



**REPORT ON THE MONITORING OF PERFORMANCE OF
RENEWABLE ENERGY POWER PLANTS – JANUARY TO JUNE
2023**

(ISSUE 22 – SEPTEMBER 2023)

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GLOSSARY OF TERMS

Bid window

Means any of the procurement phases under the Renewable Energy Independent Power Producer Procurement Programme of the Department of Mineral Resources and Energy.

Deemed Energy Payment

Means an amount (excluding VAT) that shall be due and payable by the buyer to the seller for the deemed energy during a specified period, pursuant to the provisions of the Power Purchase Agreement consequences of a system event.

Energy Regulator

Means the regulatory authority established as a juristic person in terms of section 3 of the National Energy Regulator Act, 2004 (Act No. 40 of 2004).

Government

Means the Government of the Republic of South Africa, and any of its departments, agencies or other entities that it manages or controls.

Gigawatt hour

Means the energy unit in which electricity consumption is measured. 1GWh = 1000MWh.

Independent power producer

It is defined as a typically limited-liability, investor-owned enterprise that generates electricity either for bulk sale to an electric utility or for retail sale to industrial or other customers, with certain conditions.

Megawatt hour

Means the energy unit in which electricity consumption is measured. 1MWh = 1000kWh.

Minister

Means the Minister of Mineral Resources and Energy.

Renewable energy (from the 2003 White Paper on Renewable Energy)

Renewable energy harnesses naturally occurring, non-depletable sources of energy, such as solar, wind, biomass, hydro, tidal, wave, ocean current and geothermal, to produce electricity, gaseous and liquid fuels, heat or a combination of these energy types.

ABBREVIATIONS AND ACRONYMS

B-BBEE	Broad-Based Black Economic Empowerment
BER	Bureau of Economic Research
BW	Bid Window
COD	Commercial Operation Date
CSP	Concentrated Solar Power
DMRE	Department of Mineral Resources and Energy
ED	Economic Development
EME	Exempted Micro Enterprises
GWh	Gigawatt hour
IDM	Integrated Demand Management
IPP	Independent Power Producer
IRP	Integrated Resource Plan
MW	Megawatt
MWh	Megawatt hour
NERSA	National Energy Regulator of South Africa
PPA	Power Purchase Agreement
PV	Photovoltaic
QME	Qualifying Medium Enterprise
QSE	Qualifying Small Enterprise
RE	Renewable Energy
REI4P	Renewable Energy Independent Power Producer Procurement Programme
SED	Socio-Economic Development
SSEG	Small-Scale Embedded Generator

1. INTRODUCTION AND BACKGROUND

In terms of section 4 of the Electricity Regulation Act, 2006 (Act No. 40 of 2006) ('the Act'), the National Energy Regulator of South Africa (NERSA) has the mandate to 'establish and manage monitoring and information systems and coordinate the integration thereof with other relevant information systems'. The renewable energy (RE) independent power producers (IPPs) are required to submit reports on their monthly energy production, pursuant to section 15 of the Grid Connection Code for Renewable Energy, version 3.1 of January 2023.

Table 1 shows all RE determinations made in the past, including the new determination made in 2020, which contains capacity allocations of solar photovoltaic (PV) and wind technologies. To date, the total RE capacity allocation from ministerial determinations is 36 700MW, with 28 900MW¹ being in effect.

Table 1: Renewable energy from ministerial determinations

Ministerial Determination	Year start	Year end	Capacity (MW)
<i>Renewable 2011</i>	2012	2016	3 725
<i>Renewable 2012</i>	2017	2020	3 200
<i>Renewable 2015*</i>	2022	2025	6 300
<i>Renewable (Solar Park) 2015*</i>	2026	2028	1 500
<i>Solar PV, Wind Determination 2020</i>	2022	2024	6 800
<i>PV and Battery Storage (Eskom)</i>	2029	-	404
<i>PV, Wind and Battery Storage</i>	2024	2030	14771
RE Determination Total :			36 700

*Expired

2. UPDATE ON GRID-CONNECTED CAPACITY OF RENEWABLE ENERGY PROJECTS

To date, the Department of Mineral Resources and Energy (DMRE) has procured 9 881MW from 142 RE IPP projects, through nine bid windows (BW's). These BW's were: BW1, BW2, BW3, BW4, BW5 and BW6, including BW3.5, which consisted of concentrated solar technology with thermal storage, and two BW's of small-scale renewable energy projects. On 29 June 2023, NERSA approved generation licences for five preferred bidders of the DMRE's Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) BW6. The five preferred bidders are listed in Table 2 below.

¹ Following the updated IRP2019, the two RE Determinations from IRP2010-2030 made in 2015 (6 300MW renewable – 2015 and 1 500MW renewable solar – November 2015), for which capacities were not contracted, have expired and have been replaced with 2020 Determination that has allocations of solar PV and wind.

Table 2: Details of the five preferred bidders licensed by NERSA on 29 June 2023

Company Name	Fully Indexed Price (ZAR/MWH)	Contracted Capacity (MW)	Location (Province)	Local Municipality
Doornhoek PV (Pty) Ltd	540.00	120	North West	Matlosana
Boitumelo Solar Power Plant (RF) (Pty) Ltd	469.50	150	North West	Ditsobotla
Kutlwano Solar Power Plant (RF) (Pty) Ltd	469.50	150	North West	Ditsobotla
URSA Energy (RF) (Pty) Ltd	486.50	240	Free State	Matjhabeng
Antlia Energy (RF) (Pty) Ltd	498.90	200	Free State	Tokologo
Average price/total capacity	492.88	860		

Since 2013, RE4IP projects have been connected to the grid in a phased-in approach, based on their scheduled commercial operation dates. By the end of June 2023, the total grid-installed capacity of projects was 6 184MW from 89 REI4P power plants.

