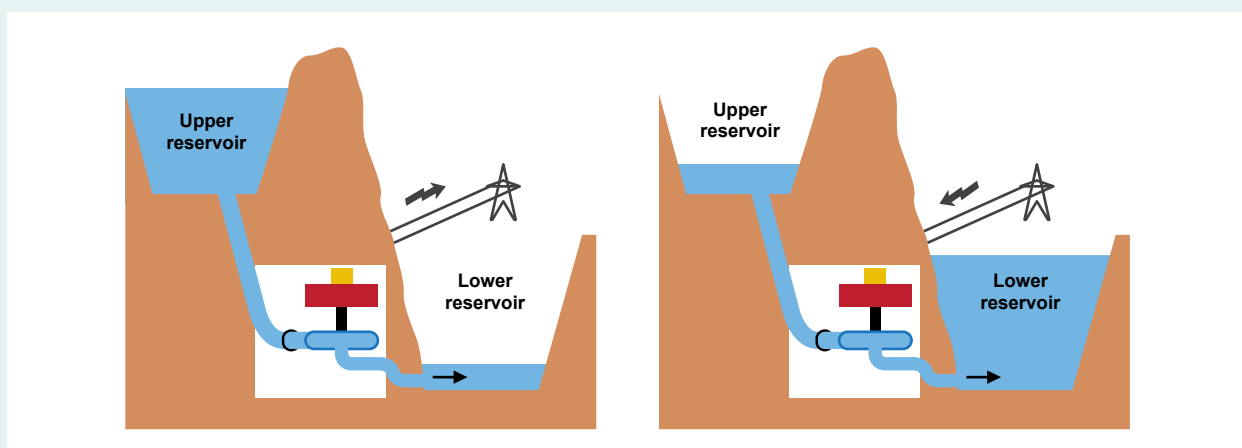
The kinetic energy of flowing water can be used to drive machinery, including electricity generators. Gravity makes water flow from a high to a low place and the moving water contains kinetic energy. Hydroelectric power stations are able to transform the kinetic energy in moving water to electrical energy. Eskom operates hydroelectric power stations at the Gariep Dam (360 MW) and the Vanderkloof Dam (240 MW).



Source: ESN in CRSES, 2017

### Schematic of a hydroelectric power station

One can also use pumped storage plants to store electricity on a large scale, by using surplus electricity to pump water to a mountain-top reservoir and then allowing it to flow down when you need electricity. An example is the Ingula pumped-storage power station on the border of KwaZulu-Natal and the Free State.



Source: ESN in CRSES, 2017

### Schematic of a pumped storage scheme

Small-scale hydro power plants are part of the REI4P (see Chapter 4). They operate on the same principle as large-scale hydro power plants and are generally smaller than 10 MW.

Source: All the above sourced from the website of the Centre for Renewable and Sustainable Energy Studies (CRSES), University of Stellenbosch. Available at: [www.crses.sun.ac.za/files/services/schools/hydro\\_energy/Hydro%20Energy%2017%20ppt.pdf](http://www.crses.sun.ac.za/files/services/schools/hydro_energy/Hydro%20Energy%2017%20ppt.pdf).

## ESKOM'S RE DELAYS THREATEN TRANSPORT INVESTMENTS

*The survival of a BEE company working in the renewables sector is threatened by Eskom delays.*

Delays by Eskom to sign off the next round of state-commissioned wind farms have cost a local black-owned transport and rigging company 30 jobs since November 2016.

Absolute Rigging, a transport specialist in abnormal loads, invested R60 million in equipment since 2014 in order to haul wind turbine components for new wind farms, and increased its staff by 50. Eskom delays threaten this investment.



## 2. ESKOM vs RE AND THE SWAY OF HISTORY

No discussion of renewable energy will be complete without touching on Eskom's role in South Africa's carbon-intensive electricity landscape.

*“Eskom, South Africa's state-owned and vertically integrated power utility, controls the country's electricity transmission infrastructure.”*

### 2.1 INTRODUCTION

Eskom, South Africa's state-owned and vertically integrated power utility, controls the country's electricity transmission infrastructure. It currently supplies approximately 95% of South Africa's electricity and 45% of electricity used on the continent (Eskom, 2017a). The organisation was established in 1923 under the Electricity Act 42 of 1922 (Eskom, 2017b) with the mandate to establish generation and distribution undertakings to supply electricity at the lowest possible cost (Eberhard, 2007).

As the main producer and distributor of electricity in the country, Eskom has been the key player and beneficiary of the Minerals Energy Complex (MEC). The MEC is the system of accumulation in which the South African minerals and energy sectors are intertwined. Eskom's generation undertaking was built around the availability of cheap, abundant coal resources, with power stations located adjacent to coal mines. These mines, which were privately owned, entered into long-term supply contracts with Eskom (Eberhard, 2007).

### 2.2 THE YEARS OF PLenty

By the 1970s, Eskom was the sole national electricity producer with the exception of a few industrial, mining and municipal self-generators. Before this, most municipalities generated their own electricity (Eberhard, 2007; see also Eskom, 2017b). The oil shocks in the 1970s, which saw oil prices rising, led to an increase in the demand for electricity as oil became more expensive. One of the consequences was South Africa's reliance on coal (Eberhard, 2007). During 1973 and 1974, electricity demand grew by 12% and 13% respectively (Eskom, 2017b). All indications were that demand would soon outstrip Eskom's capacity at the time. In light of anticipated growth, Eskom increased its capacity by building more coal-fired power stations.

The cost of the expansions led to an increase in the price of electricity, causing criticism of Eskom. Furthermore, it became apparent that the anticipated growth in demand had been over-estimated. (This is relevant to Eskom's current expansion plans, particularly related to new nuclear capacity.) This left Eskom with surplus generation capacity (Eskom, 2017c). Following the findings of the De Villiers Commission that was appointed in 1983 to investigate Eskom's inefficiencies, the Electricity Acts of 1987 (Eskom Act 40 of 1987; Electricity Act 41 of 1987) were promulgated. These Acts allowed Eskom to recover revenue and created a new organisation with a two-tier structure (Eskom, 2017c). In a dramatic turn of events, the newly established Eskom worked on getting rid of surplus generation capacity through measures such as price-incentive policies, delaying construction of new plants and mothballing and decommissioning older plants from 1987 to the early 1990s.

During this period, Eskom introduced policies to promote load growth through low-cost electricity contracts to energy-intensive users, particularly those in the mineral beneficiation industry (Eberhard, 2007). The low-cost electricity contracts set a precedent for the energy-intensive industrial sector in South Africa. This had a permanent impact on South Africa's electricity planning and contributed significantly to South Africa's high carbon emissions in the years to follow. Then, in 2001, Eskom was converted from a statutory body to a public company with the government as its only shareholder under the Eskom Conversion Act of 2001 (Baker, 2016).

## 2.3 THE YEARS OF SCARCITY

The years of plenty were followed by capacity constraints. These were caused by a confluence of circumstances: strong economic growth that stimulated stronger electricity demand following the 1994 democratic election, which continued until the global economic crisis in 2008; the continuation of the historical management practices and investment decisions followed under the apartheid government up until 1994; and investment decisions taken by the new democratic government after 1994.

After 1994 the national grid was also extended to mostly black households, increasing connected households from 35% under the apartheid government to 85% in 2015 (DoE, 2016; Marquard et al., 2007). However, the biggest consumers of electricity remained energy-intensive industries as a result of the price-incentive policies during the years of surplus. This remains the case today: it is estimated that 40% of electricity is used by energy-intensive industries such as steel manufacturing in South Africa (EIUG, 2017).

How did the government's indecision lead to the electricity crisis in 2007/08? In 2001, the national government prevented Eskom from investing in new generation capacity because it wanted to introduce competition in the electricity generation sector and slowly move away from the Eskom monopoly. However, the government failed to put effective policy and regulatory frameworks in place to support private sector participation. When it became clear that the private sector would not be able to assimilate into the South African electricity sector, Eskom was finally, in 2005, given the go-ahead to invest in new generation capacity (Baker, 2016).

*“Delayed policy resulted in a national electricity crisis and in early 2008, the government declared a national emergency.”*

In 2005, Eskom commenced with plans to build two coal-fired power stations, Medupi (near Lephalale, Limpopo province) and Kusile (near Witbank, Mpumalanga), and a hydro pumped storage scheme, Ingula (near Ladysmith on the border of KwaZulu-Natal and the Free State). However, these interventions came too late and the 2007 blackouts could not be avoided. This resulted in a national crisis and in early 2008 the government declared a national emergency. Eskom was forced to resort to country-wide rotational ‘load shedding’ to protect the power system from a total shutdown. Load shedding lasted from 2007 until March 2008. Although Eskom put temporary interventions in place, the country experienced another round of load shedding and blackouts in 2015. The temporary intervention in the form of diesel generators cost Eskom an estimated R22.8 billion during the 2013/14 period, which affected the utility's cash flow and its operations (Sesant, 2016).

## 2.4 THE EMERGENCE OF RENEWABLE ENERGY

These challenges, coupled with South Africa's voluntary pledge at the COP 15 climate conference in Copenhagen in 2009 to reduce its carbon emissions from a ‘business-as-usual’ scenario, opened the doors for the integration of renewable energy in South Africa's electricity mix. In August 2011, the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP or REI4P) was announced. After decades of control by Eskom, the power generation part of the equation was about to shift formidably. The way was now clear for the entrance of independent power producers into the power generation market (Forder, 2016).

However, the South African electricity sector has been described as something of a paradox (Baker, 2016). On the one hand it continues to build large coal-fired power plants that underpin the country's carbon-intensive electricity sector, while on the other hand it pursues renewable energy, to the extent that South Africa has been labelled the leading destination for renewable energy investments (DoE, 2015). Further complicating matters is the fact that Eskom still holds the monopoly historically bestowed on it and has ‘significant interests vested in maintaining the status quo and little incentive to treat competition [such as the IPPs] fairly’ (Montmasson-Clair, 2017). These aspects will be discussed in more detail in Chapter 4.



# THINK PIECE

## RETHINKING THE ROLE OF COAL

**Saliem Fakir, Head of the Policy and Futures Unit, WWF-SA**

South Africa's high dependence on coal is a result of a natural endowment and has been critical to the development of its industrial capability and economic diversification. Historically, coal was a cheap energy source and cheap energy was critical to the mining sector and other energy-intensive industries such as steel making, smelting and the development of the railways. Coal is also important in other ancillary industries such as heavy manufacturing and the chemical industries. Although coal use has enabled South Africa to become the most industrialised economy in Africa, it has also created a certain path-dependent form of industrialisation and exports. The decision path South Africa has historically followed continues to limit present scenarios, even though past circumstances have changed. In this way, heavy industry and mining still remain at the heart of South Africa's industrial trajectory and exports.

Because the abundance of coal has allowed energy to become an essential feature of production and the economy in general, there is a tight link between coal and the South African economy. Coal has been used as an industrial development policy tool to harness the enormous wealth and diversity of South Africa's rich mineral endowment. This has subsequently developed links into downstream industries, creating a broad and loosely defined MEC. The MEC has been described by some as a unique feature of a system of accumulation in which the minerals and energy sectors are intertwined.

Given that the MEC sectors are by nature capital intensive, policies have structured incentives in a manner that has further enhanced the capital intensity of the economy. Today there are renewed policy attempts to stimulate economic development by improving the beneficiation streams and linkages between mining and industrial development. However, the extent to which these linkages can be fostered in a significant way remains a challenge.

Path dependence will remain a strong feature of the coal economy given the extensive cross-linkages with various components of the economy as a whole and the financialisation of coal assets on the Johannesburg Stock Exchange. Coal is also a significant contributor to job creation and export earnings. Thus coal will not be easily matched by other energy carriers without significant effort and resource availability.

