



ANNUAL SOLAR OUTLOOK 2024

A country-by-country review of the
status of solar energy in Africa

OFFICIAL EVENT PARTNER:



Released 19 January 2024



PART 1



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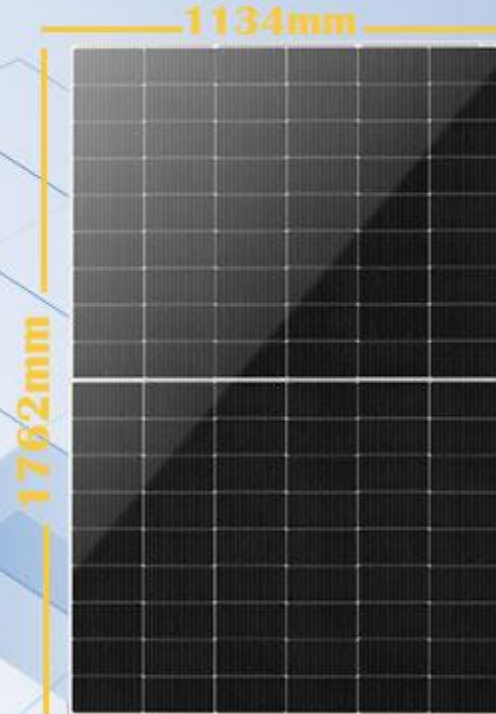


JAM54D40/LB

455W

%22.8

22kg



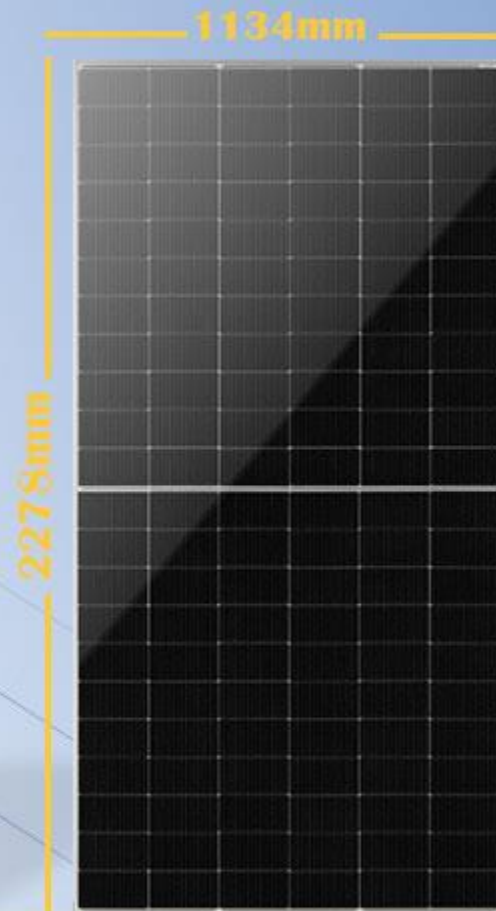
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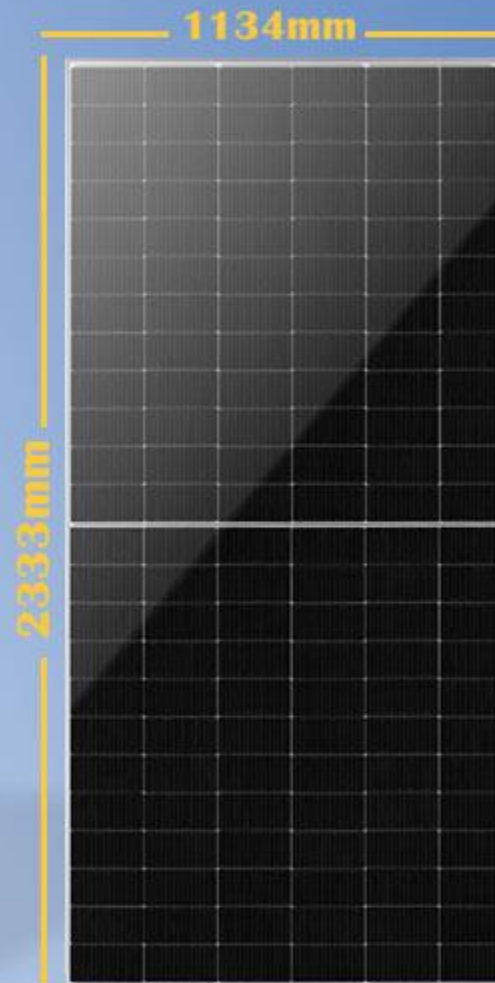


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32.5kg

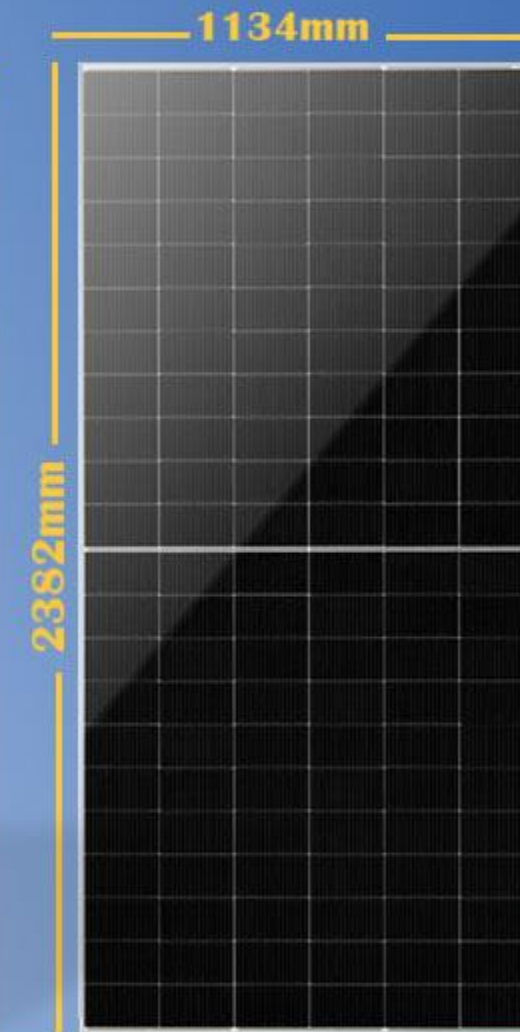


JAM66D45/LB

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%22.8

33.1kg

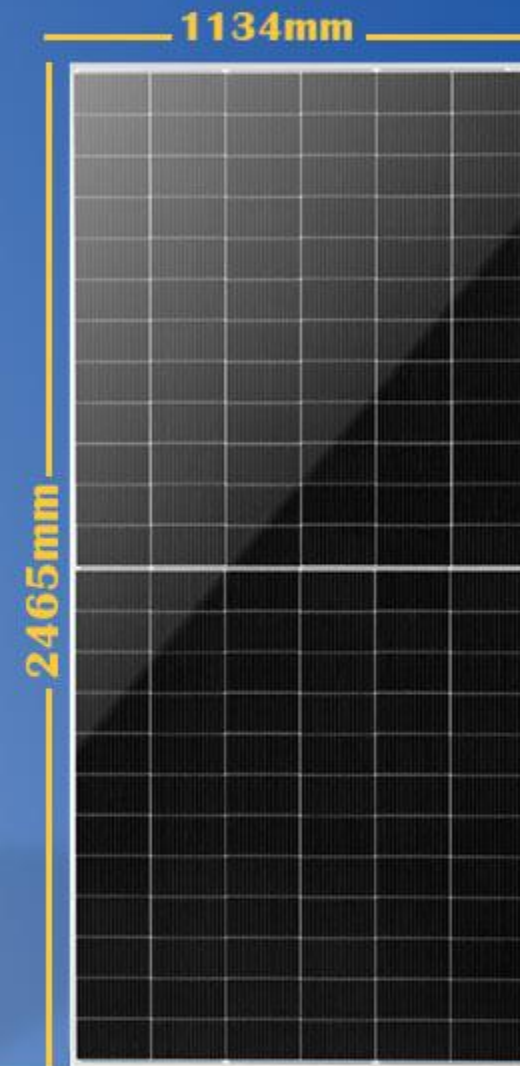


JAM72D42/LB

635W

%22.8

34.6kg



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WORDS OF GRATITUDE

The AFSIA Annual Solar Outlook report is now in its 4th edition and the AFSIA team is very proud to witness its popularity grow each year. There is no shortage of reports in our industry but we were convinced since the very beginning of this adventure that a certain type of information, shared in a convenient and digestible format, was still missing. This is what we have tried to do over the past 4 years, and the many messages of support and appreciation we receive on regular basis keep pushing us to do even more and better in our humble pursuit to share transparent market information. We are conscious that this report and the data it contains still are not perfect, but we are striving every day to improve its quality. In the African context where too little official data is available, I believe this report is one of the best and one of the most complete sources of information and this constitutes a great source of pride.

First and foremost, I would like to congratulate Aline Uwimana for the amazing work she has delivered this year, as this was her first year as lead author of the report. Next to the year-round search, collection and analysis of all possible solar updates and data points conducted by her Market Intelligence team, Aline also managed to rally the entire AFSIA team around this report.