Of this installed capacity, 6 149MW is in commercial operation. Table 3 below provides a summary of the status of projects in terms of operation and development.

Table 3: Status of procured DMRE RE IPP projects as at 30 June 2023

Bid window	Total number of projects	Procured capacity (MW)	Installed Capacity (MW)	Commercial Operational	Status	Expected annual energy (GWh) of all IPPs at P50 ²
1	28	1 425	1 425	1415	All operational	3 712
2	19	1 040	1 040	1036	All operational	2 982
3	17	1 452	1 433	1430	16 operational; one under construction	4 805
3.5	2	200	100	100	One operational	485
4	26	2 205	2182	2168	25 operational; the remaining one is under construction	7 213
Small-scale 1	10	50	0	0	Delayed signing of PPAs	175
Small-scale 2	10	49	0	0	Delayed signing of PPAs	106
5	25	2600	0	0	Awaiting Financial Close	7 121
6	5	860	0	0	Awaiting Financial Close	1 883
TOTALS	142	9 881	6180	6 149	-	28 482

Figure 1 shows the cumulative commercial capacity over the years. By the end of the current year, it is expected that the commercial operation capacity will reach 6 249MW, since one Concentrated Solar Power (CSP) project from BW3.5, with a total capacity of about 100MW, is scheduled to reach commercial operation before the end of the year.

² P50 is the level of confidence that implies that the predicted energy yield may be exceeded with a 50% probability.

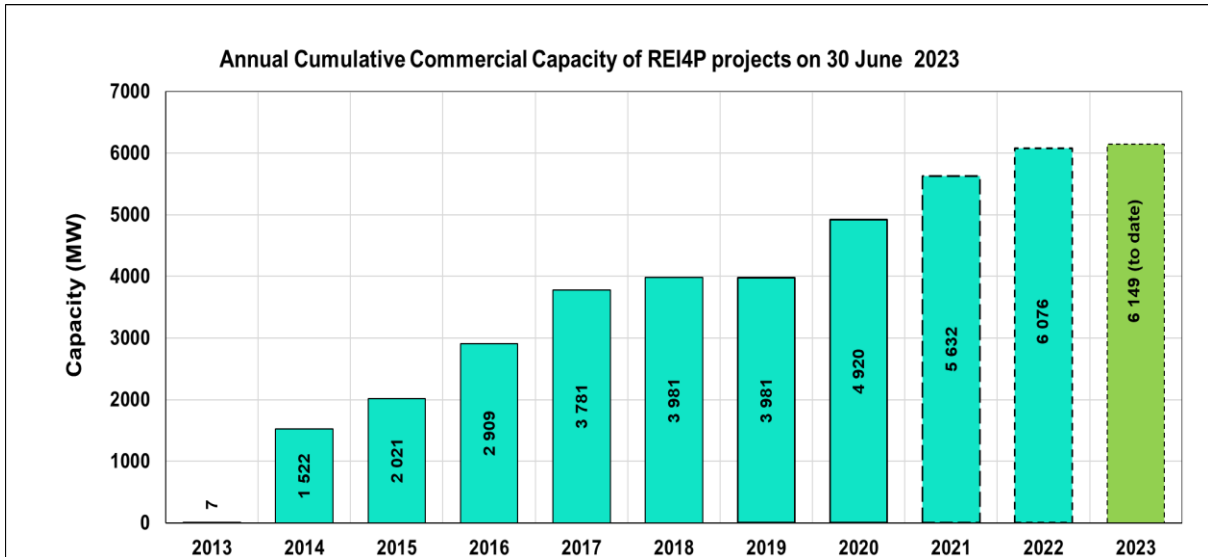


Figure 1: Cumulative capacity of REI4P power plants on 30 June 2023

Source IPPs

In addition to the DMRE REI4P plants, there are also grid-connected RE projects that have been in existence since before the REI4P was formulated. Most of these power plants are either generating power for own use, or are selling to other private companies (outside of the REI4P). For the purpose of distinguishing them from REI4P power plants, in this report they are referred to as ‘non-REI4P’ power plants. Some municipalities are contracting with non-REI4P power plants through trading companies. The total capacity of non-REI4P power plants that are connected to the grid is 823MW.

In line with the Licensing Exemption and Registration Notice³ of 15 December 2022, NERSA is registering small-scale embedded generators (SSEGs). In the first and second quarter of the 2023 calendar year, the Energy Regulator approved the registration of 182 generation facilities, with a total capacity of about 2 977MW.

3. ENERGY YIELD OF RENEWABLE ENERGY PLANTS CONNECTED TO THE GRID

Figure 2 shows the energy sent out hourly from the power system from 1 January 2023 to 30 June 2023. From the figure, it can be seen that almost constant system energy has been sent out from January 2023 to June 2023.

³ Department of Mineral Resources and Energy, Licensing Exemption and Registration, 15 December 2022, Government Gazette No. 47757 on licensing exemption and registration.