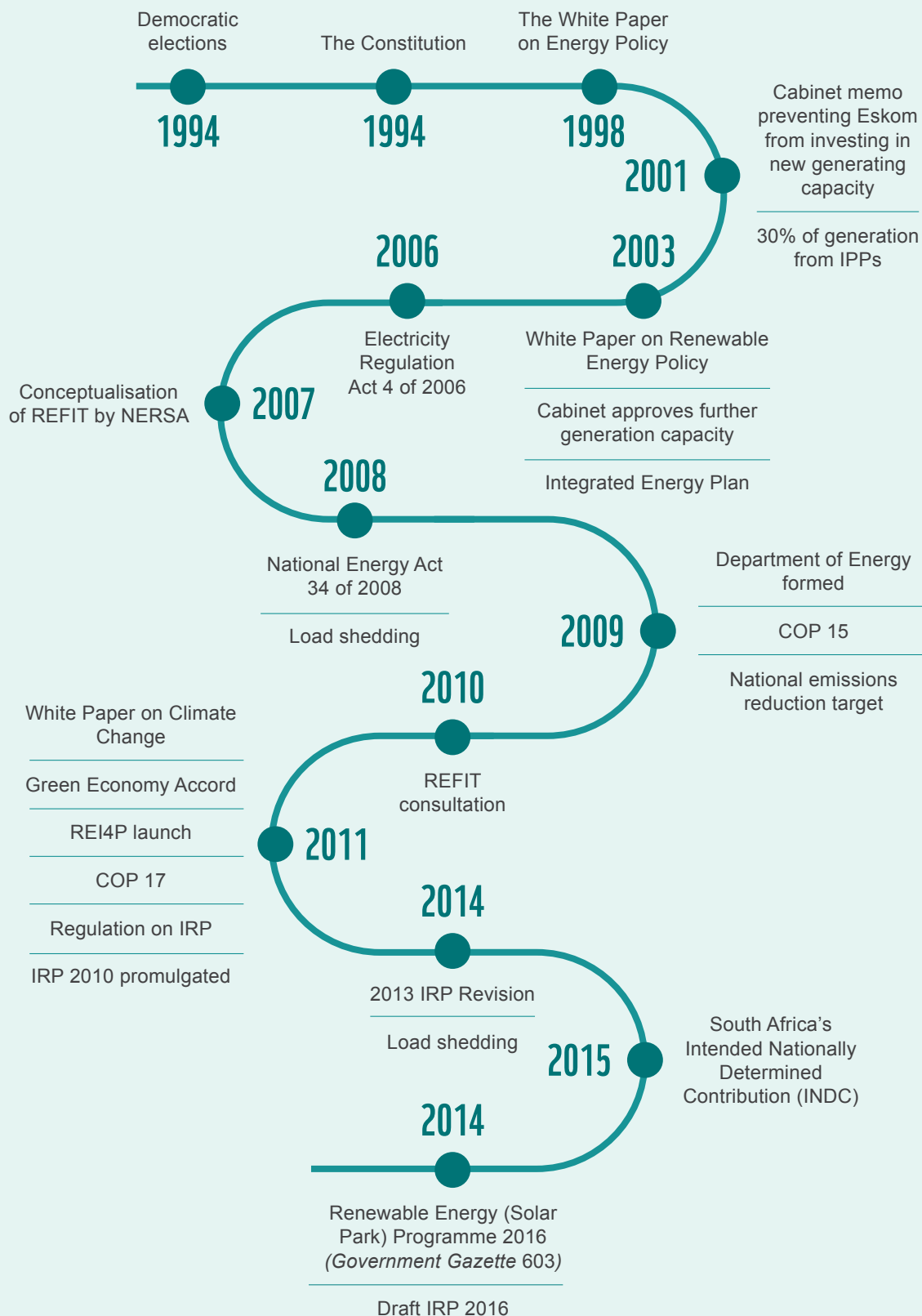
However, the high use of coal, which has marked the South African legacy, will be much more constrained in the future. Many factors are narrowing the window for coal to remain the preferred fuel for energy, despite its domestic abundance, diverse uses and cheapness. These factors vary from declining reserves, supply constraints, quality and the global impact of coal on climate change issues. Large coal deposits may even remain unexploited owing to a lack of financing and infrastructure. Coal production and transport costs will also increase because poor quality coal needs more washing, and new mines will not be located in close proximity to coal-fired power stations.

These challenges – or what one may call headwinds for coal – mean that, as natural and non-natural factors suggest, we need to find a way out of our path dependence on coal to make the South African economy more resilient.

*“Many factors are narrowing the window for coal to remain the preferred fuel for energy.”*

# TIMELINE

## Electricity policies, legislation and key events that have shaped and enabled the roll-out of renewable energy



## 3. PUTTING RE POLICY INTO ACTION

**Key policy documents and legislation guide and regulate the renewable energy sector in South Africa under the auspices of various government departments.**

### 3.1 INTRODUCTION

In the first chapter two seminal policy documents that initiated the roll-out of renewable energy were mentioned, namely the White Paper on Energy Policy (1998) and the White Paper on Renewable Energy Policy (2003). This chapter builds on these papers, highlighting key policy documents and legislation that guide and regulate the renewable energy sector in South Africa, as well as the key government departments responsible for the roll-out of renewable energy.

### 3.2 THE INTEGRATED RESOURCE PLAN

The key policy document determining the future of renewable energy in South Africa is the Integrated Resource Plan (IRP), a subset of the Integrated Energy Plan (see 3.4 on page 22 for more information). The IRP details potential scenarios for the types of electricity resources and technologies in which South Africa should invest to meet national demand projections, and the cost of each scenario, until 2030. It was created with the intention that it would be a 'living plan' to be revised every two years by the Department of Energy (DoE). The process followed is that the DoE releases a draft document for public participation during which different stakeholders provide feedback on the content and make suggestions for the updated report. The updated report is then promulgated into an official government plan upon approval. Three IRP drafts have been published to date since its inception in 2010 but only the IRP 2010–2030 document has been approved and gazetted as an official government plan (Figure 3.1).

| IRP 2010<br>2010–2030 | IRP 2010 (UPDATED)<br>2013–2050 | DRAFT IRP 2016<br>2020–2050 |
|-----------------------|---------------------------------|-----------------------------|
| Gazetted (official)   | Not gazetted                    | Revision 1                  |
| 25 March 2011         | 21 November 2013                | October 2016                |

**Figure 3.1: Timeline of IRPs to date**

#### 3.2.1 IRP 2010

This document details the electricity plan for the 2010–2030 period and introduces RE-based generation capacity. The context of this version is important because it came at a time when South Africa was facing security-of-supply challenges following national load shedding in 2007/08. As a result, the report calls for 52.2 GW of new additional capacity from 2010 until 2030. In terms of the document, coal remains dominant but its share of energy production will fall from 90 to 65% by 2030, while the renewable energy share will increase from 0 to 9%. The nuclear energy share is envisaged to increase from 5 to 23% (DoE, 2011; see also Joffe, 2012).

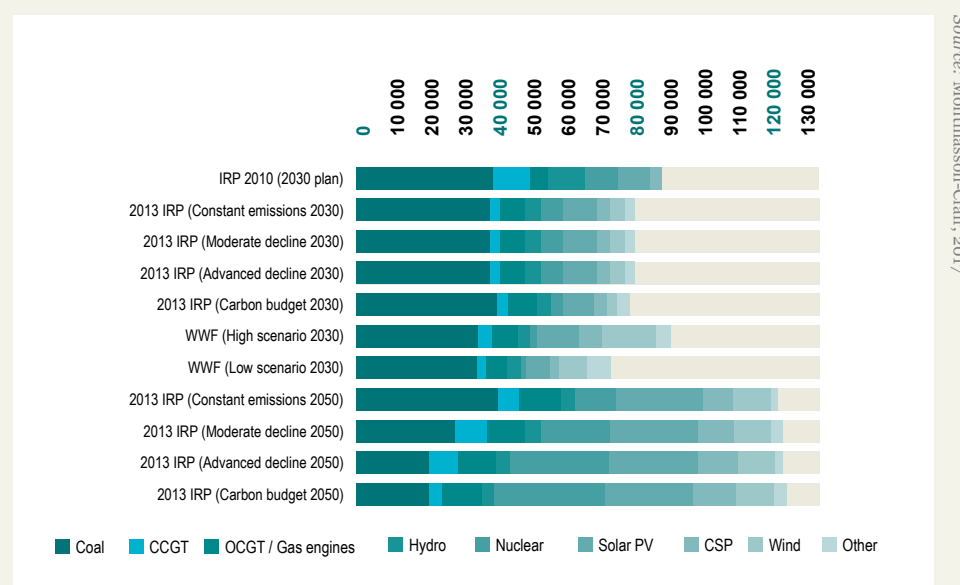
Critical to note, however, is that this does not translate into an absolute decline, or even the stabilisation of coal-based electricity. Coal-based electricity generation is still expected to grow in capacity from 235 GWh to 295 GWh per annum over the 2010–2030 period, largely owing to the completion of the two large-scale power plants, Medupi and Kusile (Montmasson-Clair, 2017).

### 3.2.2 IRP 2010 UPDATE (2013)

*“The 2013 review proposes more aggressive scenarios aimed at setting the electricity sector on a genuine low-carbon development path compatible with the country’s climate objectives.”*

This document is an update of the IRP 2010 document and is often also referred to as the IRP 2013. The planning horizon was extended to include the years 2013 to 2050, but the IRP 2013 was never adopted as a government policy document. However, the document acknowledges that the cap of 275 Mt CO<sub>2</sub>e per annum for electricity, set in the IRP 2010, is not sufficient for the electricity sector to align with the country’s climate change commitment (Montmasson-Clair, 2017). While keeping the IRP 2010 target as its base, the 2013 review proposes more aggressive scenarios aimed at setting the electricity sector on a genuine low-carbon development path compatible with the country’s climate objectives (Montmasson-Clair, 2017).

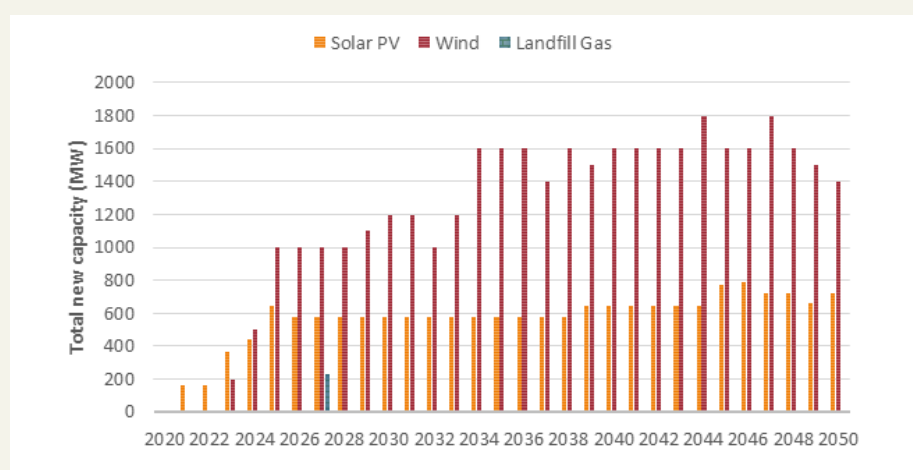
In general, solar photovoltaic (PV) and wind energy sources are pursued across all the scenarios, except for the ‘Big Gas’ scenario, which assumes an increase in the availability of shale gas and imported gas for generation. The best scenario for renewables in this IRP is the ‘High Nuclear Cost’ scenario, where newly built nuclear power stations are assumed to cost approximately R56 000 per kilowatt (kW). As a result, the nuclear fleet is replaced with a mixture of coal, gas and renewables. This scenario is especially favourable for new wind and concentrated solar power (CSP) developments. Under this scenario CSP capacity shoots up to 38 GW (Figure 3.2).



**Figure 3.2: Electricity mix (in MW of generation capacity) in 2030 and 2050 according to different scenarios**

### 3.2.3 DRAFT IRP 2016

This document is still under consultation and therefore only the base case scenario can be considered (Figure 3.3). Regarding renewable energy new-build options, this draft only makes allocations for solar PV, wind and landfill gas technologies. Unlike previous versions, solar CSP is excluded from new-build options. This means only CSP projects committed to in the REI4P project up until bid window 4.5 are considered.