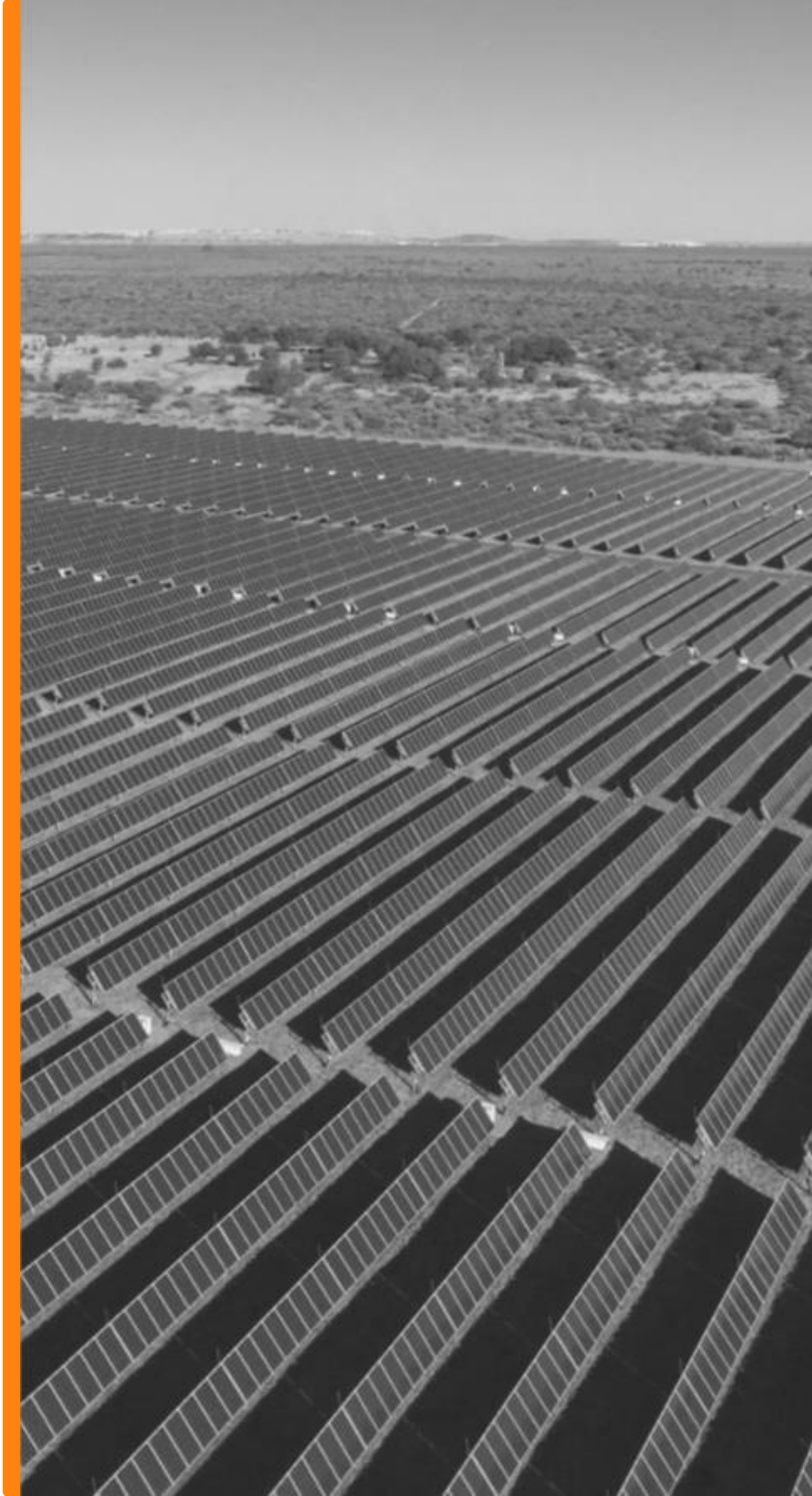


We can truly speak of a collective effort in this case. Under the guidance of Aline, the AFSIA team has delivered yet another amazing solar outlook report. Understanding and summarizing the key info is one of the objectives of this report, but it requires a high level of attention and considerable time and effort. Congratulations to the entire team for this new great delivery and for making this valuable report available to many professionals of the African solar industry.

This report is also the fruit of amazing collaborations with individuals and partners outside of AFSIA. I would like to highlight some of these supporters here and thank them once again for making this report possible each year.

First, I would like to thank our amazing group of country experts who accepted to be the peer reviewers of this edition to ensure that it contains the most correct and complete information about solar about each country. I am particularly grateful as this effort is requested during a very busy time of year from both the professional and private commitments perspective.

Further, I would like to thank the authors of the various articles which you can find across this report. AFSIA is extremely lucky to count many of the best industry experts among its community and we are delighted to give some of them a platform to share their expertise with the readers. This year, you will find 16 articles in this report about the key trends driving our industry and written by the best topic experts the continent has to offer.



As every year, I would also like to extend a warm thank you to WFES – the World Future Energy Forum - for giving us a global platform for the release of this important report. This year the timing of WFES is slightly misaligned with the release of the Annual Solar Outlook but we are delighted to get an opportunity to share about the growth of African solar at this global event. Your continued support means a lot to us.

Finally, I would also like to thank you, our readers! For the first year, this report will be split in two parts. The first part containing an analysis of the main industry trends and the topic articles will remain freely accessible to all. The second part, with the country vignettes and other country-specific info will now be concentrated in a report which will be charged to non-AFSIA members. For the last 4 years, we were humbled by your gestures and words of appreciation about this report. We want to continue providing you with the best possible quality, but we have to move to a paid and/or members-only approach to maintain this quality in the long run. We thank you for your understanding and hope you will continue to support our work.

John van Zuylen

MEET THE TEAM



John
CEO



Josée
Community
Manager



Omolara
Director of
Operations



Aline
Market Intelligence
Manager



Ange
Market Intelligence
Associate



Kersy
Research
Associate



Vestine
Digital Comms
Manager



Christian
Community
Management
Associate



Eugénie
Events
Manager



Salim
Digital Comms
Associate

HOW TO GET THE MOST OUT OF THIS REPORT

Since its inception, the AFSIA Annual Outlook report was developed as an addition to the already very generous collection of industry reports, looking at the solar industry from both a different format and content perspective. This report intends to help solar professionals get **fast access to verified and sourced information** and quickly identify business opportunities. Our approach is to present a collection of concise yet information-rich topical articles and **“country vignettes”** summaries, containing all key information about solar. As a result, the report can be used year-round as the go-to reference document for all solar decision-makers active in Africa.

For 2024, we have brought in some changes and have therefore split the Annual Solar Outlook report into 2 main parts.

Part 1 will look back at 2023 to identify and analyze the major solar developments witnessed across the continent. This part will also contain numerous topical articles on key trends of the industry. Part 1 will not only analyze the 2023 solar performance of various countries and/or segments, but it will also venture into identifying key trends to look out for based on new project and national programs announcements.

Part 2 will present a collection of country vignettes and summary tables, aimed at being the year-round solar companion of decision-makers. Country vignettes present a snapshot of the current situation of solar in a specific country





In the country vignettes, all key national information about solar is presented in a synthesized way so as to have a complete overview in a matter of seconds. All info is sourced, so the reader may then take the time to delve deeper into the data points of interest. Summary tables are also provided at the end of Part 2 so as to conduct quick comparison between countries on some key metrics and policies pertaining to solar in Africa.

The solar market evolves permanently and recent examples such as South Africa and Nigeria have shown that drastic changes and opportunities can arise in just a few months. In order to stay as close as possible to the latest developments, **Part 2 will now be available as a written report (published in January) but also as an online information resource.** This online resource, accessible through the AFSIA website, is updated by the AFSIA team on a daily basis as new information becomes available. This new approach therefore allows the reader to stay informed and get access to the latest information and developments.

We hope you will enjoy AFSIA's 4th Annual Solar Outlook report and look forward to your comments to make future reports better and more useful. Please do not hesitate to share your suggestions and remarks so that we can continue building a strong and growing industry together.

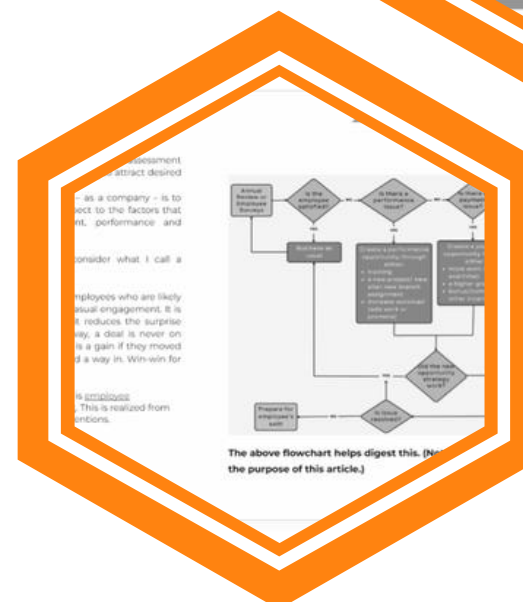
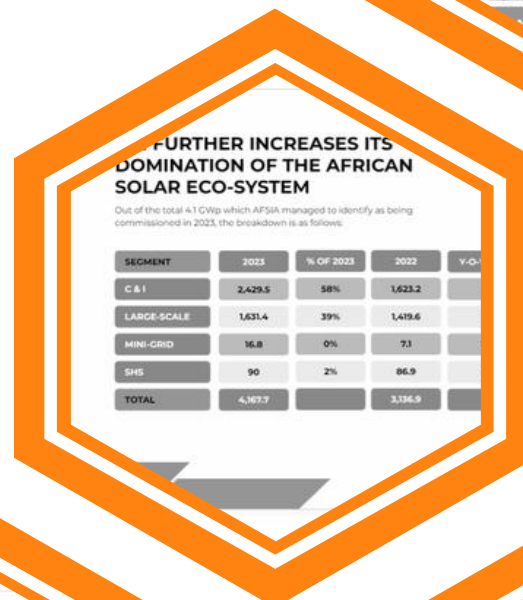
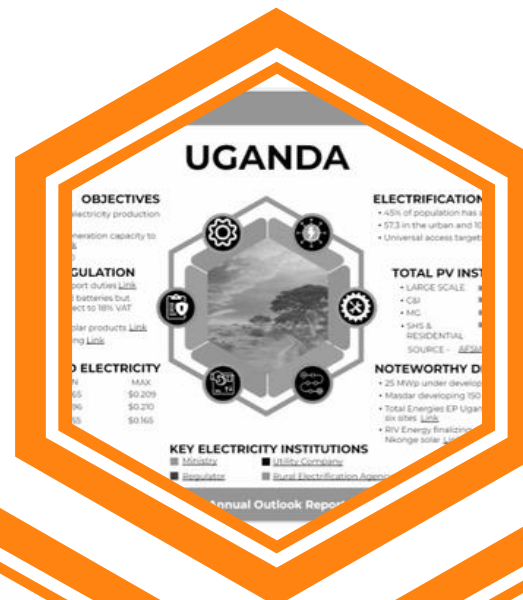
While Part 1 remains a freely accessible report to anyone interested in learning about trends in the African solar industry, we have made Part 2 more restricted in 2024 and only make it available to companies that are either members of AFSIA or decide to purchase the report. For additional information about becoming an AFSIA member, please contact [Josee Umugwaneza](#). And if you would like to purchase Part 2 of the Annual Outlook Report and get year-round access to AFSIA online resources which are updated daily, please contact [Aline Uwimana](#).