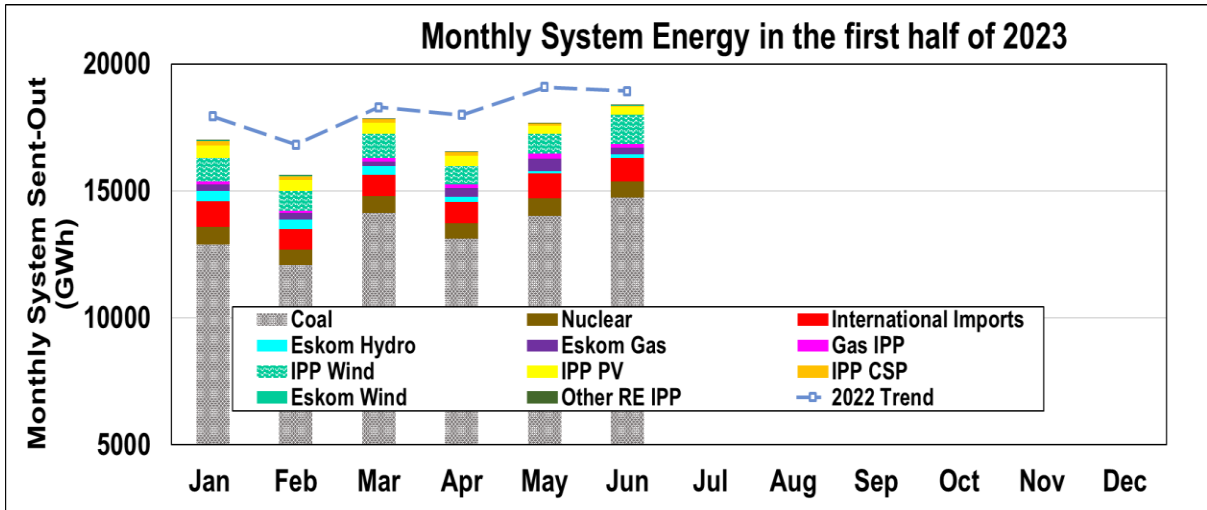


Figure 2: Monthly energy sent out from the power system from January 2023 to June 2023
 Data Source: Eskom, IPPs

Figures 3 and 4 show the monthly energy production of grid-connected renewable energy power plants under the REI4P and those outside the REI4P. The total energy sent out by the REI4P and non-REI4P power plants in this period was approximately 8 346GWh and 428GWh, respectively. The REI4P energy produced was higher than that sent out from January to June 2022, which can be attributed to improved wind energy resources.

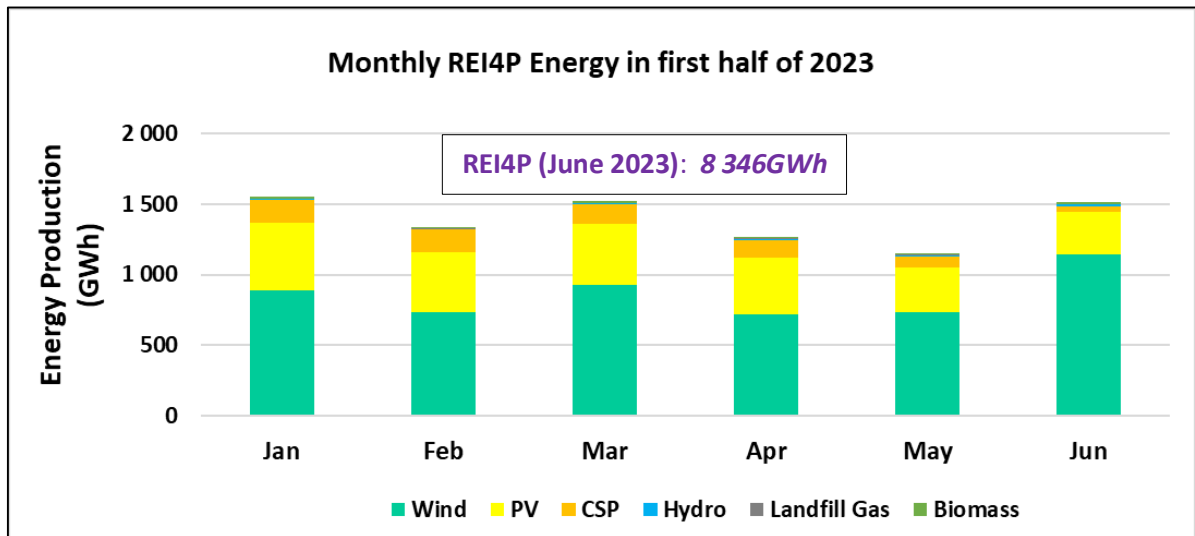


Figure 3: Monthly energy production of REI4P power plants in the first six months of 2023
 Data sourced from IPPs

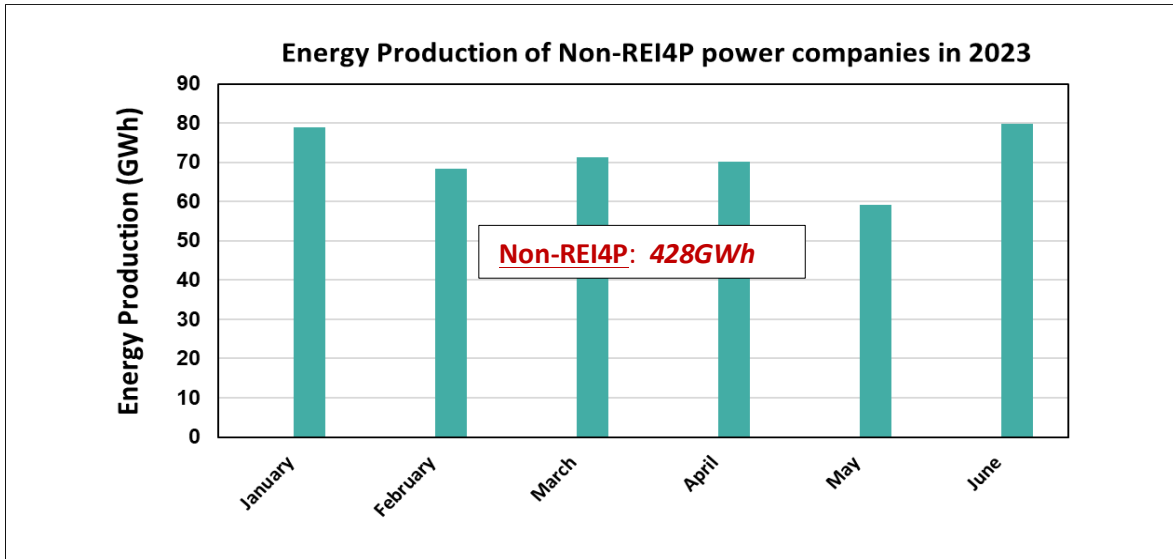


Figure 4: Monthly energy production from non-REI4P power plants in the first half of 2023 (Data includes Eskom RE power plants)

Data sourced from IPPs

Table 4 summarises the energy production of both REI4P and non-REI4P power companies during the first half of 2023.