**Figure 3.3: Renewables base case new-build options in the IRP 2016 draft**

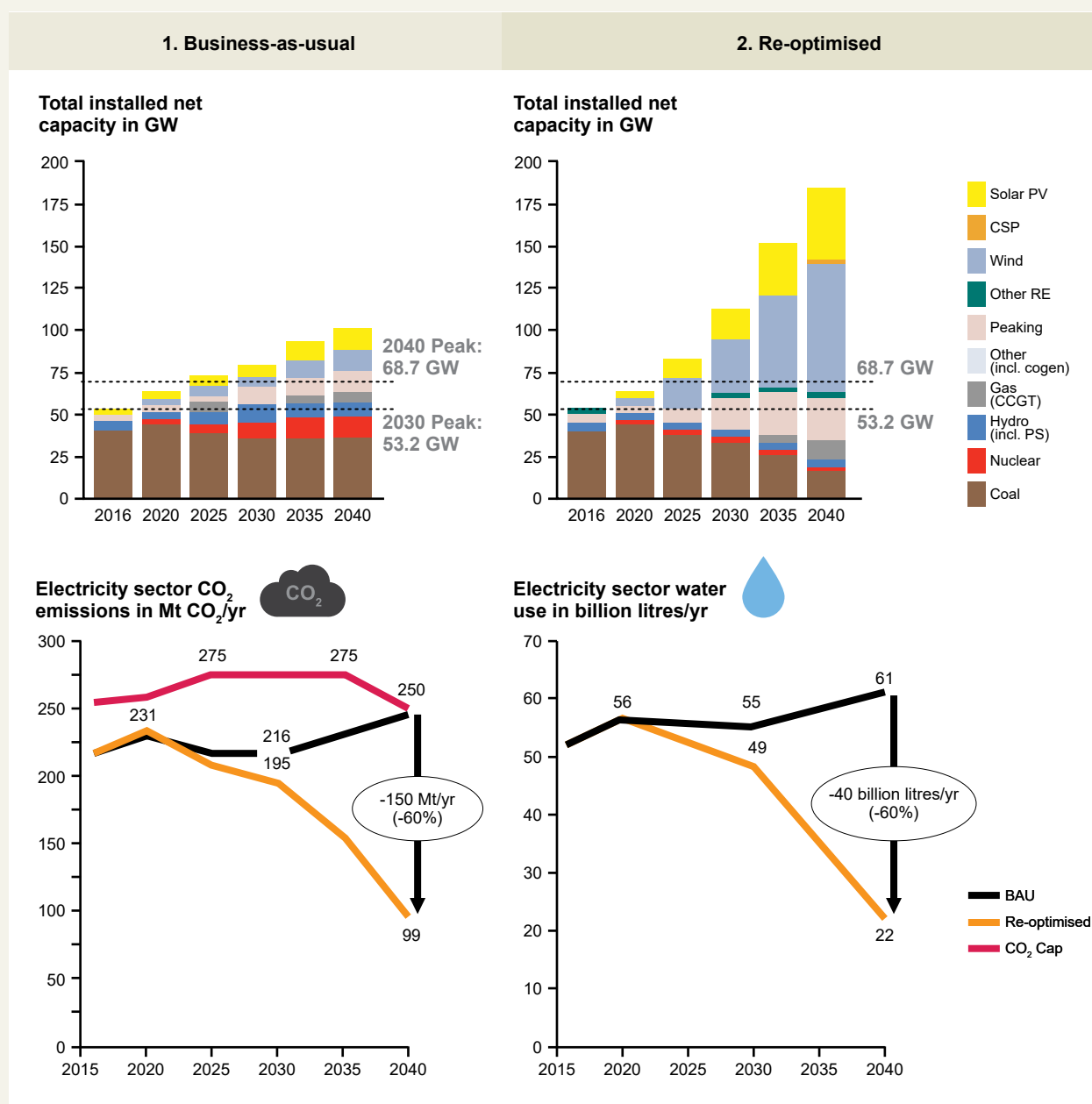
Much criticism has been aimed at the IRP 2016, ranging from erroneous inconsistent technology costs used for renewable energy in the draft base case presented, to the arbitrary and artificial constraints on the delivery of renewable energy, namely 1 000 MW per year for solar PV, and 1 600 MW per year for wind power. Critics have pointed out that there is no justification for these constraints, other than the fact that these same constraints were contained in the previous IRP in 2010, albeit at a time when there was no South African renewable energy industry, utility-scale solar PV or wind power plants in South Africa, and when international solar PV and wind prices were significantly higher compared to what they are now. In spite of not having commissioned any large renewable integration study to support their contention, Eskom cites as reasons for these constraints limitations on the ability of the grid to accommodate more than a fixed amount of renewable energy capacity per year. Further limiting the potential of increased renewable energy to address climate change concerns is the inclusion of a carbon emission constraint for the years ahead to 2050, in the form of the ‘moderate peak-plateau-decline’ carbon emission trajectory (Scholtz & Fakir, 2017).

### 3.3 THE FUTURE: THE IRP RE-OPTIMISED

The CSIR developed the ‘least-cost electricity mix for South Africa by 2030’, which was published in November 2016 at around the same time that the IRP 2016 draft was published. This document is an updated analysis of the IRP 2010 for the planning period 2020–2040. The primary aim is to update two main assumptions since the IRP 2010 was published, namely that the demand that was forecast has dropped significantly since then, and that the costs of solar PV and wind technologies are lower than those used in forecast predictions.

The research demonstrates that the most cost-optimal expansion is a >70% renewable energy share by 2050, which will also be R80 billion (\$6 billion) per year cheaper by 2050 than the current base case scenario. It also reduces CO<sub>2</sub> emissions by 65% (-130 Mt/yr) compared to the base case scenario. This means that South Africa can de-carbonise its electricity sector without having to trade off clean energy against lowest cost. The CSIR recommends, similar to the Ministerial Advisory Council on Energy, that the base case scenario should be least-cost, and free of any artificial constraints. Limits of building new renewable energy developments should be lifted, relative costs of wind and PV should be updated, and the unconstrained re-optimised case should form the base case scenario of IRP 2016. If this option is implemented, the lowest-cost option for South Africa’s energy mix is a 70% share of renewables by the year 2040 with a cost reduction of R90 billion annually by 2040. In addition, this scenario will use less water and has a higher number of employment opportunities. Most importantly, there is no need to bring expensive nuclear plants into the system that forms a large part of the proposed future energy mix (Wright et al, 2016; see also Scholtz & Fakir, 2017).

*“The CSIR research demonstrates that solar PV, wind and flexible power generators are the cheapest new-build mix for the South African power system.”*



**Figure 3.4: The re-optimised scenario for renewables by the CSIR compared to a 'business-as-usual' scenario**

### 3.4 OTHER KEY POLICIES AND LEGISLATION

The **National Development Plan** (NDP) outlines the 2030 vision for South Africa's energy sector and envisages a sector that will promote, inter alia, 'economic growth and development through adequate investment in energy infrastructure and the provision of quality energy services that ... promote environmental sustainability through efforts to reduce pollution and mitigate the effects of climate change' (NDP, 2011). In particular, it proposes that renewable energy and gas should make up 20 000 MW of the electricity supply by 2030 (GCIS, 2016).

The **Green Economy Accord** is an agreement between government, business and labour sectors which focuses on the need to stimulate the green economy and the critical need to create jobs. This document commits to achieving low-carbon-based economic development growth through renewable energy and green jobs (Department of Economic Development, 2011).

More energy specific is the **Integrated Energy Plan (IEP)** (2016), which provides a roadmap for the future energy landscape in South Africa, and guides future energy infrastructure investments and policy development (DoE, 2015a). It has still not been approved by the Cabinet (Baker, 2016) and is currently out for public comments.

Energy-specific legislation includes the **National Energy Act 34 of 2008**, which provides (in the Preamble to the Act) ‘for energy planning, increased generation and consumption of renewable energies, contingency energy supply, holding of strategic energy feedstocks and carriers, adequate investment in, appropriate upkeep and access to energy infrastructure’.

*“In particular it proposes that renewable energy and gas should make up 20 000 MW of the electricity supply by 2030.”*

The **Electricity Regulation Act 4 of 2006** empowers the Minister of Energy to determine, approve and procure new electricity generation capacity. A licence for generation capacity is subject to ministerial approval. Renewable energy projects by IPPs that are larger than 1 MW need a generation licence (DoE, 2015b). In view of the rapid rise of embedded generation (primarily PV on rooftops), in particular project developers who are increasingly developing large renewable energy generation facilities, it has been necessary to review existing regulations relating to these facilities. (The amendments contained in the Draft Licencing and Registration Notice published for public comment in December 2016 will be discussed in more detail in Chapter 5.)

## 3.5 GOVERNMENT MANDATES

Over and above Eskom, there are a multitude of government departments and stakeholders whose decisions and actions impact on the development and implementation of renewable energy. Key players include the DoE, the Department of Public Enterprises (DPE), the South African National Energy Development Institute (SANEDI), and the National Energy Regulator of South Africa (NERSA). Each of these bodies has a different role and intervenes at a different stage in the electricity value chain (Table 3.1).

**Table 3.1: Key role players and their mandates**

| Role player                                       | Mandate                                                                                                                                                                        |
|---------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Department of Energy (DoE)                        | Custodian of policy and planning for the energy sector, focusing on energy security through diversifying the country’s energy mix to include renewable energy sources          |
| National Energy Regulator of South Africa (NERSA) | Regulates the energy sector in the context of national policy and planning, license new energy infrastructure and regulate electricity and hydrocarbons infrastructure tariffs |
| National Treasury                                 | Governs fiscal and procurement policies                                                                                                                                        |
| Department of Trade and Industry (DTI)            | Develops local industries and trade with particular focus on green industries and job creation; works to attract foreign investment                                            |
| Department of Public Enterprises (DPE)            | Shareholder in Eskom, the sole power off-taker                                                                                                                                 |
| Department of Economic Development                | Sets and develops economic policy, economic planning and economic development; focuses on employment creation and the green economy                                            |
| Department of Environmental Affairs (DEA)         | Sustainable development and environmental integrity; grants environmental authorisations in terms of the National Environmental Management Act (NEMA)                          |
| Provincial departments and municipalities         | Regulate private renewable energy generation (embedded generation) through by-laws and policies                                                                                |

## RENEWABLES REVITALISE RURAL AREAS

*The Bokpoort solar thermal power plant south of Upington is creating thousands of jobs in local communities.*

The 50 MW Bokpoort concentrated solar thermal power plant outside Groblershoop, an hour south of Upington, has eight 'solar fields', which means rows and rows of mirrors that need cleaning each week. The operational jobs associated with this and similar renewable power plants around the country will benefit communities living near the plants for the 20-year life-span of each plant. At its construction peak, over 1 300 jobs were created at the plant, filled largely by the local community previously dependent on farm work.

An analysis of the job opportunities associated with the state's renewable energy programme by the University of Cape Town's Graduate School of Business estimates that the number of construction and operational jobs across all 96 plants in the REI4P programme will be close to 110 000 in total. Nearly 85 000 of these will be specifically for black South Africans, and nearly 58 000 for people living in the vicinity of the sites.





# THINK PIECE

## ELECTRICITY SUPPLY IN SOUTH AFRICA: PATH DEPENDENCY OR DECARBONISATION?

**Gaylor Montmasson-Clair, Senior Economist: Sustainable Growth, TIPS**

Renewable energy technologies have experienced an exponential growth in South Africa, thanks to the government-run REI4P and a number of pioneering municipalities active in the promotion of small-scale embedded generation. However, South Africa's electricity sector lacks a level playing field and the country remains far from demonstrating a strong, long-term commitment to developing renewable energy technologies. Significant vested interests have maintained overwhelming support for centralised, coal-based electricity generation, preventing the development of renewable energy technologies to their full potential and desired level.

Indeed, despite factoring in the transition to a lower-carbon and more environmentally friendly energy mix, the IRP 2010 fails to set the country's electricity sector on a sustainable development path (as acknowledged by the 2013 IRP Update). Negating the benefits of renewable energy technologies, the persistent domination of coal-based electricity remains at the core of energy planning in South Africa, with solid-fuel technologies expected to grow in megawatt of generation capacity, notably with the construction of two large-scale power plants, at Medupi and Kusile respectively.

More broadly, vested interests have gangrened all attempts at restructuring the electricity supply industry, such as the Independent System and Market Operator Bill, which was never passed. While the REI4P has constituted a stepping stone for renewable energy technologies in the country, it has had no real impact on competition in the electricity market, only introducing competition for a limited, defined market. Moreover, facing the strong public rejection of the national vertically integrated utility Eskom, the REI4P programme now appears to be in an uncertain stand-by, turning from a world-acclaimed initiative to a missed opportunity. Similarly, the national government, failing to develop an enabling policy framework, has muted the development of small-scale embedded generation and energy trading, further entrenching the domination of large-scale, utility-driven projects.

What is more, not only is the policy environment constrained for renewable energy but the coal value chain continues to receive significant governmental support via national departments (such as the DoE and the Department of Mineral Resources), development finance institutions (such as the Industrial Development Corporation) and state-owned enterprises (such as Eskom and Transnet). Indirect subsidies linked to externalities associated with fossil fuels, such as global warming, reached \$38.5 billion (or 10.9% of GDP) in the same year.

The electricity sector in South Africa is a highly contested space and the emergence of renewable energy technologies has generated a healthy revitalisation and disturbance of the status quo in the industry. Going forward, active efforts are however required to provide a level playing field for all energy technologies and accelerate the transformation of electricity supply in the country. This includes truly incorporating the low-carbon transition in electricity planning, opening the policy space for the development of embedded generation and phasing out fossil-fuel subsidies.

*“The amount provided for fossil-fuel subsidies in South Africa is impressive.”*

## 4. REI4P SUCCESSSES AND CHALLENGES

**The Renewable Energy Independent Power Producer Procurement Programme was initiated in 2010 to call for the procurement of renewable energy projects in South Africa.**

### 4.1 INTRODUCTION

As highlighted in Chapter 3, the South African government's steps to introduce renewable energy technologies were a clear policy choice outlined in the White Paper on Renewable Energy Policy (2003). This was subsequently formalised by the Electricity Regulation Act 4 of 2006. This Act directed that the Minister of Energy will determine what new generation capacity is needed and which requires participation by IPPs. In addition, the Act makes provision that electricity generated by IPPs must be purchased by the designated buyer (Eskom), who must also provide non-discriminatory access to the transmission and distribution power systems and, in doing so, enable private sector participation in electricity generation (DoE, 2017).

*“South Africa surprised the international renewable energy stage with its call to perform at an unprecedented scale and pace.”*

The REI4P was initiated by the 2010 Integrated Resource Plan for Electricity (IRP) 2010, a subset of the IEP (Montmasson-Clair, 2017). In accordance with the IRP 2010, a Request for Proposals was issued on 3 August 2011, calling for the procurement of 3 725 MW of renewable energy projects from the private sector over five rounds, subject to minimum qualification criteria and a competitive bidding process (see the text box below). With only a small number of independent power producers (IPPs) in existence, no history of large-scale renewable energy installations, and a very short timeline of three months to submit the bids for the first round, South Africa surprised the international renewable energy stage with its call to perform at an unprecedented scale and pace (Papapetrou, 2014).