2023 INSIGHTS AND ARTICLES

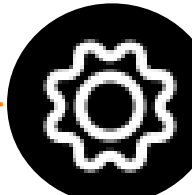
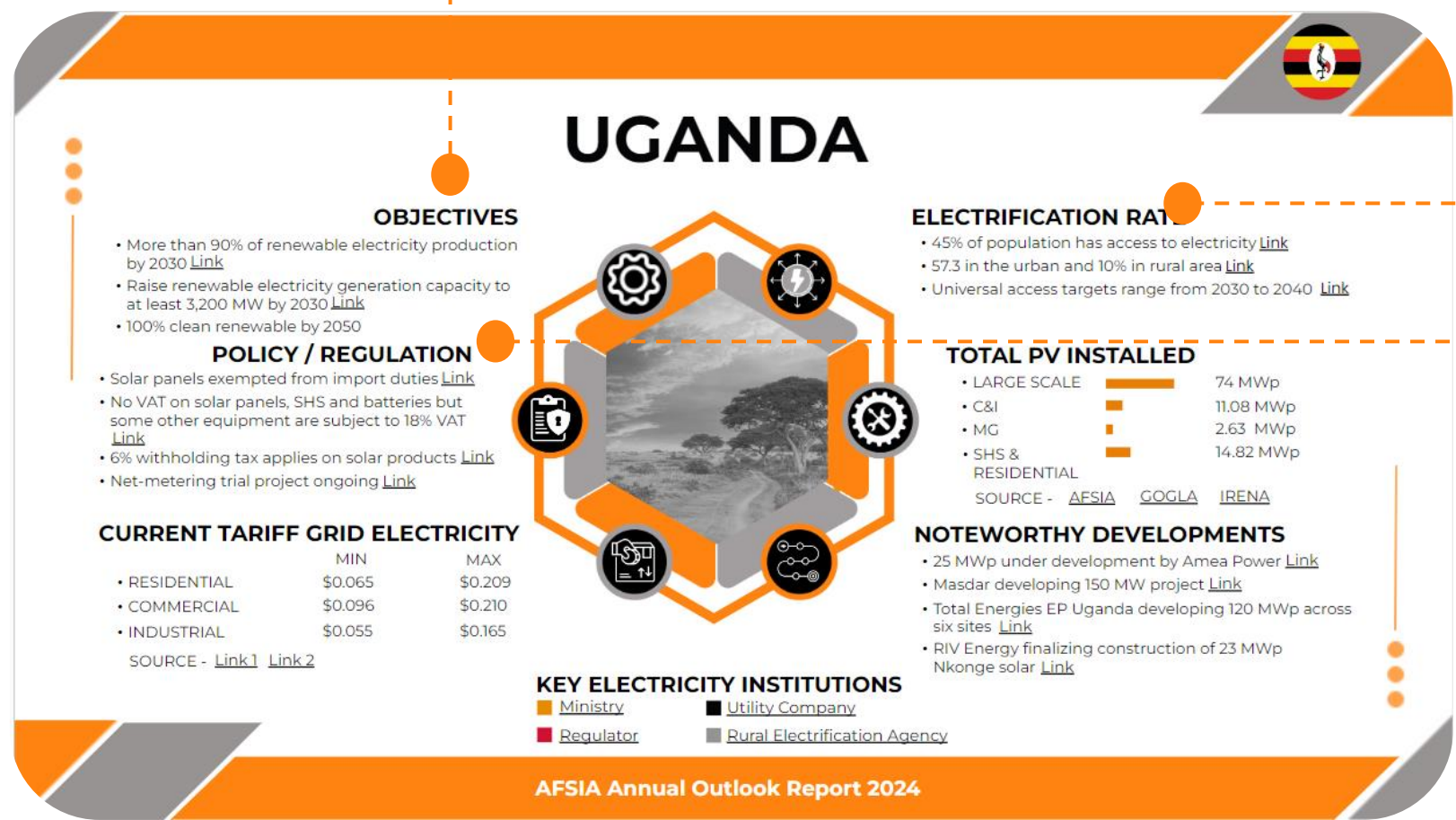
Part 1 of this report is publicly available and will look back at what has been the most amazing year ever for solar in Africa and the world.

This part will identify and analyze the major solar developments and trends witnessed across the continent based on multiple information sources collected by the AFSIA team throughout 2023. This part, which is heavily based on actual aggregate figures of the industry, will allow to take a look back at what has happened in solar in Africa in 2023, and in turn also identify upcoming trends. It literally allows the reader to make a pause and look at the entire market evolution of the past year with various reading lenses (continental vs. global performance, national specificities, performance of various segments, key growing developments and trends to watch out for).

This part also contains numerous topical articles on key trends of the industry. These articles have been contributed by several leading experts of the African solar eco-system. With the wide geographic and technical diversity of solar in Africa, it is of course impossible to cover all solar topics each year. So, we have made a selection of what we thought were the topics to watch out for the most in 2024 and we thank you in advance for your understanding if one of two equally-interesting topics are not covered in this year's report. Moreover, these articles are intentionally short to focus on the key message and spark interest if this is the first time you read about this specific topic. We highly encourage all interested readers to follow up with and contact the authors directly to engage into further stimulating conversations. All the contact details of the authors are shared at the end of the report.

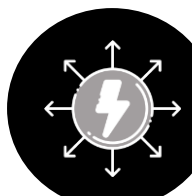


COUNTRY VIGNETTES EXPLAINED



OBJECTIVES

This section contains information on the objectives of a country to include renewable energy in its energy mix. Targets are set for the next 5 years, 10 years or maybe more. These objectives are only the targets officially announced by the country and do not constitute a guarantee of future solar development. It may be interesting to compare these various announcements with actual solar that has been developed a few years later.



ELECTRIFICATION RATE

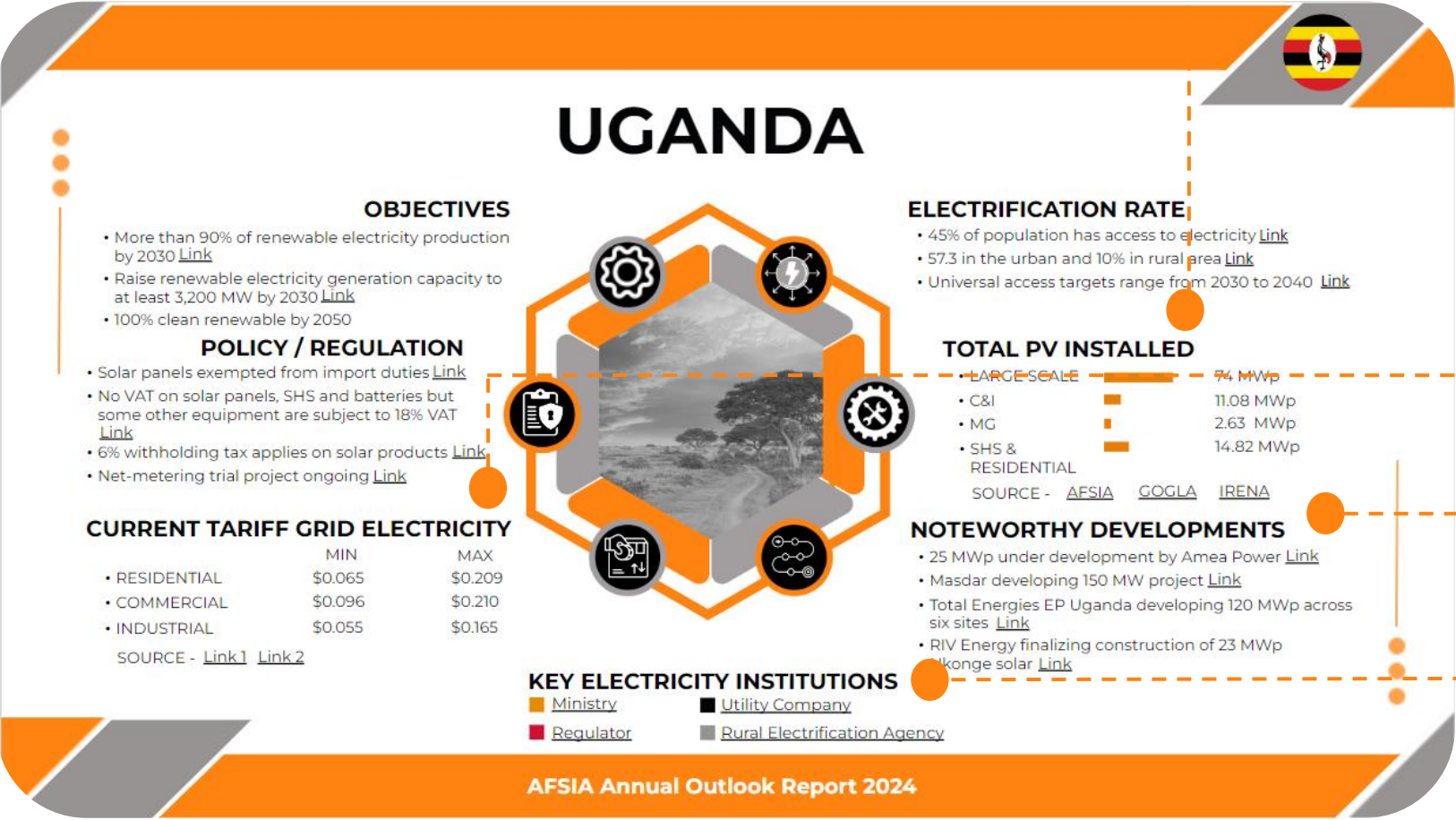
This shows the percentage of people in each country that has access to the grid and/or electricity. It also highlights electrification rate objectives in the near future. Please keep in mind that different countries count “electrification” differently. In some countries it means “connected to the grid”, in some other it means “has access to lighting, even through SHS”.