Table 4: Summary of RE generation in the first half of 2023

Category of power plants	GWh in first half of 2023
REI4P	8 346
Non-REI4P	428
Totals (GWh)	8 774

From Table 4 it can be seen that the total energy sent out from renewables was 8 774GWh, which is equivalent to about 7% of the total power system energy sent out in the same period.

Figure 5 shows the calculated load factors of various types of REI4P power plant technology.

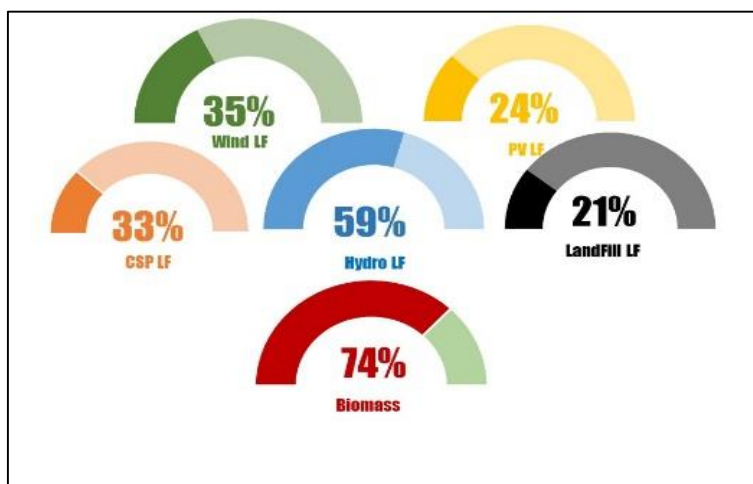


Figure 5: Monthly load factors of REI4P power plants in the first half of 2023

Data sourced from IPPs

The highest load factors were achieved by biomass and small-hydro, with 74% and 58%, respectively. The load factors of wind, solar PV and CSP plants were 35%, 24% and 33%, respectively. These load factors are well within the acceptable levels for South Africa.

Figure 6(a) shows the contribution of various technologies of REI4P power plants (in green, yellow and orange) to the power system during hours of Stage 4 load-shedding in March 2023. As can be seen in the plot, load reduction/shedding, shown in 'chequered' pattern, occurred almost throughout the week, subsiding on Sunday, 19 March 2023. During that week, wind alone contributed more than 1 000MWh/h for more than three consecutive days, from Wednesday to Thursday, thereby effectively reducing load-shedding by one level. This positive impact of wind is illustrated by the blue rectangular box in Figure 6(b). From the latter plot, it is also evident that wind and CSP technologies contributed significant energy in the evening peak-periods, while solar PV contributed the most during midday.

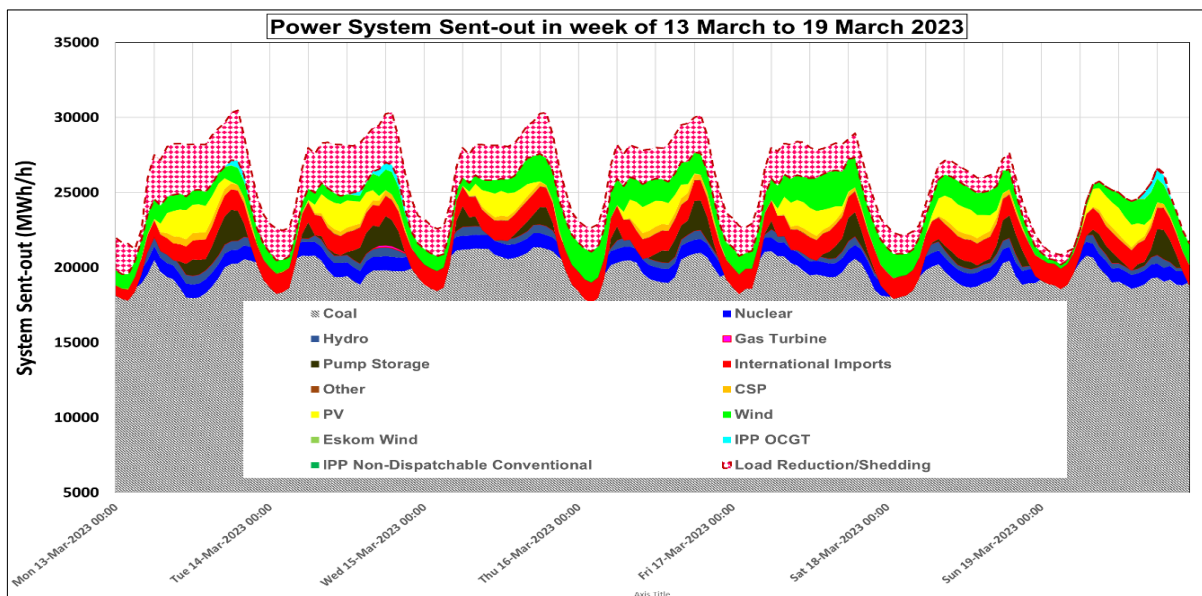


Figure 6(a): System sent-out including renewable energy during times of Stage 4 load-shedding
Data sourced IPPs and Eskom