Over and above climate change considerations and energy diversification, the REI4P was also developed to attract private investment, stimulate the development of the local renewable energy technology manufacturing sector through setting local content requirements, and drive socio-economic and enterprise development (Baker & Wlokas, 2015).

#### BOX 1

#### THE COMPETITIVE REI4P BIDDING PROCESS

Potential project developers compete against one another through a comparative rating system (Eberhard et al., 2014). The successful projects sell electricity to Eskom under a 20-year power purchase agreement. The project bids are evaluated based on 70/30 scoring criteria, where 70% is scored on a price below a certain cap, decreasing with each round, and 30% on economic development criteria, which include factors such as job creation, participation of historically disadvantaged individuals, protection of local content, rural development, community ownership and skills development (Greencape, 2017a). Funding for the REI4P to date has been provided through a variety of foreign private equity, local private equity and large commercial and development banks (IPP Office, 2016).

## 4.2 OVERVIEW OF KEY OUTCOMES TO DATE

### 4.2.1 NUMBER OF PLANTS

To date 102 preferred bidders have been selected to develop utility-scale projects across the country. The projects are spread out throughout seven provinces in South Africa, with the Northern Cape having the highest number of projects at 33, followed by the Eastern Cape at 13 (IPP Office, 2016) (Figure 4.1).

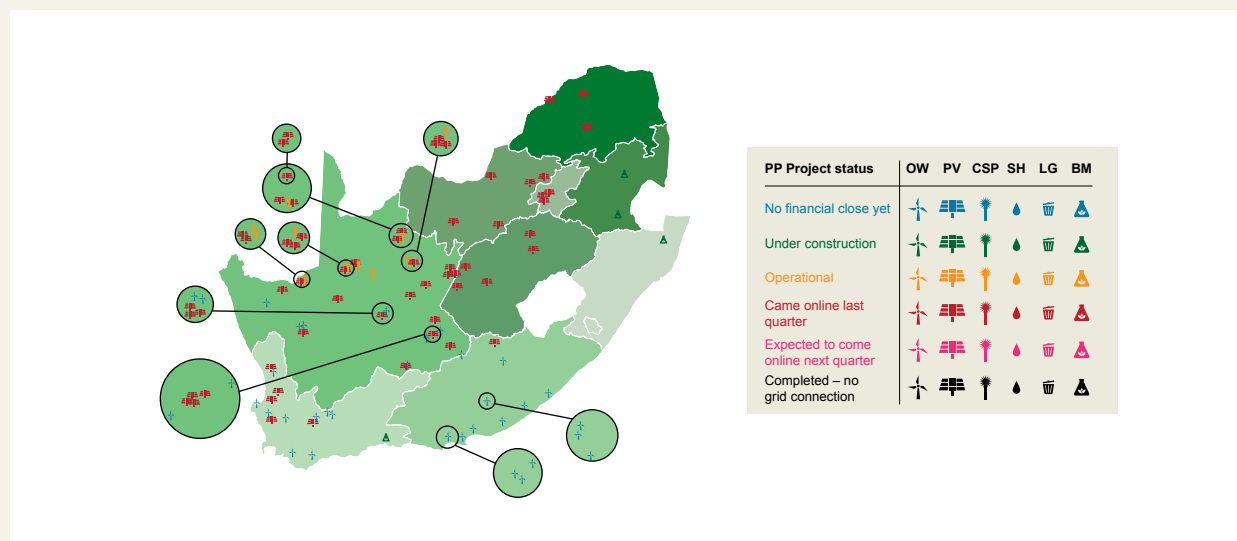


Figure 4.1: South Africa's renewable energy footprint

### 4.2.2 CAPACITY

Over and above the initial allocation of 3 725 MW in 2011, an additional 3 200 MW was added in 2012. A further 6 300 MW and 1 500 MW were added in 2015 and 2016 respectively (IPP office, 2016) (Figure 4.2). This brought the ministerial determination to 14 725 MW.

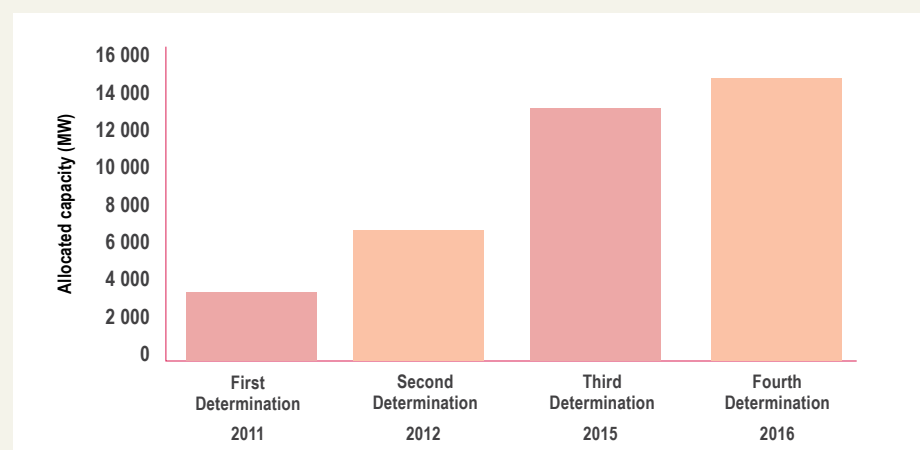
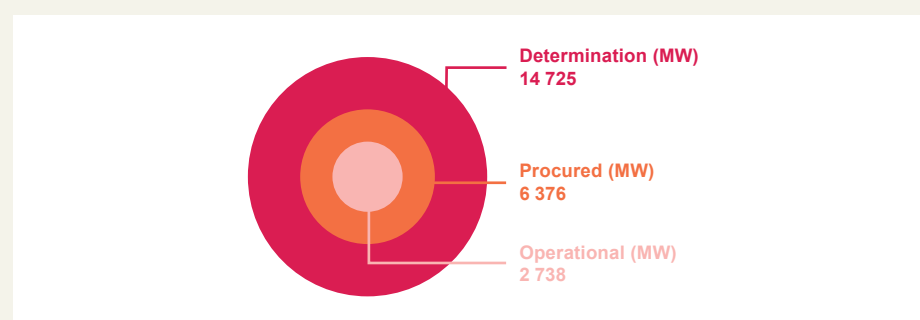


Figure 4.2: Cumulative determined renewable energy capacity

In contrast to the budget and time overruns experienced by the large-scale coal-fired plants that were commissioned (Medupi in Limpopo province and Kusile in Mpumalanga), the renewable energy projects under bid window (BW) 1 and 2 have been delivered on time, on budget and are connected to the grid. Most of the projects from bid windows 3, 3.5 and 4 are still under construction, but some projects have already been connected to the grid.

By 2016, the REI4P had already successfully procured 43% of the 14 725 MW target, i.e. 6 376 MW of generation capacity (IPP Office, 2016), which leaves a remaining 6 300 MW still to be procured. By October 2016 all the projects from bid windows 1 and 2, with a generating capacity of 2 738 MW, had already been connected to the grid (IPP Office, 2016). Figure 4.3 shows the progress of the programme by 2016 in comparison to the ministerial determination.

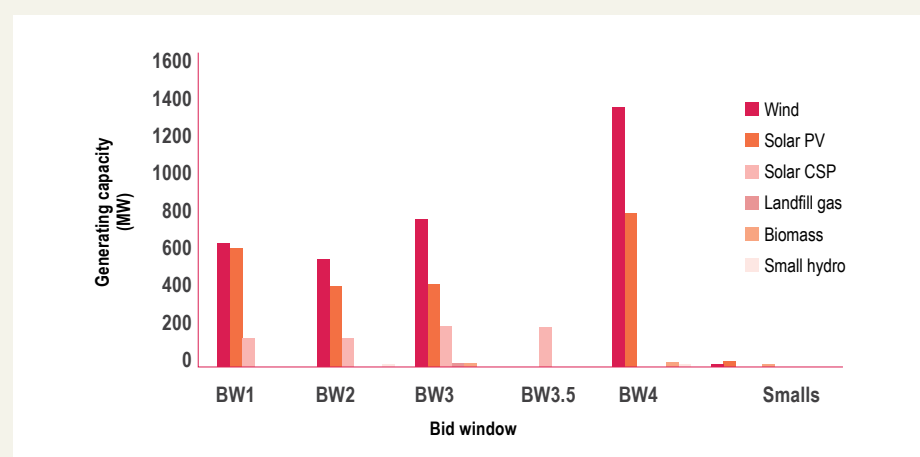


Source: IPP Office, 2016

**Figure 4.3: REI4P progress against the ministerial determination**

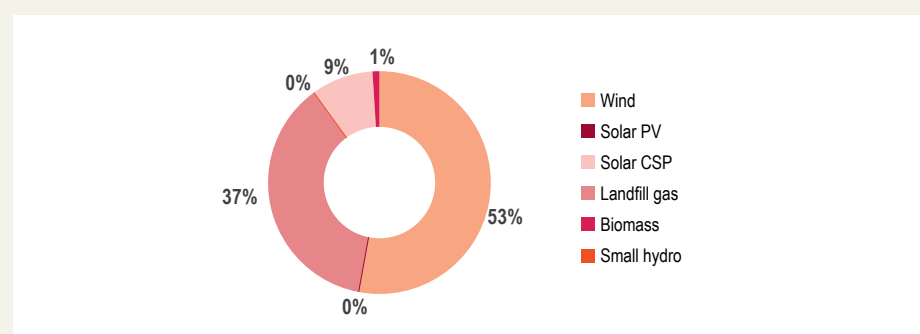
### 4.2.3 MIX OF TECHNOLOGIES

The procured generation capacity consists of different sources of renewable energy: wind, solar, landfill gas, biomass and small hydro. Wind energy is the most-procured technology with half of the taken-up generating capacity of the bid window to date, with solar PV following in second place (Figures 4.4 and 4.5).



Source: IPP office, 2016b

**Figure 4.4: Generating capacity procured under the REI4P based on the type of technology used**



Source: Author and IPP Office, 2016

**Figure 4.5: Generating capacity procured under the REI4P based on the type of technology used**

*“The number of construction and operational jobs across all 96 plants in the REI4P programme will be close to 110 000. Nearly 85 000 of these will be specifically for black South Africans, and nearly 58 000 for people living in the vicinity of the sites.”*

(UCT Graduate School of Business)

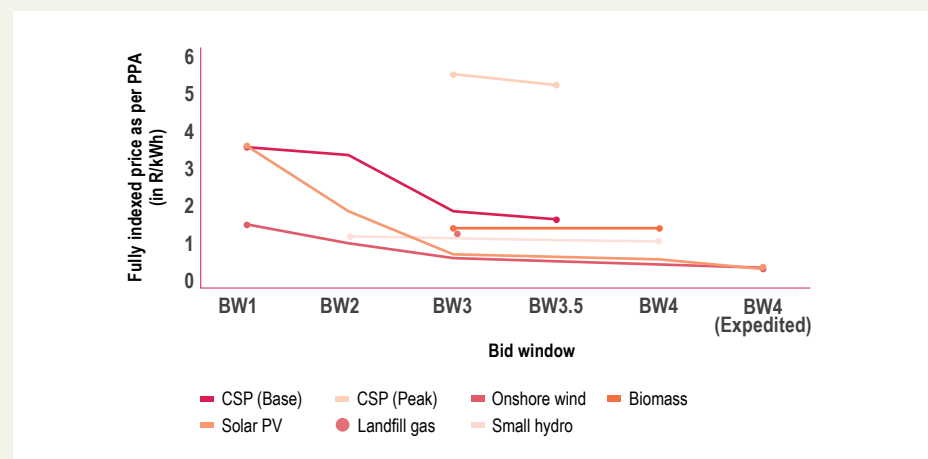
#### 4.2.4 SOCIO-ECONOMIC BENEFITS

The programme has attracted R195 billion in large investments to South Africa, 25% of which came from foreign investors (IPP, 2016; Greencape, 2017), and R31.6 billion from South Africa’s development finance institutions and state-owned enterprises (Montmasson-Clair, 2017). It is reported that in a three-year period the REI4P has created 26 790 jobs for South Africans, mostly in the construction and operation of the plants (IPP Office, 2016). It has also contributed to a more effective implementation of a higher impact Industrial Policy Action Plan and attracted new investment in local manufacturing, for example solar PV panels and wind towers (DoE, 2017).

The REI4P procurement requirements have ensured that broad-based black economic empowerment (B-BBEE), local ownership and local content have been taken into consideration for each project. In this regard a total of R65.5 billion has been procured from B-BBEE firms for the projects that have signed up and an amount of R32.1 billion has been spent on local content (IPP Office, 2016). In addition, 31% of the shares in the procured projects are held by black South Africans, of which 31% is held by local communities.

#### 4.2.5 DECREASED PRICES

Successive capacity bidding rounds have seen tariffs fall to the point that renewables are now the cheapest form of electricity generation available to South Africa. Independent research by the CSIR has confirmed that wind and solar PV energy are, without a doubt, the lowest-cost generation option for South Africa’s future (SAWEA, 2017).