POLICY / REGULATION

Lists all applicable rules in terms of duties, taxes, exemptions, net-metering, wheeling, feed-in tariffs or any special government program that supports or restricts the deployment of solar or renewables in general in a country.

COUNTRY VIGNETTES EXPLAINED



TOTAL PV INSTALLED

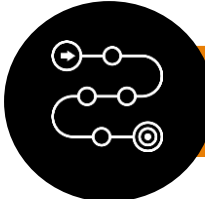
Displays figures of the currently installed capacity as identified by AFSIA for each solar segment.

We only display figures of projects that have been verified by AFSIA and are recorded as such in AFSIA projects database.



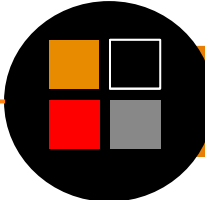
ELECTRICITY TARIFFS

Represents the tariff charged to different types of consumers classified by residential, commercial, and industrial depending on their electricity consumption. This tariff provides the range between the minimum and the maximum \$/kWh charged per category in this country. The prices shown are exclusive of VAT



NOTEWORTHY DEVELOPMENTS

Identifies bigger projects/programs that are either under development, construction, tendering or any other phase of development and which are expected to significantly contribute to the solar opportunity in a given country.



KEY ELECTRICITY INSTITUTIONS

This section gives you direct links to the nation's key electricity institutions including the Ministry, the regulator, the national utility company and the rural electrification agency if any.

SUMMARY TABLES

SUMMARY TABLE (Duties & Taxes)			
COUNTRY	IMPORT DUTIES	VAT ON IMPORT	VAT
Algeria	30% import duties on foreign solar panels		VAT rates applicable are 9% and 19%
Angola	Import duties are on average 10.9%		14% VAT applies
Benin	No import duties on panels and storage	VAT exemption on import of materials	No VAT on solar panels and batteries
Botswana	20% import duties on solar lights/lanterns and 5% on batteries		14% VAT applies to all taxable goods not qualifying for an exemption or zero rating
Burkina Faso	Solar equipment are exempted from customs	Solar equipments are exempted from import taxes	Solar equipments are exempted from VAT
Burundi	No import duties on solar panels but batteries are subject to 25%-35%		Panels, batteries, and inverters are VAT exempt; other solar products are taxed at 18%
Cameroon	No custom duties on solar products	30% import tax on Pico solar products	No VAT on solar energy materials and equipments
Cape Verde	No custom duties on solar products	No VAT on imports of solar panels and storage	No VAT on panels, but 30% on batteries
Central African Republic	5% import duties on solar batteries and 30% on solar lights and lanterns		No VAT on solar panels but 10% on batteries
Chad	Batteries subjected to 5% import duties	Renewable energy equipment exempted from import VAT	No VAT on renewable energy equipment
Comoros	0% duties on PV materials		No VAT on import of solar panels, battery and inverters
Côte d'Ivoire	0% duties on solar panels, but 20% on battery		9% VAT is applied on solar panels and 18% on battery

If you are looking to compare how various countries perform with regards to their neighbors, the summary tables are what you need!

The summary tables provide a quick and easy-to-manuever overview of the key info for each country about:

- Electrification rate
- Electricity tariffs
- Import duties
- VAT on import
- VAT
- Availability or absence of special policy (FiT, net-metering, wheeling)

SUMMARY TABLE (Electrification Rate & Electricity Tariff)								
COUNTRY	ELECTRIFICATION RATE	RESIDENTIAL		COMMERCIAL		INDUSTRIAL		SOURCE
		MIN	MAX	MIN	MAX	MIN	MAX	
Algeria	99.80%	0.009	0.061	0.008	0.061	0.004	0.050	Link Link Link
Angola	56.63%	0.003	0.008	0.012	0.014	0.009	0.009	Link Link
Benin	62.77%	0.138	0.237	0.146	0.262	0.141	0.240	Link Link
Botswana	76.32%	0.064	0.089	0.077	0.115	0.053	0.058	Link
Burkina Faso	23.16%	0.128	0.281	0.092	0.272	0.119	0.238	Link
Burundi	10.68%	0.029	0.191	0.068	0.140	0.068	0.112	Link Link
Cameroon	66.40%	0.080	0.158	0.134	0.158	0.097	0.113	Link Link
Cape Verde	95%	0.240	0.336	0.228	0.257	0.228	0.257	Link
Central African Republic	16%	0.109	0.229	0.043	0.060	0.043	0.060	Link
Chad	12.04%	0.330	0.330	0.136	0.200	0.136	0.200	Link Link
Comoros	87.94%	0.370	0.370	0.270	0.330	0.228	0.330	Link Link
Côte d'Ivoire	77%	0.037	0.179	0.089	0.190	0.043	0.124	Link Link
Democratic Republic of Congo	20%	0.027	0.087	0.098	0.150	0.136	0.110	Link
Djibouti	65.44%	0.151	0.308	0.224	0.308	0.270	0.23	Link





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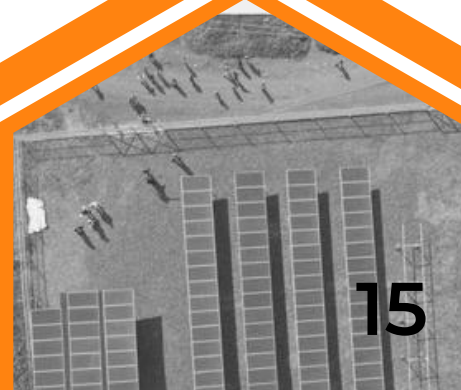
Thanks to experts

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AFSIA Members

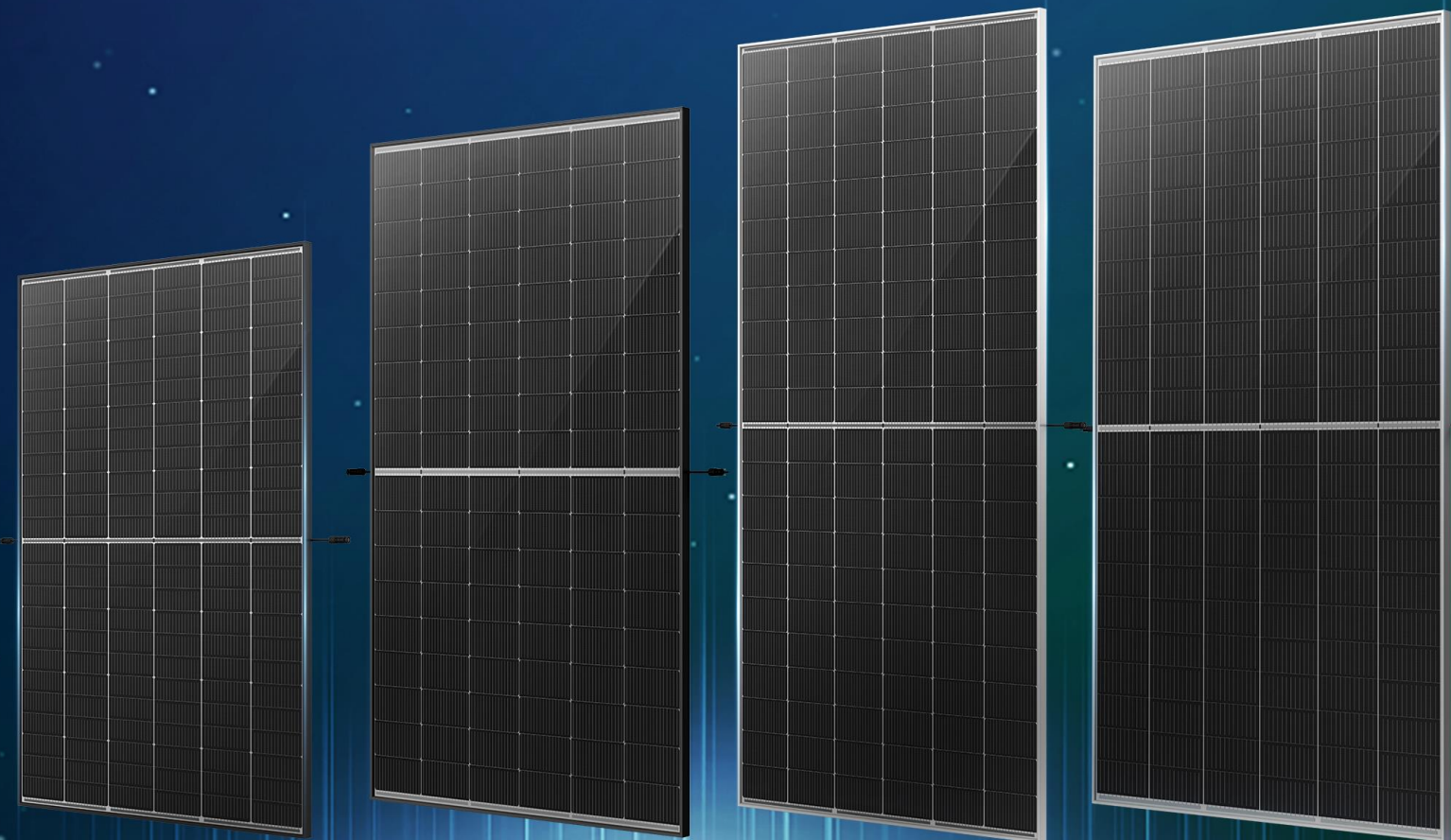
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AFSIA Contacts