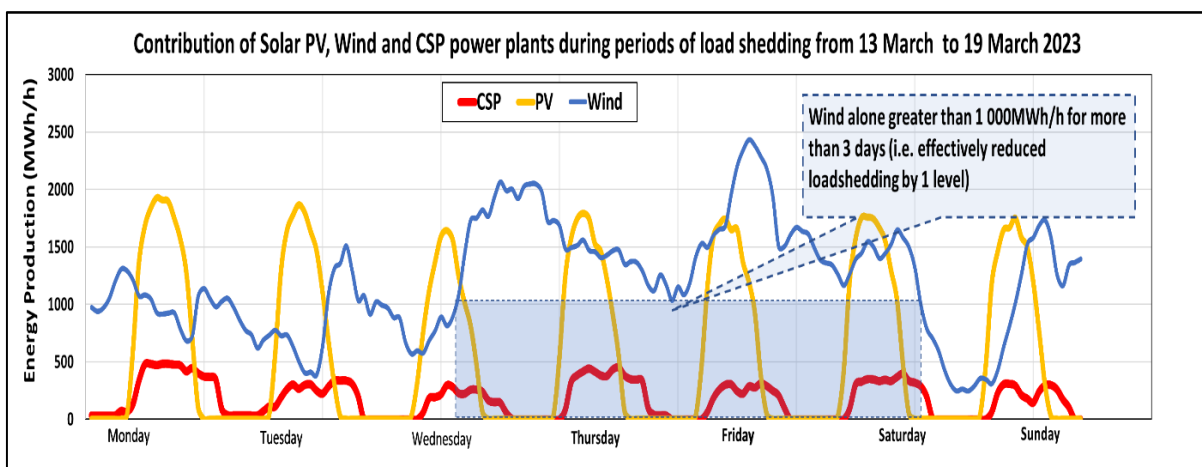


Figure 6 (b): Energy production of wind, solar PV and CSP during times of Stage 4 load-shedding
Data sourced IPPs and Eskom

The combined peak energy contribution of REI4P power plants was about 1 782GWh, which was approximately 21% of the total REI4P energy sent out in that period. It has been demonstrated by the CSIR study⁴ that when the power system is constrained, renewable energy sources are useful in that they assist in reducing the hours of load-shedding or even prevent such a situation from arising.

Figure 7 shows the results that were published in July 2023 by the Bureau for Economic Research (BER), highlighting the weekly impact of renewable energy on the overall electricity generation. A reduction between the demand and electricity generation was observed when renewables were factored in. A positive balance between supply with renewables and demand was also observed during week 12 in March 2023, and during four weeks of June 2023, resulting in less load-shedding being experienced by the country.

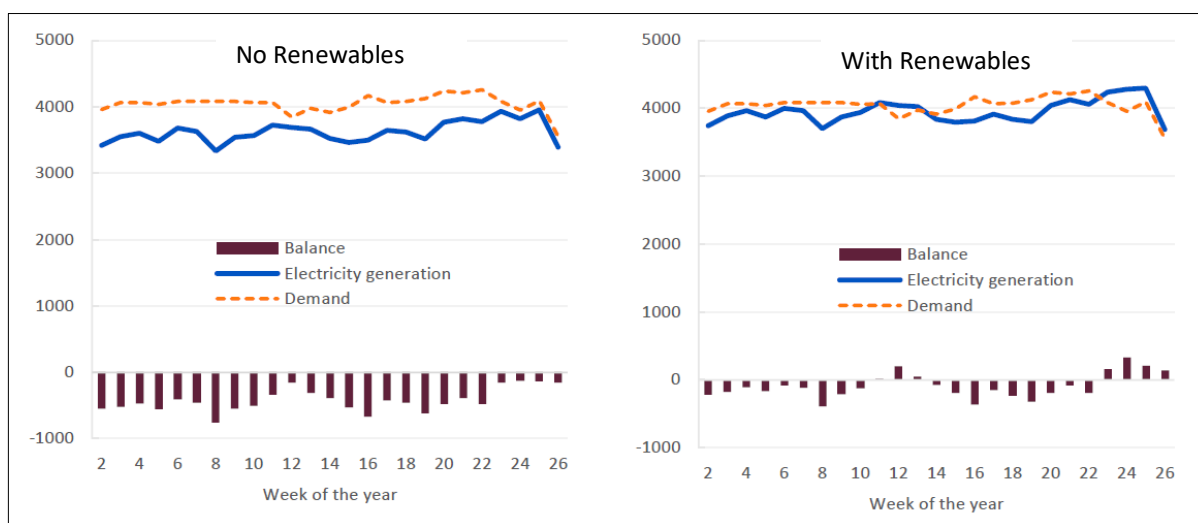


Figure 7: Impact of REI4P power plants on energy supply and demand in the first half of 2023
Source: BER July 2023

4. GLOBAL PRICE TRENDS FOR RENEWABLE ENERGY TECHNOLOGIES

Figure 8 shows the cost from the International Renewable Energy Agency (IRENA) 2022 report⁵, highlighting some of the Renewable Energy technologies over the ten-year period from 2010 to 2020. It is evident from the levelised cost trends of solar PV and wind technologies that there has been a significant decrease over the past ten years, and this can be attributed mainly to the capital cost reductions of these technologies. The report indicated that between 2010 and 2020, the global weighted average levelised cost of energy (LCOE) of utility-scale solar PV for newly commissioned projects fell by 85% (i.e. LCOE fell from USD 0.381/kWh to USD 0.057/kWh, as total installed costs fell from USD 4 731/kW to USD 883/kW).

⁴ CSIR Energy Centre Study, 2019, Brief analysis of variable renewable energy contribution during load-shedding (Q1-2019), Available Online: https://www.csir.co.za/sites/default/files/Documents/Renewable%20Energy_Q1_2019.pdf

⁵ IRENA (2023), Renewable Power Generation Costs in 2020, International Renewable Energy Agency, Abu Dhabi.