Source: Montmasson-Clair et al., 2017

Figure 4.6: Movement of prices per technology for the REI4P (in R per kWh)

### 4.3 FUTURE CHALLENGES

In spite of its promising beginnings and the extensive socio-economic and environmental benefits that the REI4P unlocked, the future is looking fraught. As discussed in earlier sections, Eskom is a vertically integrated utility that controls the transmission infrastructure and is by far the largest electricity generator in the country (Montmasson-Clair, 2017). The IPPs are wholly dependent on Eskom for transmission of the electricity that they generate and can also only sell to Eskom as the sole off-taker. Increasingly, concerns are being raised that Eskom is abusing its position to favour its own investment in new power plants, thereby in essence opposing the government’s energy policy (Montmasson-Clair, 2017; SAWEA, 2017).

*“Concerns are being raised that Eskom is abusing its position to favour its own investment in new power plants, thereby in essence opposing the government’s energy policy.”*

This became clear in 2016 when Eskom’s CEO publically indicated the utility’s unwillingness to sign further power purchase agreements (PPAs) with IPPs from bid windows 3.5, 4 and 4.5 (Slabbert, 2017; Creamer Media, 2016), citing an oversupply of electricity from its own generation plants and what it considers to be the high tariffs agreed upon with IPPs as some of the reasons for its refusal to honour the REI4P agreements (Slabbert, 2017). In January 2017, Eskom verbally indicated that they would be willing to sign the off-take agreements for bid window 3.5 at a renegotiated price of equal or less to 77c/kWh (DoE, 2017).

Many would argue that Eskom is being disingenuous when it argues that renewable energy will be more expensive than the proposed 9.6 GW new nuclear build programme with a projected cost of \$50 billion (about R776 billion) (see Chapter 3). Irrespective of how the financing is structured, an amount of this magnitude raises the spectre of ‘crippling principal debt and interest payments’ that can lead to the reallocation of public budgets away from critical state spending (Scholtz & Fakir, 2017). Rather, what we are seeing is an attempt to entrench Eskom’s monopoly in the energy sector. Should the DoE proceed with the least-cost unconstrained scenario, the bulk of new-build renewable energy and gas will be built by IPPs. This will over time reduce Eskom’s role in generation and limit its role in the sector to the distributor of the electricity generated by IPPs.

In response, the South African Wind Energy Association (SAWEA) has lodged an official complaint with the National Energy Regulator of South Africa (NERSA) over Eskom’s failure to comply with ministerial determinations by refusing to enter into PPAs with preferred bidders (SAWEA, 2017).

In spite of President Zuma’s directive to Eskom that it must proceed and sign the outstanding PPAs, this has not been done to date. In addition, there is a new minister at the helm of the Department of Energy. All these factors add to the uncertainty about the continuity and long-term future of the REI4P. Complicating matters, and once again spotlighting the critical role of coal, has been the announcement of early closures of coal-fired electricity power plants. This has galvanised trade unions, such as the National Union of Metalworkers of SA (NUMSA) and the National Union of Mineworkers (NUM) to oppose the further roll-out of the REI4P on the basis that it will lead to job losses in the coal sector. Earlier this year, coal truck drivers went on strike against the REI4P, claiming that the programme was to blame for Eskom cancelling their contracts (Van Rensburg, 2017).

Failure to sign the off-take agreements will also have wider repercussions for South Africa as a whole. It exposes the government to litigation risk and increased contingent liabilities should Eskom default. It raises questions about the government’s commitment to mitigating climate change, increases the potential of a further sovereign downgrade and lastly, creates market uncertainty that negatively affects investor confidence (DoE, 2017).

*“By including large-scale nuclear power in all its scenarios, Eskom is trying to ensure that it remains relevant.”*

The reluctance of Eskom has given ammunition to large metros, such as the City of Cape Town and the City of Johannesburg, who have expressed interest in bypassing Eskom and purchasing electricity directly from IPPs. However, they face an uphill battle on various grounds. Long-term procurement of energy from IPPs is governed by the Electricity Regulation Act 4 of 2006 (ERA) and the Electricity Regulations on New Generation Capacity of the DoE, which mandate that buyers can only purchase electricity from a renewable energy-based project approved as part of the REI4P. Projects outside the REI4P would not be allowed to supply to the grid. In addition, Eskom is designated as the ‘central buyer of power’ from IPPs, preventing municipalities from directly procuring from IPPs. Unless this is revoked or amended, the opportunity to buy from IPPs is not a possibility for municipalities at this stage (Montmasson-Clair et al., 2017; Brandt, 2017).

Given the uncertainty surrounding the future of the REI4P, eyes increasingly turn to the potential of rooftop photovoltaics to address electricity needs and climate considerations.

## RENEWABLE ENERGY PROMOTES EDUCATION IN RURAL AREAS

Since the concentrated solar power plant just outside the Karoo town of Touws River started selling electricity to Eskom in December 2014, a percentage of its revenue has been invested in study opportunities, work experience and jobs for youngsters who might otherwise have few opportunities in the region's lacklustre economy. Cornelius Flink is a graduate of this programme, and now works as one of the Touwsrivier CPV1 PV plant's 'light voltage' electricians.

About 96 renewable plants are being built around the country, each of which will fund development work in communities living in a 50 km radius of the site, and give them shares in the plant.



# 5. THE ROOFTOP PV REVOLUTION

More and more people are becoming interested in using solar photovoltaic panels that are mounted on rooftops, to generate their own electricity.

## 5.1 INTRODUCTION

**kW:** kilowatt, the unit of power that an appliance uses when switched on

**kWh:** kilowatt hour, the unit in which electricity is billed. 1 kWh = 1 unit of electricity. If 1 kW of power is generated for 1 hour, this equals 1 kWh.

**MWh:** megawatt hour, 1 000 kWh = 1 MWh

**LV:** low voltage, the typical electricity lines at points of low load, such as residential customers

**MV:** medium voltage, the typical electricity lines at points of higher loads, such as industrial customers in the country

As recently as ten years ago, only the very technically inclined or people living in areas that were not connected to the electricity grid were interested in solar photovoltaic (PV) panels. The general awareness of rooftop PV has been growing and more and more people are becoming interested in 'generating their own electricity'. The reasons for this are numerous – the cost of PV panels has dropped significantly worldwide, making them much more affordable. Other drivers for the increase in interest and uptake have been the load shedding of 2007/08 and again in 2015, and the continuously rising cost of electricity in South Africa.

The drop in installation costs, the higher-than-inflation rise in electricity tariffs, South Africa's abundant sunshine and the recurring load shedding in 2015 have triggered a silent revolution in South Africa.

Figure 5.1 illustrates how the solar PV system works. Electricity that the household does not use is fed back into the national grid.

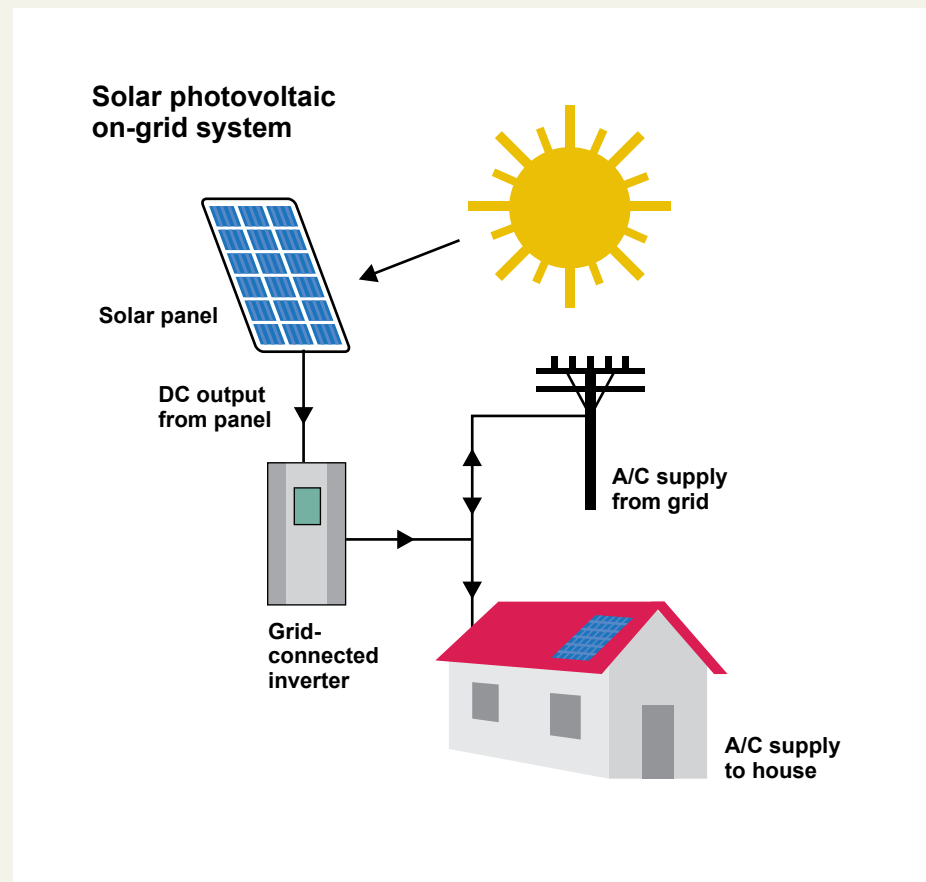


Figure 5.1: An illustration of the solar PV on-grid system

## BOX 2

### HOW DOES IT WORK?

Small-scale embedded generation (SSEG), distributed energy (DE), behind-the-meter electricity generation and distributed generation (DG) all refer to the same thing – photovoltaic (PV) installations on the roofs of buildings, which are connected to the electricity grid.

These systems typically do not have batteries, and when they do, the batteries are mostly for backup in case of power cuts. When the sun is shining, the solar PV panels generate electricity which is then either consumed by the occupants of the household or business or ‘pushed back’ to the grid so that it becomes available to other electricity consumers. When the sun is not shining and the solar PV panels are not generating electricity, the occupants use grid electricity. In this context it is often said that the systems ‘use the grid as storage’.

Some other terms connected to these installations are:

1. **Small-scale embedded generation (SSEG) tariff:** The occupant of the building buys electricity from the electricity distributor (Eskom or the municipality) at a certain tariff and sells excess generated electricity to the distributor at another (usually lower) rate.
2. **Net metering:** The occupant of the building only pays for the net electricity used from the electricity distributor (Eskom or the municipality) or, seen differently, the occupant of the building is compensated for the electricity generated. This is done at the same tariff as the tariff the occupant pays when buying electricity from the distributor.

SSEG installations can range from as small as 1 kilowatt peak ( $1 \text{ kW}_p$ ) (approximately  $6 \text{ m}^2$ ) on a residential home up to over 2 megawatt peak ( $2 \text{ MW}_p$ ) on the roofs of industrial, commercial and agricultural customers ( $1\,000 \text{ kW}_p = 1 \text{ MW}_p$ ).

## 5.2 INCREASED UPTAKE

Rooftop PV is probably the renewable energy technology that receives the most attention world-wide and is universally considered desirable. Photovoltaics had record additions for the second consecutive year, accounting for about 77% of new installations (REN21, n.d.). Electricity consumers are attracted to rooftop PV to save money, do environmental good, have greater control over their energy use, or just merely for the novelty of it.

With subsidy schemes and attractive feed-in tariffs (i.e. earnings from feeding surplus electricity back into the grid), these installations have become popular in cities in Germany, Australia and the USA, among other countries. Owing to the international popularity of the technology, combined with the growth in the independent power provider PV sector internationally, prices for this technology have dropped dramatically in the past few years, making it increasingly financially viable to install rooftop PV.

According to market analysis by PQRS (PQRS, 2017), by the end of 2016, estimated PV installations in South Africa were already at  $218 \text{ MW}_p$ . These installations comprise almost  $9 \text{ MW}_p$  in the agricultural sector,  $110 \text{ MW}_p$  in the commercial and industrial sector, and  $24 \text{ MW}_p$  in the residential sector.

However, according to the GreenCard report, ‘Status of SSEG in South African Municipalities’, municipalities in South Africa are only aware of about  $38 \text{ MW}_p$  of installation (PVGGreenCard, 2017). This is less than 20% of the estimated total installations of  $218 \text{ MW}_p$ . The larger of these installations are mostly done with the knowledge and approval of the electricity distributor (the municipality or Eskom) but it is likely that many residential installations are done illegally.

Municipalities and Eskom also play a major role in the procedural arrangements in their respective electricity distribution areas. With the national regulatory uncertainty for smaller systems, Eskom handles applications on a case-by-case basis, but only allows customers connected on their medium-voltage feeders to feed back electricity into the grid. Many municipalities, however, are allowing grid-connected rooftop PV installations for all customers in their distribution areas and quite a few have SSEG tariffs in place. The municipalities in South Africa with processes in place for rooftop PV are listed on the PVGreenCard website.