Leading the N era of solar Energy

Vertex S⁺



450W

505W

620W

710W

Vertex N

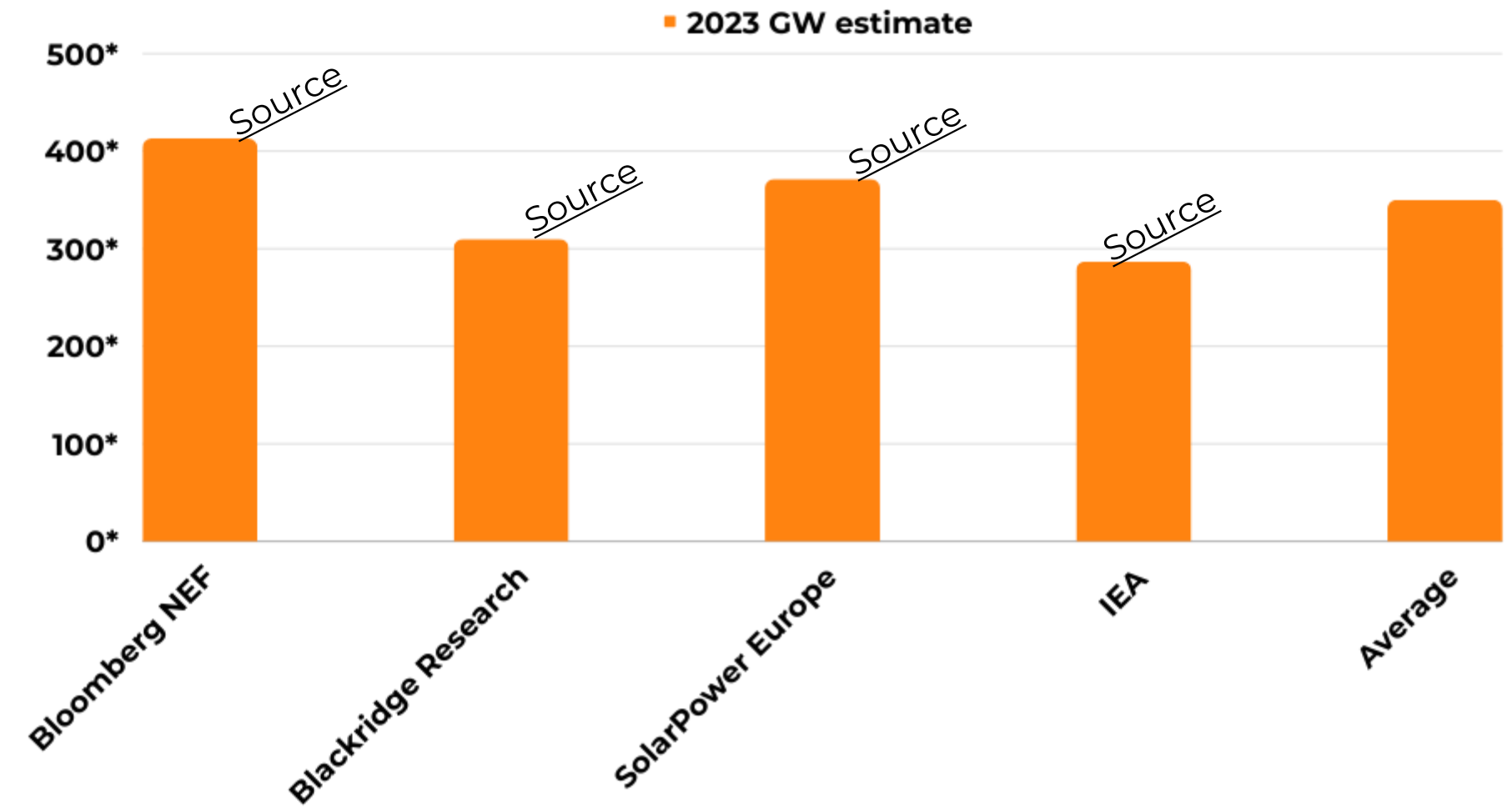
YET ANOTHER RECORD YEAR FOR SOLAR ACROSS THE GLOBE

**The world has added around 350 GW
in 2023, the most it has ever added in
history**

As mentioned in our previous reports, no official figures exist for global PV installations unfortunately. But a comparison of various sources can help us identify a range of potential capacities and define a reasonably acceptable figure for each year.

Here is an overview of the various sources we have taken into account





*SolarPower Europe defines a minimum scenario of 341 GWp and a maximum scenario of 402 GWp. Hence we have considered the average.

In 2022, 240 GWp were estimated to have been added. So, with 350 GWp, 2023 has experienced an increase of 46% in solar installed globally. This is a solid rebound and almost equals the 2 historical performance years of 2016 and 2021 which both saw an increase of slightly over 50% YoY.



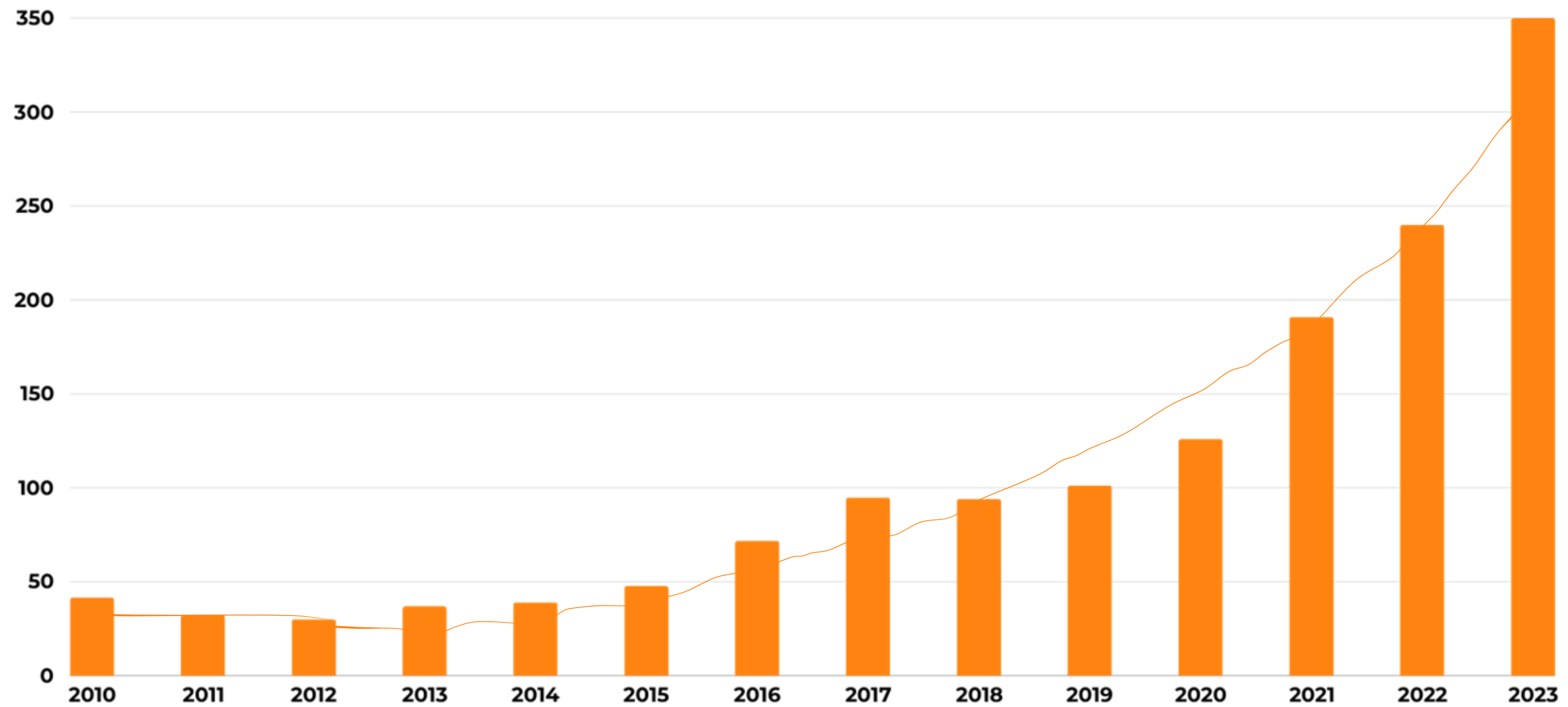
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Annual Installed	41.6	32.3	30.1	37	39	47.7	71.9	94.9	94.2	101.3	126	191	240	350
YoY Growth		-22%	-7%	23%	5%	22%	51%	32%	-1%	8%	24%	52%	26%	46%
Cumulative	41.6	73.9	104	141	180	227.7	299.6	394.5	488.7	590	716	907	1,147	1,497
Growth vs. History		78%	41%	36%	28%	27%	32%	32%	24%	21%	21%	27%	26%	31%

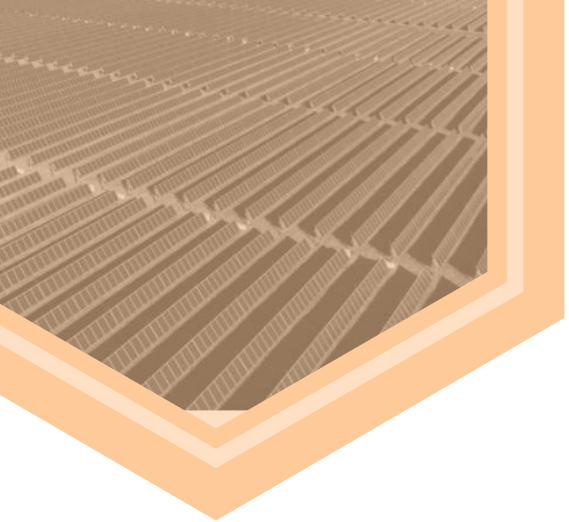


Probably even more striking is that the capacity installed in 2023 alone represents 31% of all solar PV capacity added since 2010! This type of performance had not been seen since 2017. But the PV industry has evolved massively in those 6 years, with 4 times more solar installed in 2023 than in 2017.