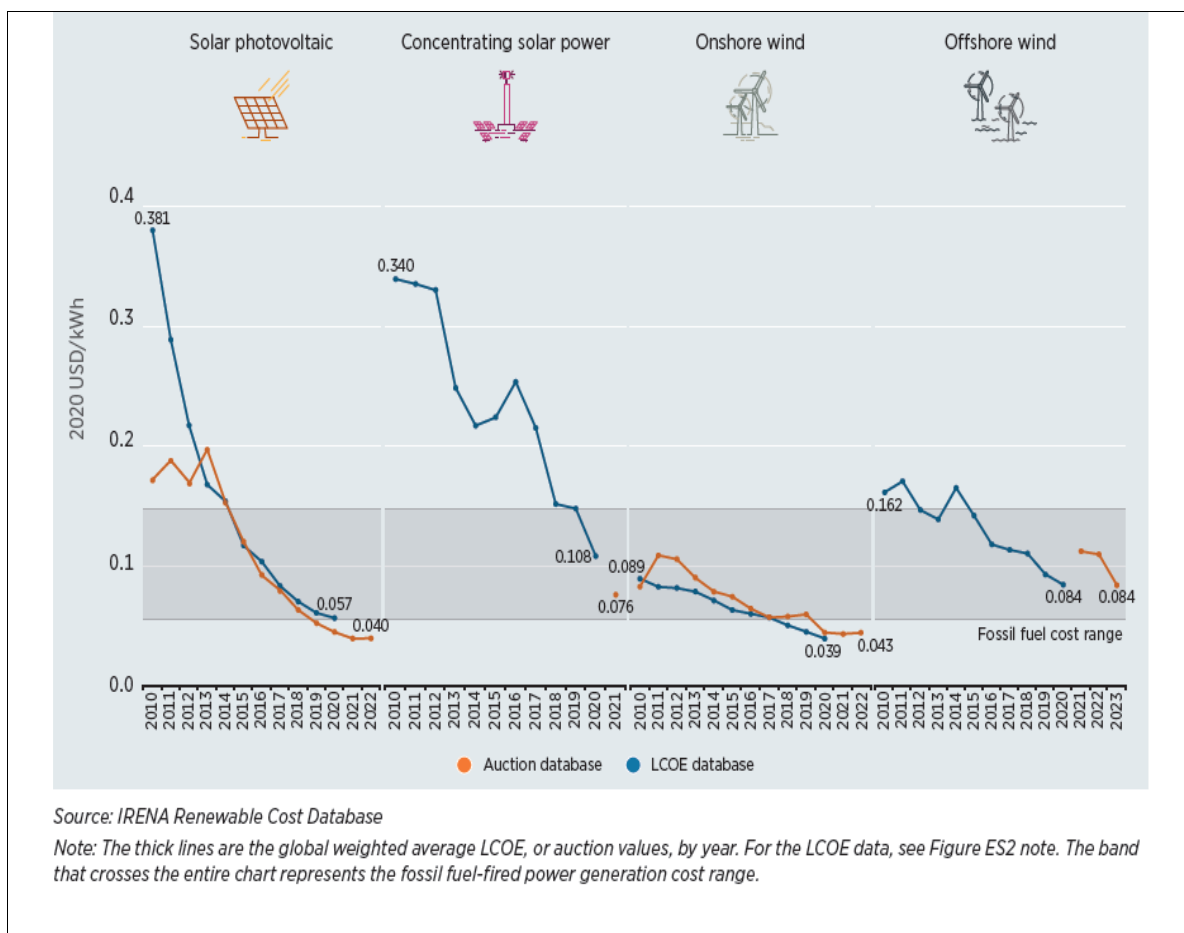


Figure 8: Trend of levelised costs of RE technologies over a period of 10 years

Source: IRENA, 2022

For wind technology, the report indicated that the global weighted average LCOE of projects using this technology and commissioned in 2020, was USD 0.039/kWh – 56% lower than that of 2010, which was USD 0.089/kWh. CSP technology has also experienced a decrease in LCOE in the past decade. CSP technology fell by 68%, from USD 0.340/kWh to USD 0.108/kWh. For solar PV shown, auction/bidding is expected to yield lower LCOE figures in 2023, as demonstrated by the orange trend line. The downward cost trends of the three technologies will induce cost reductions in future BWs, as the country will be implementing the gazetted IRP2019, between now and 2030.

5. AVERAGE COST OF RENEWABLE POWER PLANTS IN SOUTH AFRICA

Table 5 lists the energy production of REI4P power plants from various technologies. Most of the energy had been generated by wind farms with approximately 5 159GWh, followed by PV power plants with approximately 2 331GWh. From the table below, it can be seen that CSP technology was the most expensive technology at R4.91/kWh, followed by PV at R2.55/kWh. In the first half of 2023, CSP plants with storage were dispatched during peak hours and when the grid was constrained, resulting in higher costs since the Power Purchase Agreements (PPAs) have two-tier tariffs, namely for off-peak and peak periods.

Table 5: Energy and costs of REI4P power plants during the first half of 2023

	Energy (GWh)	Cost (R' Million)	Average Price (R/kWh)
Wind	5 159	6 874	1.33
PV	2 331	5 947	2.55
CSP	718	3 523	4.91
Small-hydro	49	87	1.78
Landfill	8	12	1.50
Biomass	81	182	2.25
Total/Average	8 346	16 625	1.99

Based on the total energy produced and the related total purchase cost, the average price in the first half of 2023 was approximately R1.99/kWh.

The power production was also curtailed by the utility during certain periods of the day due to low demand around midnight hours, as well as grid maintenance. The clauses of the REI4P power plants' PPAs provide for deemed energy payments that arise as a result of the curtailment of power plants. Figure 9 shows the monthly energy curtailed from 18 REI4P power plants in the first half of 2023.