## 5.3 THE BUSINESS CASE

What should you know if you want to install rooftop PV on the roof of your home or business? Apart from technical and procedural arrangements with the electricity distributor (Eskom or the municipality), most people are also interested in what the systems typically cost and how much they will save in future electricity costs. The techno-economic viability of PV installations depends on numerous factors, namely:

- the space available (strength, suitability, size)
- the design of the system (in relation to the space and resource available)<sup>1</sup>
- the system installation cost<sup>2</sup>
- the system operation and maintenance cost
- financing options (such as own financing, a grant or a loan)
- the electricity usage profile of the site<sup>3</sup>
- the generation profile of the plant<sup>4</sup>
- how often the system will be off line (due to faults or maintenance)
- applicable electricity tariffs.<sup>5</sup>

As these factors differ substantially for different sites and applications, the specifics can only be determined with certainty through pre-feasibility studies. An example of such a study is the one conducted for Drakenstein Municipality (WWF, 2015).

Even though the cost of PV installations has dropped significantly over the past few years, installing a rooftop PV system still represents a significant investment. Larger stand-alone systems are also proportionally cheaper than smaller rooftop installations. Total installation costs typically range from approximately R11 per kW<sub>p</sub> for very large, easy-to-install systems to approximately R30 per kW<sub>p</sub> for more complex and smaller systems.

In South Africa, the annual PV generation of optically inclined systems are:

|           |                           |
|-----------|---------------------------|
| Kimberley | 1 854 kWh/kW <sub>p</sub> |
| Pretoria  | 1 731 kWh/kW <sub>p</sub> |
| Cape Town | 1 621 kWh/kW <sub>p</sub> |
| Durban    | 1 409 kWh/kW <sub>p</sub> |

<sup>1</sup> Including whether the system includes a battery system, etc.

<sup>2</sup> Larger systems are cheaper per kW<sub>p</sub> than smaller ones. System installation cost also differs owing to specific installation difficulties (type of roof, distance from circuit board and space for inverters).

<sup>3</sup> To estimate whether the electricity generated by the PV will be self-consumed or fed back into the grid.

<sup>4</sup> This depends on the location, orientation and angle of the PV panels as well as the efficiency of the specific PV panels used.

<sup>5</sup> Including the active energy charge for usage and the feed-in tariff for excess generation, if needed.

Without denying that the business case for each installation will depend on all the factors listed above, for the sake of simplicity only the following will be considered in an example of estimating the viability of an installation:

- the cost of the system
- the active energy charge of electricity (kWh).<sup>6</sup>

Table 5.1 shows a few simplified examples of rooftop installations.

**Table 5.1: Example of electricity cost saving in Year 1 for different installations and locations**

| Size of the system | Capital cost per kW <sub>p</sub> | Total capital cost | Location | Active energy charge per kWh | Annual PV output (optimally inclined) | Electricity saving Year 1 |
|--------------------|----------------------------------|--------------------|----------|------------------------------|---------------------------------------|---------------------------|
| 1 MW <sub>p</sub>  | R14                              | R14 000 000        | Pretoria | R0,90                        | 1 731 kWh/kW <sub>p</sub>             | R1 557 900                |
| 3 kW <sub>p</sub>  | R25                              | R75 000            | Pretoria | R2,00                        | 1 731 kWh/kW <sub>p</sub>             | R10 386                   |
| 1 MW <sub>p</sub>  | R14                              | R14 000 000        | Durban   | R0,90                        | 1 409 kWh/kW <sub>p</sub>             | R1 268 100                |
| 3 kW <sub>p</sub>  | R25                              | R75 000            | Durban   | R2,00                        | 1 409 kWh/kW <sub>p</sub>             | R8 454                    |

## 5.4 CHALLENGES FOR MUNICIPALITIES

The question is no longer whether the installation of SSEG will continue to increase; the evidence is there that it will. Installations of this nature might be disruptive to the existing electricity distribution system because they are smaller, cheaper, better and, perhaps most importantly, they empower individuals and communities. This is a positive trend from a climate change mitigation perspective, but the popularity of rooftop PV installations have radical implications for municipalities as many rely on the income from electricity to subsidise electricity provision to lower income groups and also other municipal services.

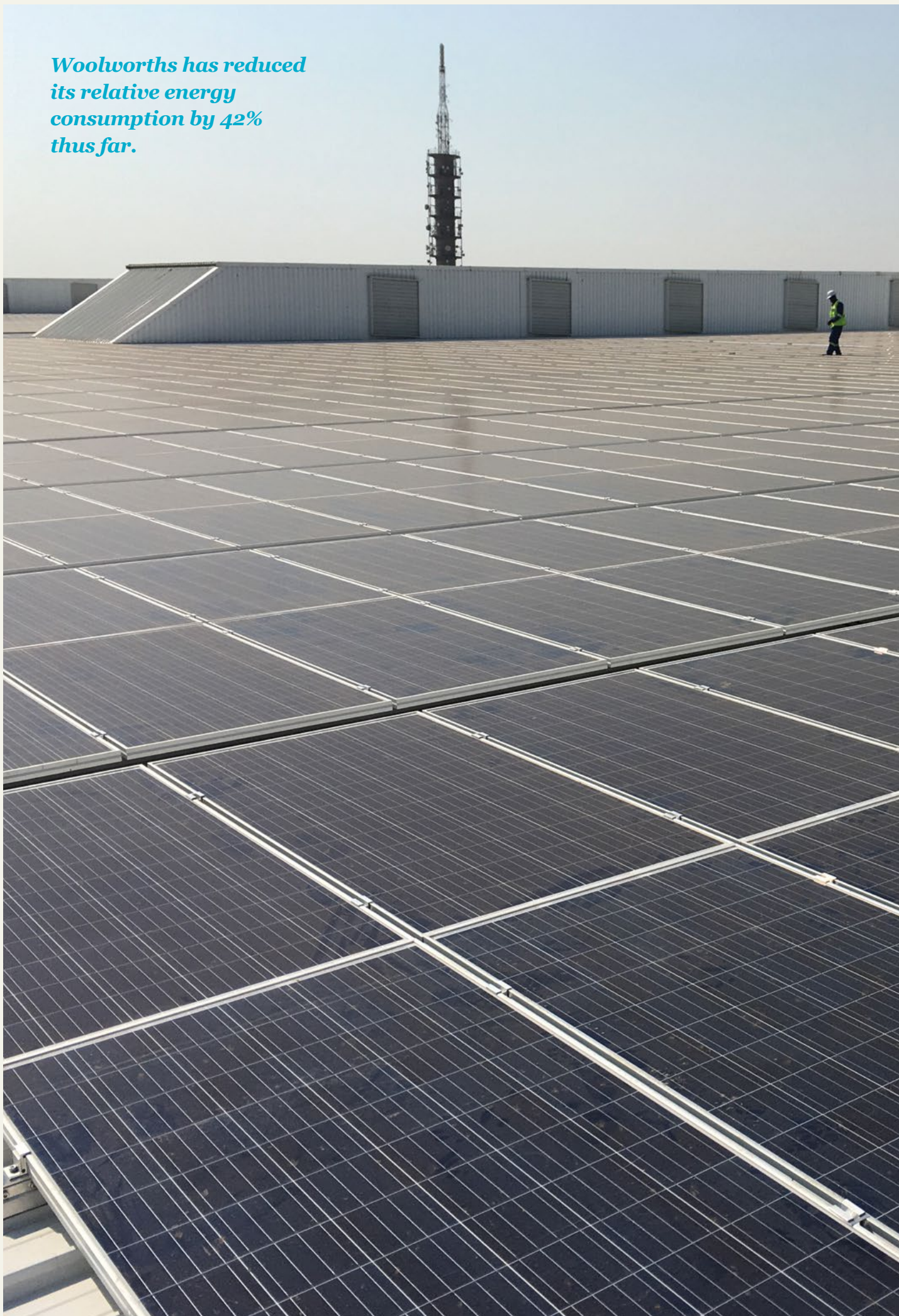
Municipalities licensed for electricity distribution generate on average about 26.8% of their revenue through a mark-up on the electricity bought from Eskom. However, it is not only rooftop installations that affect the municipal revenue from electricity but also the installation of solar water heaters and heat pumps, energy-saving appliances and fuel switching (replacing an electric stove with a gas one). However, rooftop PV installations are the only ones for which the municipality is required to keep a list and where the rules and regulations about the safety of the installations are in some cases still unclear.

Even though many municipalities have a political commitment to reduce carbon emissions and, in doing so, to support rooftop PV installations, they often struggle to come to terms with the potential loss of revenue that these installations pose. However, if there is no impact on municipal revenue after the rooftop PV installation and the customer still pays the same amount every month for electricity, the installation will not be viable at all. Municipalities thus understand that the promotion of energy technologies with the potential to reduce carbon emissions will have a revenue impact.

The question is now how these installations will be integrated and managed on the grid and also how SSEG customers will be billed at rates that are both fair to them and also fair to the remaining electricity customers. The old top-down utility infrastructure model will increasingly come under pressure as new technologies become a disruptive force in electricity infrastructure. Renewable energy, microgrids, smart grids and distributed generation will change the way we manage our electricity forever.

<sup>6</sup> Not the average kWh charge, but the actual kWh charged for the electricity not bought from the utility anymore and/or the kWh tariff paid by the utility for excess electricity fed back into the grid.

*Woolworths has reduced  
its relative energy  
consumption by 42%  
thus far.*





# THINK PIECE

## A PRIVATE SECTOR PERSPECTIVE: GOOD FOR BUSINESS, GOOD FOR THE CLIMATE

**Justin Smith, Good Business Journey Manager, Woolworths**

With energy and climate change as one of the pillars of Woolworths's Good Business Journey, the company has committed to increasing energy efficiency in their operations and reducing their overall carbon emissions in line with the global climate change imperative. In this regard Woolworths has set aggressive targets, namely a 50% reduction of their carbon footprint by 2020 and further, and to source all their energy required for their direct operations from renewable sources by 2030.

The company's renewable journey kicked off in 2012 with a decision to investigate the feasibility of using renewable energy installations for the business through pilot installations. Two considerations underpinned the decision. In the first instance, Woolworths realised that it should seize the opportunity to be part of building scale for renewable energy in South Africa and their other areas of operation. In the second instance, it made business sense to invest in renewable energy as energy availability and cost were increasingly becoming a company risk that needed a proactive approach. Their first installation was a 30 kW<sub>p</sub> rooftop PV installation on one of their Cape Town head office rooftops, consisting of 120 x 250 W panels mounted on the surface of the rooftop. This installation generated 48 000 kWh, which equalled 3% of the building's electricity demand in its first year of operation, loosely translating to R33 000 in financial savings per annum.

The second phase of this installation increased its capacity to a 108 kW<sub>p</sub> system consisting of 432 x 250 W panels that generated 157 616.13 kWh per annum. This presented an opportunity to save at least R110 000 per annum. Their biggest installation to date, a 2 MW<sub>p</sub> phased installation at their Midrand Distribution Centre, is being installed in phases with 1 MW<sub>p</sub> already operational. Once completed, the system will generate over 30% of the facility's energy needs. Apart from the cost benefits, the installations will also contribute to the ongoing reduction of the company's carbon footprint across their business.

Woolworths is learning valuable lessons from the current installations. Their strategy is further refined through continuous engagement with industry bodies, facility managers and their finance teams. The knowledge thus gained is employed to improve the business case for renewables for the business in future through exploring all the renewable energy sources available, prioritising facilities that are more at risk, and ensuring that appropriate and relevant renewable energy systems are implemented.

In addition, their facilities use a building management system and a computerised system installed for the central control of electro-mechanical devices. With these systems the company is able to monitor electricity use across their operations in real time, and also detect leaks. Thanks to these efforts Woolworths has reduced its relative energy consumption by 42% thus far, with an additional 4% efficiency improvement in their African stores year on year. Overall savings from their energy reduction and efficiency interventions to date translate to an estimated R396 million in financial savings – a great story to tell as they build the business case for meeting their 2020 and 2030 targets.

*“By 2020 Woolworths wants to reduce their carbon footprint by 50%, and by 2030 all the energy required for their direct operations must come from renewable sources.”*

## 6. GOING FORWARD

**Increasing the percentage of renewable energy in South Africa's electricity mix is the most effective measure to address the country's strong commitment to reduce harmful greenhouse gas emissions.**

On 25 September 2015, South Africa submitted its Intended National Determined Contributions (INDCs), including the target of reducing its greenhouse gas emissions, to the United Nations Framework Convention on Climate Change. The INDCs have transitioned South Africa's international mitigation commitment from a relative deviation from 'business-as-usual' to an 'absolute peak, plateau and decline greenhouse gas emissions trajectory range'. In other words, emissions will rise to 34% below business-as-usual levels by 2020, peak at 42% in 2025, plateau until 2030 and then decline to 2050. The INDCs make the persuasive point that 'in the short term (up to 2025), South Africa faces significant rigidity in its economy and any policy-driven transition to a low-carbon and climate resilient society must take into account and emphasise its overriding priority to address poverty and inequality' (RSA, 2015).

Noting the importance of addressing South Africa's present energy system, the INDCs note the following (RSA, 2015):

'... South Africa is investing heavily in transforming its energy sector. At the heart of this part of the transition to a low-carbon energy sector is a complete transformation of the future energy mix, which is designed to replace an inefficient fleet of ageing coal-fired power plants with clean and high efficiency technology going forward.'