This clearly indicates a sustained growth trajectory for solar across the globe. If we take a step back and look at the performance of the past 13 years, we can clearly see an exponential growth of PV installations across the world:

GLOBAL ANNUAL INSTALLED CAPACITY





How far can this go?

With this new addition of 350 GWp, the world is now hosting 1.5 TWp of solar. If the trend continues in 2024, there is a very high probability to surpass 2 TWp by the end of 2024. This doubling of installed capacity would come just 2 years after the world hit the symbolic threshold of 1 TWp.

With decreasing solar and storage prices ([see article later in this report](#)) and growing concerns about energy security at national and individual level, it seems business and geostrategic fundamentals unite to support a continued exponential growth of solar across the globe.

One interesting element may further support this:

According to Bloomberg NEF, in 2023 Tier 1 module manufacturers counted a total of 839 GWp/year production potential. This is more than double what has been installed in 2023, leading to believe that manufacturers are already in the starting blocks to address a booming demand in the coming year(s).





AFRICA ADDED CAPACITY

A RECORD YEAR FOR AFRICA WITH 3.7 GWp ADDED IN 2023!

The African continent has experienced a solid growth of solar in 2023 in line with the rest of the world. While solar additions in Africa still only represent 1% of the global additions, the continent has seen not less than 3.7 GWp coming online identified by the AFSIA in 2023, the best performance ever recorded!

With this 2023 addition, Africa is now home to more than 16 GWp of solar.

This number is an underestimation of the real capacity added as a) it does not account for residential installation (not tracked by AFSIA) and b) as it is based only on projects identified by AFSIA and some installations projects may still be unknown at this point.

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Annual Installed (IRENA)	0.09	0.08	0.31	1.01	0.53	1.14	1.8	2.9	1.3	1.2	0.8	0.9	
YoY Growth		-11%	288%	226%	-48%	115%	58%	61%	-55%	-8%	-31%	-14%	
Cumulative	0.3	0.4	0.7	1.7	2.3	3.4	5.2	8.1	9.4	10.6	11.4	12.4	
Growth vs. History	38%	24%	76%	140%	31%	50%	53%	56%	16%	13%	8%	8%	
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Annual Installed (AFSIA)	0.0	0.0	0.1	0.9	0.2	0.5	0.7	1.4	2.5	0.9	1.1	3.1	3.7
YoY Growth		-51%	6193%	820%	-79%	152%	52%	83%	83%	-64%	24%	180%	19%
Cumulative	0.0	0.0	0.1	1.0	1.2	1.7	2.5	3.9	6.4	7.3	8.4	11.6	15.3
Unassigned to year													1.0
Total Cumulative													16.3
Growth vs. History	39%	14%	767%	814%	19%	40%	43%	55%	65%	14%	15%	37%	32%

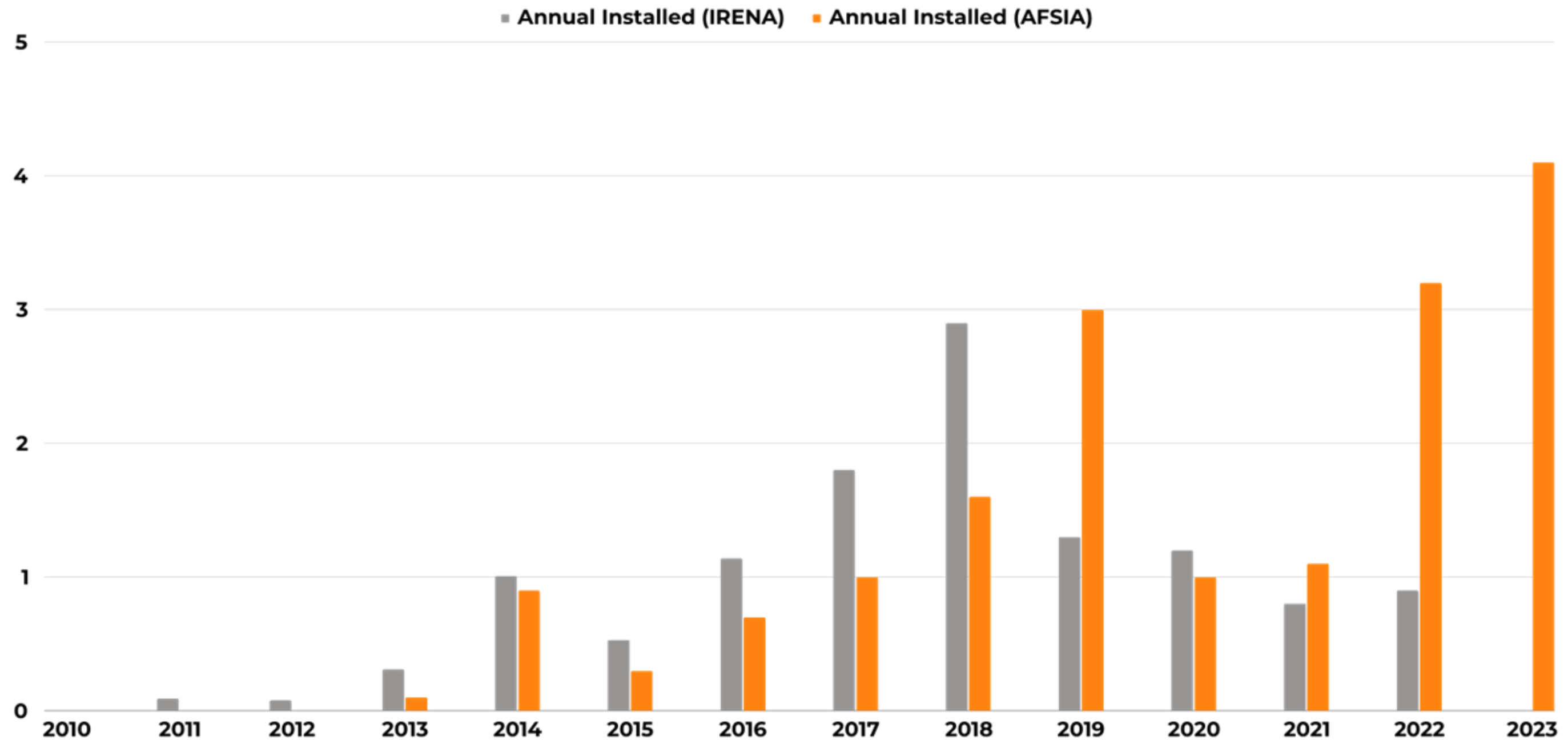


Several elements are required to interpret the above figures adequately.

First, the figures presented by AFSIA are based on actual projects that have been identified and verified. These are real projects that the AFSIA team has knowledge of, but these figures may underestimate the full solar reality as some projects may have slipped through the AFSIA research net. Our bottom-up approach is different from other institutions that are also trying to share the fairest picture of solar in Africa. IRENA, for example, which has amazing data about solar from around the world, has a more top-down approach basing their statistics on import figures or other sources to approximate solar capacities in specific countries. Despite our best efforts, it is therefore inevitable that some discrepancies are observed.

But thanks to continued research efforts, the gap between AFSIA and IRENA historical figures from 2010 to 2022 has been reduced from 2 GW to only 0.8 GW in the span of 1 year. However, at the same time, a major discrepancy has appeared for 2022 specifically with AFSIA identifying 3.1 GW worth of installations where IRENA has identified only 0.9 GW. The 3.1 GW figure for 2022 is a major revision from the figure announced last year by AFSIA, as new projects have been discovered in the course of the last 12 months. A dedicated section to follow will share more details on this.

AFRICA ANNUAL INSTALLED CAPACITY



Another important element to take into account is that more than 1 GW of projects already identified by AFSIA but not assigned to a specific year have this year been assigned. This was the result of further research and verification to confirm in which year certain projects were commissioned. At the end of 2022, AFSIA had 1.8 GW worth of operational unassigned to a specific year. One year later, this capacity has reduced to 1.0 GW (1.1 GW of previously identified projects have been assigned, while 0.3 GW of new projects have been added to the category “missing year of operation”). Therefore, the proportion of unassigned projects has drastically reduced from 14.5% (1.8 GW out of 12.4 GW in 2022) to 6% (1.0 GW out of 16.3 GW).

Finally, it seems important to note that while Africa has followed a similar growth path as the rest of the world in 2022 and 2023, the drivers of that growth may be fundamentally different. In Europe, the US and China, most of the added capacity is the result of government programs and tenders, leading to large utility-scale projects being connected and injecting into the grid. The main motivation is to increase electricity supply to meet the demand on the grid, but at the cheapest possible cost and while reducing carbon emissions. In the case of Europe and in the context of the Russia-Ukraine conflict, a layer of energy security concerns also adds to the mix, leading various European countries to launch supportive policy to aggressively add renewables to the grid.

In Africa however, the picture seems to be very different. Most of the added capacity in 2023 was through C&I projects (65%). Unlike other parts of world, there have actually only been a handful of utility-scale projects, driven by government requirements, connected to the Africa grid in 2023.



In Africa, new solar additions have mostly been driven by economic decisions of the business community. In absence of reliable utility companies and grid supplying the required electricity, African companies and businesses finally have found an alternative with solar and storage thanks to plummeting prices of both key components. There is a low probability that this downward trend of solar equipment prices would change and we may therefore expect an acceleration of C&I solar across the continent.

This is great news for the continent's economic activity, but this also becomes a serious threat to national utility companies that have been struggling financially for years and whose financial balance is not going to improve with more and more large customers covering a large portion of their electricity consumption with their own solar energy and/or going completely off-grid.



DISCREPANCY BETWEEN 2022 DATA IN AFSIA OUTLOOK REPORT 2023 AND 2024

In our Annual Outlook report 2023, we announced that Africa had added 0.9 GWp in 2022 and that the continent then counted 10.5 GWp that had been uniquely identified by the AFSIA team.