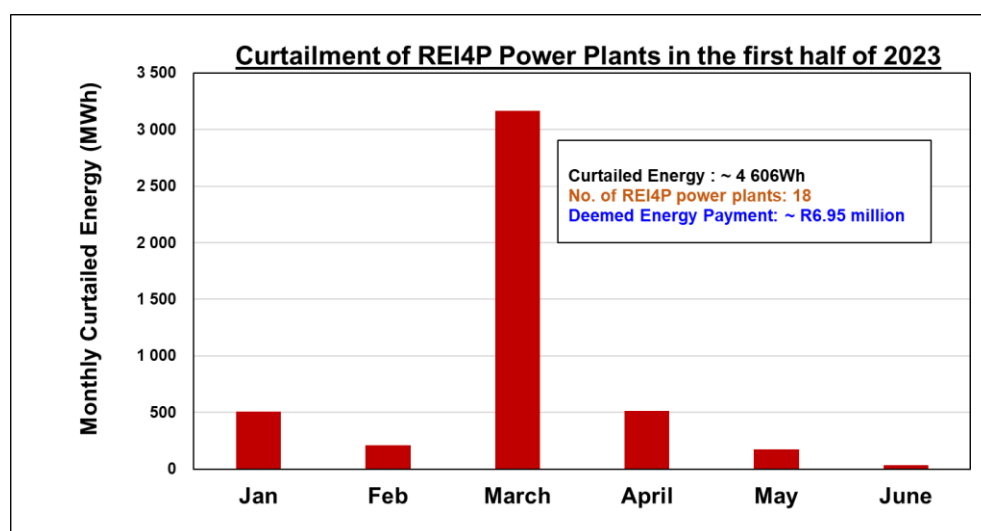


Figure 9: Curtailment of energy from REI4P power plants in 2023

Source: IPPs

From the plot in Figure 9 it can be seen that most of the energy curtailment of REI4P power plants occurred in March 2023, and it reached a total of 4 606MWh in the first six months of 2023. The corresponding total amount of curtailment over the six months of 2023 resulted in a deemed energy payment of approximately R6.95 million to 18 REI4P power plants.

6. CONTRIBUTION OF RENEWABLE ENERGY TO SOCIAL ECONOMIC DEVELOPMENT

6.1. Economic Development Obligations of IPP Projects

To ensure that the introduction of RE benefits the citizens of the country, the DMRE, National Treasury (NT) and Department of Trade and Industry (DTI), through the Inter-Ministerial Committee, identified key socio-economic development (SED) elements where RE will be used to improve the living standards of the communities where IPPs are located.

These SED elements are in line with the key policies of the country, such as the National Development Plan and Green Economy Accord 2011. Furthermore, the Government developed the IPP Procurement Programme Economic Development Policy (dated 15 March 2011) to fulfil other outcomes for the society, which are:

- a) job creation;
- b) use of local content through increased local manufacturing;
- c) fostering rural development and involving communities;
- d) education and the development of skills;
- e) enterprise development through the promotion of small businesses and packages for new entrants; and
- f) socio-economic development and participation by historically disadvantaged citizens and marginalised regions in the mainstream of the industrial economy.

The following sections of this report highlight the achievements of REI4P projects in the first half of 2023.

6.2. Employment by RE Power Plants

Table 6 lists the aggregated obligation of REI4P power plants against the achieved employment opportunities for South African citizens, based on the information submitted by IPPs. The REI4P power plants exceeded their respective obligations in all categories. The main category surpassed the requirement by about 13%, with 5 250 employed citizens. From the table below, it can be seen that 93% of the employed citizens were black, and 63% of the employed citizens were skilled black citizens. Lastly, 73% of the employed citizens were from the communities where the REI4P power plans are located.

Table 6: Employment statistics in first half of 2023

Employment statistics	Obligation	Achieved	As a percentage of Employees who are Citizens
Employees who are Citizens	4 661	5 250	-
Employees who are Black Citizens	3 242	4 871	93%
Employees who are Skilled Black Citizens	2 659	3 083	59%
Employees that are Citizens from Local Communities	2 200	3 858	73%

Source: IPPs, June 2023

6.3. Socio-Economic Development and Enterprise Development

6.3.1. Socio-economic development performance

Under SED performance, the required minimum threshold contribution of IPPs should be 1% of the revenue per quarter, and the targeted SED spending over the 20-year period of the PPA is 1.5% of the total revenue. Figure 9 shows the share of IPPs' spending on various SED activities.

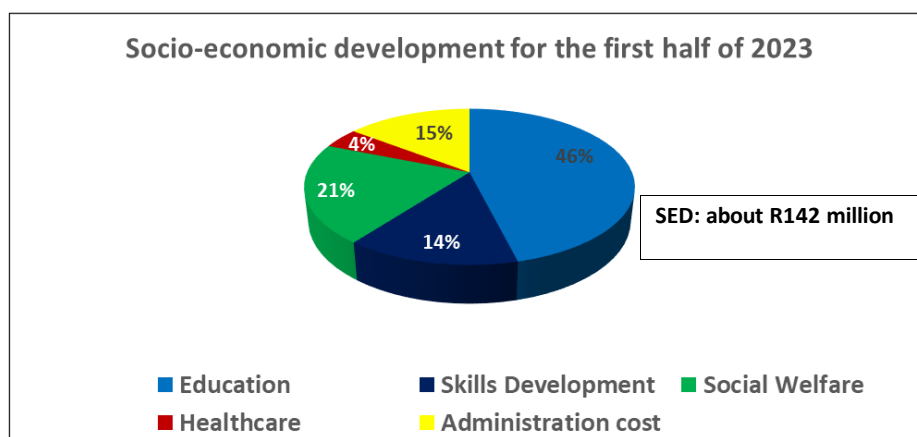


Figure 9: Socio-economic development spread in first half of 2023

Source: IPPs, June 2023

The data from IPPs showed that R142 million had been spent towards SED. This amount is equivalent to 1.29% of the R11.03 billion revenue generated. Furthermore, the latter percentage amount is higher than the average SED minimum threshold of 1% prescribed by the DMRE.