*Wind and solar power are now demonstrably the cheapest sources of power in the world.*

These commitments are aligned to energy objectives outlined in the NDP 2030, which outlines a future vision for South Africa's energy sector. In terms of the document, the sector will promote, among other things, 'economic growth and development through adequate investment in energy infrastructure and the provision of quality energy services that are competitively priced, reliable and efficient', as well as 'environmental sustainability through efforts to reduce pollution and mitigate the effects of climate change' (RSA, 2015).

Given South Africa's dependence on coal-fired power stations for 90% of its electricity generation, which in turn contributes close to 45% to our country's greenhouse gas emissions, reducing the dominant role of coal in our electricity mix provides South Africa with an obvious opportunity to make good on the country's climate mitigation commitment while also realising the vision of the NDP. Reducing the dependence on coal will also address other environmental externalities such as acid mine drainage from coal mining. In addition, the reduction of pollution originating from coal-fired power plants will positively impact on the health and well-being of communities living in the vicinity of these power plants.

Research conducted by the CSIR shows that 'South Africa has the unique opportunity to decarbonise its electricity sector without pain' by dramatically increasing the percentage of renewables in its energy mix. Wind and solar power are now demonstrably the cheapest sources of power in the world, and through smart investments in electric vehicles and transport, the possibility exists to move away completely from the fossil-fuel heavy development paradigm that is destroying the world (Wright et al., 2016).

However, the first draft of the draft IRP 2016 falls well short of the ideals articulated in the government's own NDP 2030, as well as the potential outlined by the CSIR, as discussed more fully in Chapter 3. Rather than maximising the percentage of renewable energy in our future energy mix, the document proposes an artificial limit to the amount of renewable energy that can be introduced into South Africa's electricity system on a yearly basis, and prefers to address the reduction of greenhouse gas emissions through the pursuit of costly nuclear energy.

**WWF believes that South Africa needs to embrace renewable energy and build on the good start made by the internationally recognised REI4P to decarbonise the energy sector.**

---

*‘Important changes in the provision and consumption of electricity services are now underway, driven to a significant degree by a confluence of factors affecting the distribution side of power systems. A variety of emerging distributed technologies – including flexible demand, distributed generation, energy storage, and advanced power electronics and control devices – are creating new options for the provision and consumption of electricity services. At the same time, information and communications technologies are rapidly decreasing in cost and becoming ubiquitous, enabling more flexible and efficient consumption of electricity, improved visibility of network use, and enhanced control of power systems.’*

– MIT Energy Initiative: Utility of the Future

---

To date the REI4P has been very effective in attracting large investments, creating jobs, funding socio-economic as well as enterprise development initiatives in communities living in close proximity to renewable energy plants, and supporting the setting up of new industries. In so doing, the programme has had a much wider impact than merely decarbonising South Africa’s electricity; it has also impacted positively on other key objectives of the NDP 2030 such as the critical imperatives to create jobs and alleviate poverty.

Steering away from costly nuclear power and dirty coal is the best financial decision we can make. But this low-carbon transition needs to be well thought through and just. This can be achieved by developing most of the renewable energy technologies locally, and providing targeted training and investment to address the loss of jobs that will flow from the closing of coal mines and the decommissioning of coal-fired power plants. In line with other countries in the world, South Africa has the potential to generate far more jobs in renewables, than will be lost from coal mining and related activities.



## CALL FOR ACTION

If South Africa is serious about meeting its climate commitments, it should:

- leave its coal in the ground
- maximise the percentage of renewable energy in the country’s electricity mix to bring about an energy future that is both least-cost and most impactful from a climate mitigation perspective
- maximise the complementarity of the country’s solar and wind resources and avoid investment in climate-unfriendly fossil fuels and expensive nuclear energy to provide base load
- enable cities and municipalities to plan their own electricity provision systems, allowing them the opportunity to both procure and build their own renewable energy plants, which is essential to ensure future sustainability
- ensure that policies on both national and sub-national level support private sector investment in renewable energy technologies through incentives, loans, etc.
- exert pressure on Eskom to ensure that the utility complies with its contractual obligation to sign the outstanding off-taker agreements
- ensure that any transition from fossil fuels to renewables happens within the context of a just transition that thoughtfully handles pressing socio-economic challenges, namely poverty and inequality.



# THINK PIECE

## A JUST TRANSITION TO A RENEWABLE ENERGY FUTURE IN SOUTH AFRICA

Tasneem Essop, Founding Director, Energy Democracy Initiative

There are three key drivers for a global energy transition away from fossil fuels. The first is the imperative for all governments and non-state actors to take urgent action to address climate change. The second is the need for energy security. The third, and most exciting development, is that the renewable energy sector has made massive advances in the past few years in terms of technology innovation and affordability.

These drivers have also had an impact on South Africa, a coal-dependent economy, and all key players in the country acknowledge the need for an energy transition in the country. The renewable energy (RE) sector is best placed to fulfil the objectives for a just transition. There is much more flexibility in renewable energy systems, not only in the technologies available but also in potential models of delivery. Moreover, it has none of the harmful externalities of fossil-fuel generated electricity.

However, the key challenge for such a transition in South Africa is that we ensure that as we move away from our dependence on coal, it is done in a manner that addresses our most pressing socio-economic challenges, namely poverty and inequality. There is no doubt that an energy transition will result in 'winners' and 'losers' in the economy, which means that a rational, robust and inclusive planning system is required. Workers and communities, especially those in sectors and areas that will be most affected, such as coal plants, coal mines and coal transportation, will need alternatives to secure their well-being. Options such as re-skilling for new jobs, a social protection floor and community-based livelihood programmes are critical to ensure that those most vulnerable to these changes are protected. This is the rationale behind the concept of a 'just transition'.

South Africa is already experiencing an energy transition and the big challenge is to ensure that this transition will indeed be fair and just. This will require a paradigm shift among all critical players to ensure that a transition does indeed address many of the socio-economic challenges in the country. In this regards, there are a number of challenges that need addressing to ensure that the energy transition is fair and just:

- 1. Governance and decision making:** Much work needs to be done to ensure that the governance structures and approach are truly inclusive and transparent. Participatory democratic decision making should be a fundamental factor underpinning any transition. All social partners, and especially affected communities, should be at the table when plans and decisions are made.
- 2. Policy and regulatory environment:** A massive review of existing policies and regulations governing the energy system in the country is required to ensure that the benefits of renewable energy are maximised in a transition. In addition, social policies would also need to be reviewed, especially to ensure the social protection of the most vulnerable.
- 3. Capacity building, training and skills development:** A scaled-up and targeted programme for building the knowledge and skills in the country and within communities is needed to unlock all the potential benefits in a transition.
- 4. Financing and investment:** Both public and private investment in renewable energy and its value chains should be scaled up. In addition, new financing models should be explored to ensure the funding and revenue-generation opportunities for decentralised socially owned energy systems.

To date, there has been no nationally driven process for planning a just transition. There are many initiatives and discussions on the issue, especially among non-state actors. However, what we need is an inclusive process that includes all social partners in developing an overarching socio-economic transition plan for the country which can help to inform and guide any sector or localised transition planning for South Africa's future.

A better world is possible.

*There is no doubt that an energy transition will result in 'winners' and 'losers' in the economy, which means that a rational, robust and inclusive planning system is required.*

## RENEWABLE ENERGY SUPPORTS EARLY CHILDHOOD DEVELOPMENT

*The Excelsior Wind Farm near Swellendam will benefit little ones in the local community.*

The Vulindlela Msenge crèche takes care of 60 children in Railton, in the Western Cape town of Swellendam, and has been identified as a worthy possible beneficiary of the development work which private energy firm BioTherm Energy will commit to if it builds a 32 MW wind farm outside the town.

The crèche needs educational toys, outdoor equipment, tables and chairs for indoors and office equipment, according to its principal, Melony Scholtz.

The Department of Energy has approved the development of the Excelsior Wind Farm, which BioTherm will build and own, but delays by Eskom in finalising paperwork with the Johannesburg-based firm have put construction on hold.