However, in this year's report, you may notice that the figures for 2022 are fundamentally different, with capacities significantly larger than announced in our previous report.



Photo Credit: Namene Solar Light Company

	2023 Annual Outlook	2024 Annual Outlook
Capacity added in 2022	0.9 GW	3.1 GW
Capacity added in 2023		3.7 GW
Cumulative Capacity	8.7 GW	15.3 GW
Capacity unassigned to year	1.8 GW	1.0 GW
Total cumulative capacity	10.5 GW	16.3 GW

This difference is indeed significant but can be explained through various factors.

First, many projects contributing to the large capacity difference for 2022 come from South Africa. The load shedding issues experienced in South Africa since 2022 has caused an unprecedented wave of solar installations for both C&I and residential solar. So much so, that many companies have not had the time to document these projects as they were moving from one project to the other. We are only catching up now with many of these projects, and as a result adding them to the database. (South Africa is still experiencing a massive wave of solar installations in 2023 and 2024, but this is now happening in a more controlled way and we are able to better track installs as they are being commissioned).

Second, AFSIA's research capabilities have increased in 2023 and our team has been able to identify and track more projects than ever before. As a result, some projects that had previously gone unnoticed have finally been identified and confirmed by AFSIA, and added to the database.

Finally, thanks to more research capability, we have also been able to assign known projects to their year of commissioning. We previously had almost 2 GW of projects which were not assigned to a particular year. In 2023, we have been able to allocate 1.1 GW of these projects to a specific year and this has affected the figures that were previously presented. At the same, we have also identified new projects, some of them for which we are still looking to identify their year of commissioning. These new projects represent 0.3 GW of capacity, so that we have a total of 1.0 GW of projects which are still to be assigned to a particular year by the end of 2023.

Tracking projects and building the most reliable database for solar in Africa is not an exact science. The AFSIA team works relentlessly every day to improve the quality of our database and make the most correct and reliable information about solar in Africa available. But we are aware that our work still requires a lot of attention and improvement. We have made significant progress in 2023 to identify and list more projects and we look forward to collaborating further with companies and national government bodies to further refine and improve the quality of the solar projects database.

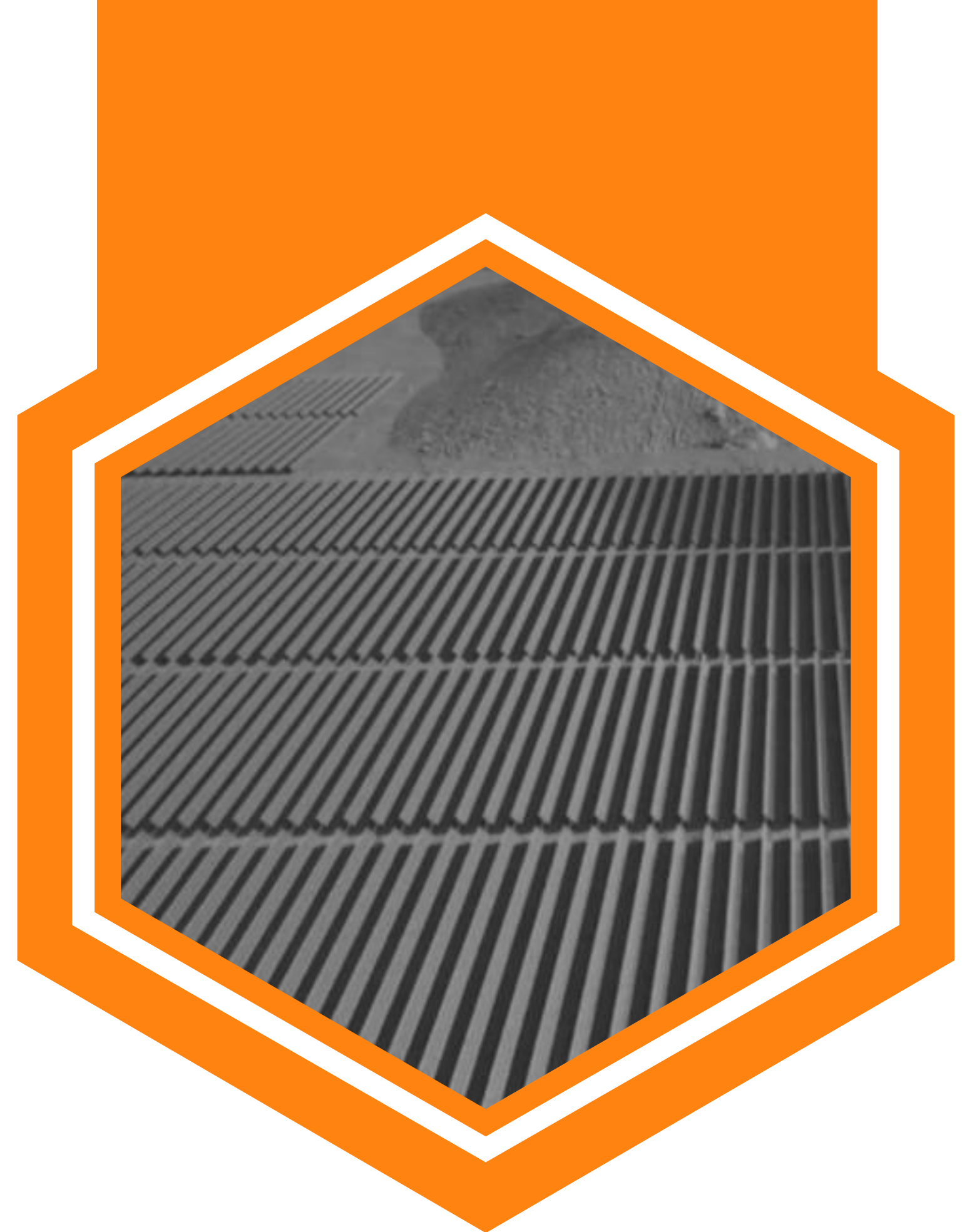


SPOTLIGHT ON SOUTH AFRICA

WILL SOUTH AFRICA INSPIRE THE REST OF THE CONTINENT TO GO SOLAR MASSIVELY?

South Africa has experienced some of its most challenging times in history since 2022 with the occurrence of massive load shedding. The situation is gradually getting back under control, but solving the problem entirely will take years as this is the time required to build the required electricity infrastructure (which lacked adequate planning in the past decade).

The positive side of this terrible situation for South Africans is that this made companies and residents realize that they could take their electricity fate in their own hands thanks to solar (albeit, those who could afford it). As a result, South Africa has witnessed the most important increase of solar installations in African history in 2022, and then beating that record again in 2023.



But even before 2022, **South Africa was already the absolute leader of solar in Africa**. 2022 and 2023 have only made this domination even more obvious. Some quick numbers illustrate this very easily:

- By the end of 2023, South Africa is home to at least 7,781 MW of solar, representing **almost 47% of all installed capacity in the continent**
- **79% of all new capacity installed in 2023** identified by AFSIA was in South Africa (2,965 MWp out of 3,745 MWp)
- Since 2022, new **C&I capacity added is surpassing new utility-scale capacity**
- in 2014, at the height of REIPPPP 1, South Africa was home to 84% of all solar capacity in Africa
- Since 2014, South Africa has been home to at least 29% of all solar installed in Africa at any point in time



Continent	2007	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
New	0.3	0.1	8.0	3.3	1.6	101.8	936.9	196.7	495.6	754.2	1,381.6	2,532.8	902.1	1,119.8	3,136.9	3,745
Cumulative	0.3	0.4	8.4	11.7	13.3	115.1	1,052	1,248	1,744	2,498	3,880	6,413	7,315	8,435	11,572	15,227
Unassigned																1,006
Growth vs. History	100%	49%	1912%	37%	13%	761%	772%	18%	39%	42%	54%	64%	14%	15%	37%	32%
YoY growth	100%	-44%	5598%	443%	-51%	6276%	823%	-79%	152%	52%	83%	83%	-64%	24%	180%	19%

South Africa	2007	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
New				2.4	0.3	23.2	917.5	14.1	294.7	187.8	209.3	35.2	579.5	524,6	1,443.0	2,964.7
Cumulative				2.4	2.7	25.9	943.4	957.5	1,252	1,440	1,649	1,684	2,264	2,788	4,232	7,196
Unassigned																585
Growth vs. History					13%	844%	3352%	1%	31%	15%	14%	2%	34%	23%	51%	69%
YoY growth					-86%	6932%	3854%	-98%	1988%	-36%	11%	-83%	1545%	-9%	175%	105%
South Africa % new				73%	20.7%	22.8%	97.6%	7.2%	59.5%	24.9%	15.2%	1.4%	64.2%	46.8%	46%	79.2%
South Africa % cumulative				20.6%	20.6%	22.5%	89.7%	76.7%	71.8%	57.6%	42.5%	26.3%	31.0%	33.1%	36.6%	47.0%

By switching very radically and swiftly to self-reliance on solar for electricity supply, South Africans are showing a clear path to the rest of the continent. A path where alternative options do exist and are financially viable if the national utility fails. South Africans had no choice and had to adapt very quickly. The conversion to solar in South Africa was also greatly helped by the presence of many experienced solar companies and the existence of a solid financing environment that understands solar and could propose adequate financing instruments for all kinds of solar project requirements.

It will be interesting to see in the coming years in how far companies and residents of other African countries will be inspired by the South African example. Prices of solar and storage are constantly declining, making the switch to solar easier and more affordable every day. Yet, despite the need for stable electricity and the attractiveness of solar, the absence of a mature enabling environment (composed of solar and financing experts, as well as adequate policy), may slow down the speed at which solar will penetrate the rest of the continent.



SOLAR CONTINUES SPREADING ACROSS AFRICA

As highlighted in our previous report, solar continues to spread its wings across the continent.
In 2023:

- 1 country installed more than 100 MW
- 17 countries installed more than 10 MW
- 27 countries installed more than 1 MW

This is very much aligned with figures from 2022. However, the magnitude of solar installations has considerably increased in 2023.