In line with the trend of the previous years, education and skills development had the highest contribution, with a combined total SED expenditure of 60%. The spending by IPPs towards social welfare and healthcare accounted for 21% and 4% of the total

SED expenditure, respectively. The IPPs' total own-administration expenditure in the period was about 15% of the total SED expenditure.

6.3.2. Enterprise development performance

The local communities are the main beneficiaries of the enterprise development activities. These activities constitute procurement or donation of equipment, providing financial assistance, payment of salaries and wages, as well as training and development initiatives.

Enterprise development (ED) has an average minimum threshold spending of 1% of the revenue over the 20-year period of operation. The total amount of revenue generated by the IPPs, as submitted in the first half 2023, amounted to R11.03 billion. The IPPs spent about R42.1 million towards ED, which is equivalent to 0.38% of the generated revenue, and is less than the targeted 1% as per the obligations.

6.4. Ownership Performance

Table 7 shows the ownership sub-elements relative to the obligation of IPPs during the first half of 2023. The shareholding of black people in the project company and operation contractor was 39% and 37%, against obligations of 31% and 20%, respectively. The local community accounted for 9% of the shareholders in the project company, which was on par with the minimum compulsory shareholding of 9%. The achievements above all indicate that the minimum obligations of ownership were met by the IPPs.

Table 7: Average ownership in first half 2023

Ownership	Obligation	Achieved
Shareholding by Black People in the Project Company	31%	39%
Shareholding by Black People in the Operations Contractor	20%	37%
Shareholding by Local Communities in the Project Company	9%	9%

Source: IPPs, June 2023

6.5. Preferential Procurement Performance

Figure 10 shows the spending on preferential procurement in the first half 2023. The REI4P projects that reported spent a combined total of R1.292 billion towards B-BBEE; R421 million on Small to Medium Enterprises (SMEs) and Qualifying Medium Enterprises (QMEs); and R105 million on women-owned vendors. The combined amount spent by IPPs exceeded the obligations on the various preferential procurement requirements as set out by the DMRE.

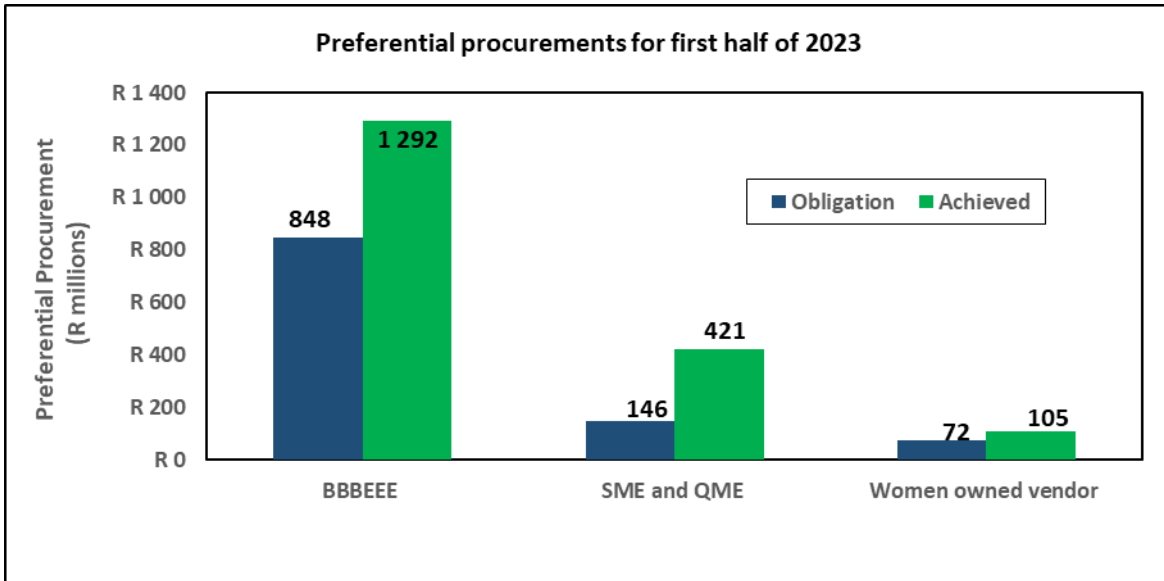


Figure 10: Preferential procurement in first half 2023

Source: IPPs, in first half 2023

7. CONCLUDING REMARKS

The total number of power projects in commercial operation was 110, consisting of 89 REI4P projects and 21 non-REI4P projects. In addition to the categories of RE power plants mentioned above, the Energy Regulator approved the registration of 182 generation facilities in the first half 2023, with a total capacity of 2 977MW.

The REI4P and non-REI4P projects produced about 8 346GWh and 428GWh of energy, respectively. The cost of the energy produced by REI4P projects amounted to R16.6 billion.

Based on the analysis of the invoices submitted by the REI4P power plants, the total deemed energy was about 4.6GWh, at a total cost of R6.95 million. The curtailment at some RE power plants occurred during the night or early morning hours, when there was low demand and excess supply.

The SED data received by NERSA indicates that REI4P projects in commercial operation exceeded their employment, ownership and preferential procurement obligations prescribed by the DMRE in all the quarters. The REI4P operating projects that submitted SED information generated a combined revenue of about R11billion. The expenditure on SED and ED amounted to R142 million (1.29% of revenue) and R42.1 million (0.38% of revenue), respectively. The SED amount spent was higher than the annual target 1% of revenue, while the ED amount spent was lower than the target of 1% of revenue spending.