# BIBLIOGRAPHY

- Baker, L. & Linnea Wlokas, H.L. 2015. 'South Africa's renewable energy procurement: A new frontier? Key points'. Available at: [www.erc.uct.ac.za](http://www.erc.uct.ac.za) (Accessed: 4 May 2017).
- Baker, L. 2016. 'Post-apartheid electricity policy and the emergence of South Africa's renewable energy sector'. doi: 10.13140/RG.2.1.3597.0968, pp. 1–26.
- Bischof-Niemz, T. & Wright, J. 2016. 'Least-cost electricity mix for South Africa by 2040 Scenarios for South Africa's future electricity mix'. CSIR Energy Centre. Available at: [www.ee.co.za/wp-content/uploads/2016/11/RE-Futures-Windaba-CSIR-3Nov2016\\_FINAL3.pdf](http://www.ee.co.za/wp-content/uploads/2016/11/RE-Futures-Windaba-CSIR-3Nov2016_FINAL3.pdf).
- BizNews. 2015. 'Medupi Timeline: Costs, delays spiralling – no completion in sight'. Available at: [www.biznews.com/leadership/2015/08/06/medupi-timeline-costs-delays-spiralling-no-completion-in-sight](http://www.biznews.com/leadership/2015/08/06/medupi-timeline-costs-delays-spiralling-no-completion-in-sight) (Accessed: 22 May 2017).
- Brandt, K. 2017. 'City of CT set for legal action against Energy Minister over renewable energy'. Available at: [ewn.co.za/2017/04/19/city-of-ct-could-take-action-against-energy-minister-over-renewable-energy](http://ewn.co.za/2017/04/19/city-of-ct-could-take-action-against-energy-minister-over-renewable-energy) (Accessed: 11 May 2017).
- Creamer Media. 2016. Eskom letter sends shock waves through private power sector. Available at: [www.miningweekly.com/article/eskom-letter-sends-shock-waves-through-private-power-sector-2016-07-21/rep\\_id:3650](http://www.miningweekly.com/article/eskom-letter-sends-shock-waves-through-private-power-sector-2016-07-21/rep_id:3650) (Accessed 14 July 2017).
- CRSES. Centre for Renewable and Sustainable Energy Studies, Stellenbosch University. Available at: [www.crses.sun.ac.za/files/services/schools/sun\\_energy/Solar%20Energy%2017%20ppt.pdf](http://www.crses.sun.ac.za/files/services/schools/sun_energy/Solar%20Energy%2017%20ppt.pdf).
- CNBC Africa. 2017. 'Eskom's Medupi power station unit online a year ahead of schedule'. Available at: [www.cnbc.co.za/news/southern-africa/2017/04/04/eskoms-medupi-power-station-unit-online-year-ahead-schedule](http://www.cnbc.co.za/news/southern-africa/2017/04/04/eskoms-medupi-power-station-unit-online-year-ahead-schedule) (Accessed: 22 May 2017).
- CSIR. 2016. 'Wind power potential in South Africa on par with solar – recent CSIR study shows'. Available at: [www.csir.co.za/wind-power-potential-south-africa-par-solar-recent-csir-study-shows](http://www.csir.co.za/wind-power-potential-south-africa-par-solar-recent-csir-study-shows) (Accessed: 4 June 2017).
- DEA. 2015. The South African Climate Change Response Objective, National Climate Change Response. Available at: [www.climatechange.co.za/home/gp/2](http://www.climatechange.co.za/home/gp/2) (Accessed: 25 August 2015).
- Department of Economic Development. 2011. 'New Growth Path: Accord 4 – Green economy accord'. Available at: [www.gov.za/sites/www.gov.za/files/Accord\\_GREEN.pdf](http://www.gov.za/sites/www.gov.za/files/Accord_GREEN.pdf) (Accessed: 24 May 2017).
- DoE. 2011. 'Integrated Resource Plan for Electricity 2010–2030'. Available at: [www.energy.gov.za/IRP/irp\\_files/IRP2010\\_2030\\_Final\\_Report\\_20110325.pdf](http://www.energy.gov.za/IRP/irp_files/IRP2010_2030_Final_Report_20110325.pdf) (Accessed: 19 April 2017).
- DoE. 2015. Resolving the IPP Procurement Impasse. Presentation to the Portfolio Committee on Energy, Cape Town, 20 June.
- DoE. 2015a. Integrated Energy Plan. Available at: [www.energy.gov.za/files/IEP/2016/Integrated-Energy-Plan-Report.pdf](http://www.energy.gov.za/files/IEP/2016/Integrated-Energy-Plan-Report.pdf) (Accessed: 10 April 2017).
- DoE. 2015b. State of Renewable Energy in South Africa. doi: 9781920435080.
- DoE. 2016. IRP 2016. Available at: [www.energy.gov.za/files/irp\\_overview.html](http://www.energy.gov.za/files/irp_overview.html).
- DoE. 2017. Renewable energy. Available at: [www.energy.gov.za/files/renewables\\_frame.html](http://www.energy.gov.za/files/renewables_frame.html) (Accessed: 22 May 2017).
- Eberhard, A. 2007. 'The Political Economy of Power Sector Reform in South Africa', in T.C. Heller & D.G. Victor (eds). The Political Economy of Power Sector Reform. Cambridge: Cambridge University Press, pp. 215–253. Available at: [www.gsb.uct.ac.za/files/stanfordcupbookchapterp215-253\\_6.pdf](http://www.gsb.uct.ac.za/files/stanfordcupbookchapterp215-253_6.pdf).
- Eberhard, A., Kolker, J. & Leigland, J. 2014. 'South Africa's Renewable Energy IPP Procurement Program: Success Factors and Lessons', PPIAF, Washington DC, USA, pp. 1–56. Available at: [www.ee.co.za/article/south-africas-reipp-programme-successfactors-lessons](http://www.ee.co.za/article/south-africas-reipp-programme-successfactors-lessons).
- EIUG. 2017. About – EIUG. Available at: [eiug.org.za/about/](http://eiug.org.za/about/) (Accessed: 19 May 2017).
- Eskom. 2017a. Supply status. Available at: [www.eskom.co.za/Whatweredoing/SupplyStatus/Pages/SupplyStatusT.aspx](http://www.eskom.co.za/Whatweredoing/SupplyStatus/Pages/SupplyStatusT.aspx) (Accessed: 18 May 2017).
- Eskom. 2017b. ESCOM 1923–1929 – The Years of Establishment – Electrifying our beloved country. Available at: [www.eskom.co.za/sites/heritage/Pages/1923.aspx](http://www.eskom.co.za/sites/heritage/Pages/1923.aspx) (Accessed: 18 May 2017).
- Eskom. 2017c. ESCOM 1970–1979 – The Years of Consolidation – Demand for electricity soars. Available at: [www.eskom.co.za/sites/heritage/Pages/1970.aspx](http://www.eskom.co.za/sites/heritage/Pages/1970.aspx) (Accessed: 22 March 2017).
- Fakir S. 2015. COP 21 and South Africa's position. *Engineering News*. Available at: [www.engineeringnews.co.za/article/cop-21-and-south-africas-position-2015-10-09](http://www.engineeringnews.co.za/article/cop-21-and-south-africas-position-2015-10-09) (Accessed 8 June 2017).
- Forder, S. 2016. There are grounds for optimism about South Africa's energy future – 2050. Paper developed for WWF Internal Strategy Process. (Unpublished).
- Gauchè, P., Rudman, C. & Silinga, C. 2015. Feasibility of the WWF Renewable Energy Vision 2030 – South Africa: A spatial-temporal analysis, A WWF Technical Report. Available at: [awsassets.wwf.org.za/downloads/re\\_vision\\_2030\\_feasibility\\_report\\_final.pdf](http://awsassets.wwf.org.za/downloads/re_vision_2030_feasibility_report_final.pdf) (Accessed: 4 June 2017).
- GCIS. 2016. 'Energy and Water'. Available at: [www.gcis.gov.za/sites/www.gcis.gov.za/files/docs/resourcecentre/pocketguide/Pocket-Guide15-16SA\\_water.pdf](http://www.gcis.gov.za/sites/www.gcis.gov.za/files/docs/resourcecentre/pocketguide/Pocket-Guide15-16SA_water.pdf) (Accessed: 23 May 2017).
- Greencape. 2017a. Small Scale Embedded Generation (SSEG) Resource Pack. Available at: [www.greencape.co.za/index.php/content/small-scale-embedded-generation-sseg-resource-pack/](http://www.greencape.co.za/index.php/content/small-scale-embedded-generation-sseg-resource-pack/) (Accessed: 18 May 2017).
- Greencape. 2017b. 'Utility-scale renewable energy – 2017 Market Intelligence Report'. Available at: [www.green-cape.co.za/assets/Uploads/GreenCape-Renewable-Energy-MIR-2017-electronic-FINAL-v1.pdf](http://www.green-cape.co.za/assets/Uploads/GreenCape-Renewable-Energy-MIR-2017-electronic-FINAL-v1.pdf) (Accessed: 22 May 2017).
- Gulati, M. & Scholtz, L. 2017. Paper submitted to the TIPS Forum 2017 Industrialisation and Sustainable Growth. Johannesburg, 13–14 June 2017. (Unpublished).
- IPP Office. 2016. Stakeholder consultation Workshop: Preparation of the second Edition of the State of Renewable Energy in South Africa Report: Market Overview and Current Levels of Renewable Energy Deployment. Available at: [www.energy.gov.za/files/renewable-energy-status-report/Market-Overview-and-Current-Levels-of-Renewable-Energy-Deployment-NERSA.pdf](http://www.energy.gov.za/files/renewable-energy-status-report/Market-Overview-and-Current-Levels-of-Renewable-Energy-Deployment-NERSA.pdf) (Accessed 19 June 2017).
- Joffe, H. 2012. 'Challenges for South Africa's electricity supply industry', Helen Suzman Foundation Focus, 64: 32–37. Available at: [hsf.org.za/resource-centre/focus/focus-64/HJoffe64.pdf](http://hsf.org.za/resource-centre/focus/focus-64/HJoffe64.pdf) download.
- Levington, M. 2016. 'Industrialisation is just as important as cost when considering IRP options'. *Daily Maverick* (online). Available at: [www.dailymaverick.co.za/article/2016-12-20-op-ed-industrialisation-is-just-as-important-as-cost-when-considering-irp-options/#.WJwUcmdunIU](http://www.dailymaverick.co.za/article/2016-12-20-op-ed-industrialisation-is-just-as-important-as-cost-when-considering-irp-options/#.WJwUcmdunIU) (Accessed 10 June 2017).
- Marquard, A., Bekker, B., Eberhard, A. & Gaunt, T. 2007. 'South Africa's Electrification Programme: An overview and assessment'. Available at: [www.gsb.uct.ac.za/files/SAElectrificationworkingpaperfinal.pdf](http://www.gsb.uct.ac.za/files/SAElectrificationworkingpaperfinal.pdf) (Accessed: 22 May 2017).
- Montmasson-Clair, G. 2017. 'Electricity Supply in South Africa: Path dependence or decarbonisation?' TIPS Policy Brief: 2/2017.
- Montmasson-Clair, G., Kritzing, K., Scholtz, L. & Gulati, M. 2017. 'The role of South African municipalities in renewable energy: A review of business models'. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Pretoria.
- NDP. 2011. National Development Plan Vision for 2030. 2011. Available at: [www.gov.za/sites/www.gov.za/files/devplan\\_2.pdf](http://www.gov.za/sites/www.gov.za/files/devplan_2.pdf)

- New South Energy, 2017. 'NSE "paints" the mall@reds roof blue with solar panels'. Available at: [www.newsouthernenergy.com/nse-paints-mallreds-roof-blue-solar-panels/](http://www.newsouthernenergy.com/nse-paints-mallreds-roof-blue-solar-panels/).
- Papapetrou, P. 2014. WWF Technical Report: Enabling Renewable Energy in South Africa: Assessing the Renewable Energy Independent Power Producer Procurement Programme. Available at: [awsassets.wwf.org.za/downloads/a16369\\_wwf\\_reip\\_report\\_online.pdf](http://awsassets.wwf.org.za/downloads/a16369_wwf_reip_report_online.pdf) (Accessed: 1 June 2017).
- PQRS. 2017. Available at: <http://pqrs.co.za>.
- PVGreenCard. 2017a. Available at: [www.pvgreencard.co.za/rooftop-solar-pv/number-of-installations-with-installed-capacity](http://www.pvgreencard.co.za/rooftop-solar-pv/number-of-installations-with-installed-capacity).
- PVGreenCard. 2017b. Status of Small Scale Embedded Generation (SSEG) in South African Municipalities. November 2016. Available at: [www.pvgreencard.co.za/wp-content/uploads/2017/02/Overview-of-municipalities-with-SSEG-processes-and-tariffs-Nov-2016-final-draft.pdf](http://www.pvgreencard.co.za/wp-content/uploads/2017/02/Overview-of-municipalities-with-SSEG-processes-and-tariffs-Nov-2016-final-draft.pdf).
- REN21. 2017. Advancing the Global Renewable Energy Transition. Available at: [www.ren21.net/wp-content/uploads/2017/06/170607\\_GSR\\_2017\\_Highlights.pdf](http://www.ren21.net/wp-content/uploads/2017/06/170607_GSR_2017_Highlights.pdf) (Accessed 19 June 2017).
- REN21. n.d. [www.ren21.net/](http://www.ren21.net/) (Accessed 24 June 2017).
- RSA. 2013. National Development Plan 2030. Available at: [www.gov.za/issues/national-development-plan-2030](http://www.gov.za/issues/national-development-plan-2030).
- RSA. 2015. South Africa's Intended Nationally Determined Contribution (INDC) Available at: [www4.unfccc.int/ndcregistry/PublishedDocuments/South%20Africa%20First/South%20Africa.pdf](http://www4.unfccc.int/ndcregistry/PublishedDocuments/South%20Africa%20First/South%20Africa.pdf).
- Sager, M. 2014. Renewable Energy Vision 2030 – South Africa. WWF Technical Report. Available at: [awsassets.wwf.org.za/downloads/enabling\\_re\\_in\\_sa.pdf](http://awsassets.wwf.org.za/downloads/enabling_re_in_sa.pdf)
- SAWEA. 2017. 'Independent power producers take on Eskom through national energy regulator'. Available at: [www.energy.org.za/news/independent-power-producers-take-on-eskom-through-national-energy-regulator](http://www.energy.org.za/news/independent-power-producers-take-on-eskom-through-national-energy-regulator) (Accessed: 1 June 2017).
- Scholtz, L. & Fakir, S. 2017. Making the right energy choices: The SDGs in the context of South Africa's exclusive economy. Heinrich Böll Stiftung. Available at: [za.boell.org/sites/default/files/south\\_africa\\_-\\_making\\_the\\_right\\_energy\\_choices.pdf](http://za.boell.org/sites/default/files/south_africa_-_making_the_right_energy_choices.pdf) (Accessed 21 June 2017).
- Sesant, S. 2016. 'Eskom questioned on R8bn price tag for diesel generators'. Available at: [ewn.co.za/2016/01/18/Nersa-questions-R8-mln-spent-on-Eskoms-diesel-generators](http://ewn.co.za/2016/01/18/Nersa-questions-R8-mln-spent-on-Eskoms-diesel-generators) (Accessed: 25 May 2017).
- Slabbert, A. 2017. 'Eskom stifles GDP growth by refusing to sign up IPPs'. Available at: [www.moneyweb.co.za/news/south-africa/renewable-ipp-need-movement-from-eskom-this-quarter-sarec/](http://www.moneyweb.co.za/news/south-africa/renewable-ipp-need-movement-from-eskom-this-quarter-sarec/) (Accessed: 11 May 2017).
- SolarEze. 2017. Learn about the different Solar Power Systems we offer from Brisbane to the Gold Coast and Northern NSW. Available at: [solareze.com.au/solar-power-systems-grid-hybrid-standalone](http://solareze.com.au/solar-power-systems-grid-hybrid-standalone).
- Utility of the Future. An MIT Energy Initiative response to an industry in transition. 2016. Available at: [energy.mit.edu/research/utility-future-study](http://energy.mit.edu/research/utility-future-study).
- Van Rensburg, D. 2017. 'New twist in IPP battle as Eskom may close stations early'. Available at: [www.fin24.com/Economy/Eskom/new-twist-in-ipp-battle-as-eskom-may-close-stations-early-20170407](http://www.fin24.com/Economy/Eskom/new-twist-in-ipp-battle-as-eskom-may-close-stations-early-20170407) (Accessed: 11 May 2017).
- Wright, J., Bischof-Niemz, T., Calitz, J., Mushwana, C., Van Heerden, R. & Senatla, M. 2017. Formal Comments on the Integrated Resource Plan (IRP) Update Assumptions, Base Case and Observations 2016. Available at [www.csir.co.za/sites/default/files/Documents/20170331CSIR\\_EC\\_DOE.pdf](http://www.csir.co.za/sites/default/files/Documents/20170331CSIR_EC_DOE.pdf).
- Wright, J., Bischof-Niemz, T., Van Heerden, R. & Mushwana, C. 2016. Comments on the Integrated Resource Plan 2016 Draft South African Integrated Resource Plan 2016 public hearing. Available at: [www.energy.gov.za/IRP/irp-presentations/Comments-on-IRP-2016-Draft-KabiSolar.pdf](http://www.energy.gov.za/IRP/irp-presentations/Comments-on-IRP-2016-Draft-KabiSolar.pdf).
- WWF. 2015. Potential for integration of distributed solar photovoltaic systems in Drakenstein municipality. Available at: [www.wwf.org.za/?14841/Drakenstein-solar](http://www.wwf.org.za/?14841/Drakenstein-solar).

# R65.5 BILLION

procured from BEE firms for REI4P projects

# 6 376 MW

of RE procured to date



# 26 790

new construction and  
operational jobs created  
in the RE sector

# R195 BILLION

in large investments attracted to South Africa  
by the REI4P



#### Why we are here

To stop the degradation of the planet's natural environment and  
to build a future in which humans live in harmony with nature.

[wwf.org.za](http://wwf.org.za)