Based on the info gathered this year, the top 5 countries with largest new capacities installed in 2023 are:

1. South Africa – 2,965 MWp
2. Burkina Faso – 92 MWp
3. Mauritania – 84 MWp
4. Kenya – 69.5 MWp
5. Central African Republic – 40 MWp





But capacities are highly concentrated in only 1 country

AFSIA estimates that 3.7 GWp were installed across the continent in 2023. This is a significant increase of 16% compared to 2022, which was already a record year with 3.1 GWp (based on revised figures, see article above).

But this increase is mostly to be attributed to only 1 country, South Africa, which has seen its installed capacity surge by almost 3,000 MWp! South Africa alone has indeed contributed to more than 80% of the newly installed capacities in Africa in 2023.

Two opposite trends can be witnessed among the Top 5: adding capacity through the “traditional” route of government-driven large-scale grid-connected projects vs. letting the private market forces drive solar capacity additions through C&I.

Most if not all of the 2023 new capacity in Burkina Faso, CAR and Kenya came from large-scale projects.

On the opposite, 75% of the 3 GWp installed in 2023 in South Africa came from C&I projects, while the remainder came through only 2 large-scale projects. In Mauritania, the split is even stronger with 100% coming from C&I projects, albeit composed of only 2 such projects.



2023 installed capacity	C&I	Large Scale	Mini-grid	Grand Total
South Africa	2,226.7	738.0		2,964.7
Burkina Faso	0.3	92.0		92.3
Mauritania	84.0			84.0
Kenya	10.5	57.0	2.0	69.5
Central African Republic	0.0	40.0		40.0
Côte d'Ivoire	0.6	37.5		38.1
Egypt	37.5			37.5
Cameroon		36.4		36.4
Mozambique	11.3	19.0	6.0	36.3
Nigeria	23.8	10.0	0.9	34.7
Zambia		33.0		33.0
Niger		30.0		30.0
Lesotho		30.0		30.0
Malawi	1.3	25.2		26.5

Row Labels	C&I	Large Scale	Mini-grid	Grand Total
Angola		25.0		25.0
Madagascar	10.7	5.0		15.7
South Sudan	0.0	13.0		13.0
Mauritius		9.3		9.3
Zimbabwe	8.2		0.0	8.3
Botswana	2.2	4.7		6.9
Ghana	1.8	4.0		5.8
Somalia	0.1	3.5		3.6
Senegal	0.9		2.7	3.6
Morocco	2.7			2.7
Tunisia	2.7			2.7
Uganda	1.4			1.4
Namibia	1.2			1.2
Mayotte		1.2		1.2

Row Labels	C&I	Large Scale	Mini-grid	Grand Total
DRC	0.7			0.7
Togo	0.6		0.0	0.7
Burkina Faso	0.3			0.3
somaliland	0.1			0.1
Burundi	0.0			0.0
Mali		0.0		0.0
Comoros	0.0			0.0
Rwanda			0.0	0.0
Sierra Leone	0.0			0.0
Tanzania	0.0			0.0
The Gambia				
Grand Total	2,429.5	1,213.8	11.7	3.655

EVALUATING NATIONAL PERFORMANCE THROUGH A DIFFERENT LENS

It is easy and common to evaluate and rank countries based on absolute numbers of capacities added. But countries across Africa differ greatly in terms of size, population or level of development just to cite a few.

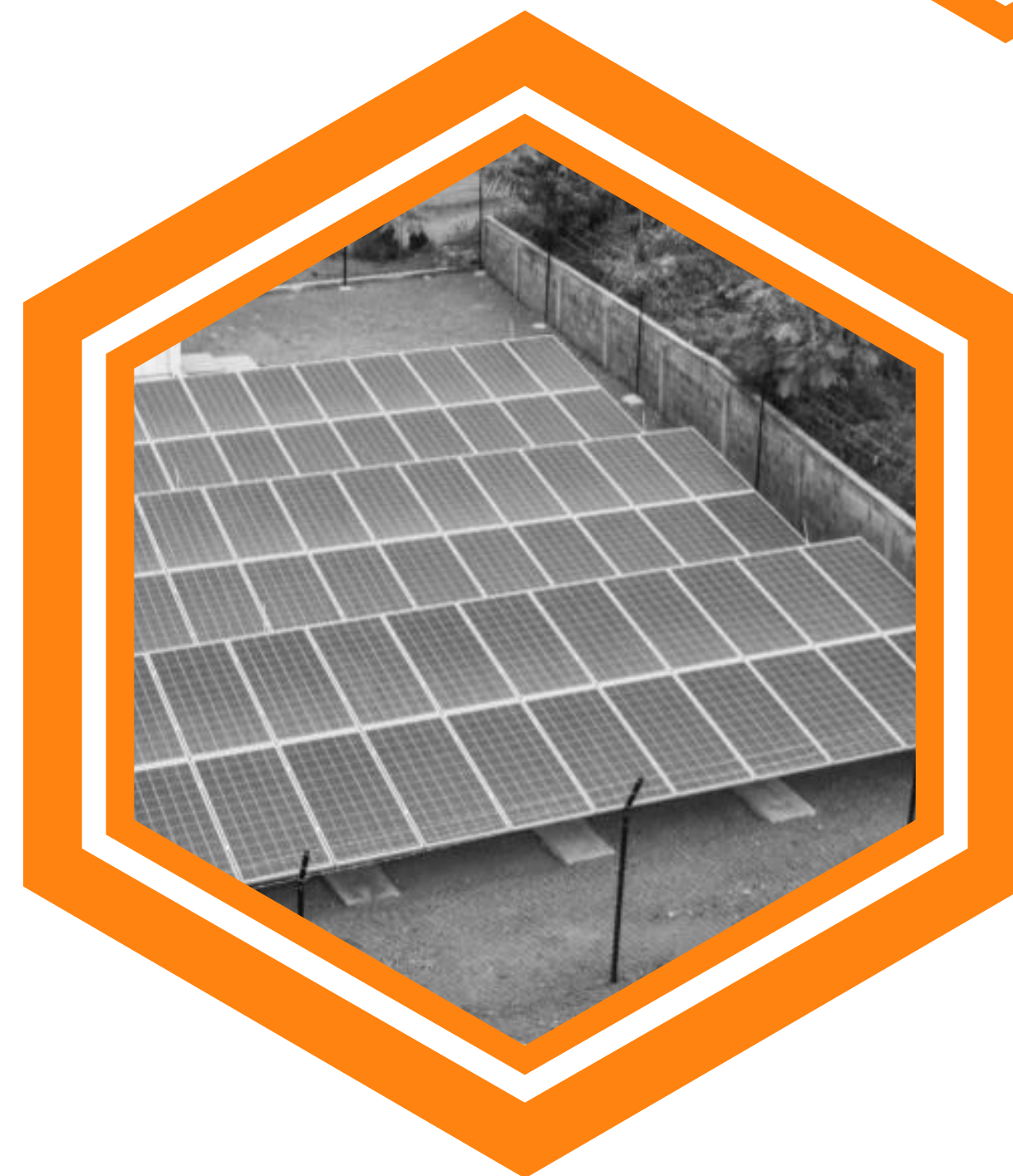
We therefore believe it is interesting to look at solar in each country through figures relative to some of those key parameters. When doing so, the ranking and the individual national performance becomes very different. This approach gives more credit and visibility to the countries that are small but deliver tangible results on solar, while on the opposite it also diminishes the importance of large countries which are comparatively doing “just OK” or “a little” when it comes to solar.

In this report, we propose to look at 2 specific relative metrics: “Wp/capita” and “solar % in the overall generation mix”

Country	Population	MWp	Wp/capita
Seychelles	107,660	19.910	184.93
Namibia	2,624,315	301.730	114.97
South Africa	69,592,654	7781.493	111.81
Mauritius	1,301,242	112.743	86.64
Cape Verde	601,518	34.276	56.98
Mauritania	4,925,999	170.091	34.53
Morocco	38,022,317	1137.597	29.92
Egypt	113,581,572	3074.648	27.07
Senegal	17,763,163	301.453	16.97
Lesotho	2,330,318	30.452	13.07
Zambia	20,844,599	262.545	12.60
Eswatini (Formerly Swaziland)	1,216,315	14.191	11.67
Angola	37,228,496	309.263	8.31
Algeria	45,935,598	355.490	7.74
Central African Republic (CAR)	5,826,523	40.110	6.88
Malawi	20,931,751	139.136	6.65

In the Wp/capita ranking, we notice that:

- The top 5 remains almost unchanged with Seychelles, Namibia, South Africa and Cape Verde still present
- It is now more difficult to enter or stay in the top 5 with the cut-off at 57 Wp/capita, while number 5 in 2023 was at “only” 25 Wp/capita
- Seychelles and Namibia maintain their two top spots with 185 Wp/capita and 110 Wp/capita respectively. Compared to 2023, this represents a slight increasing for Seychelles and a slight decrease for Namibia com
- South Africa climbs to number 3 thanks to its amazing growth of installed capacity in 2023. The country has more than doubled its capacity per capita and now reaches 112 Wp/capita
- Mauritius enters the top 5 on ranking #4 thanks to the commissioning of almost 10 MWp in 2023 with the Tamarind Falls project





SOLAR CONTRIBUTION IN ELECTRICITY MIX

The solar percentage in the overall energy mix is a new metric tracked this year. This is a particularly relevant metric because solar MWs installed produce very different levels of electricity (MWh) than hydro, coal or gas plants MWs. Therefore, comparing installed solar capacities with installed capacities of other technologies is irrelevant and provides a biased picture (for example, comparing solar installations with their equivalent number of nuclear power plants). As an example, 1 MW hydro can produce around 5,000 MWh/year of electricity (this number can vary widely based on the site specifics) while 1 MW of solar produces on average 1,500 MWh/year in Africa (here again annual solar generation varies greatly from country to country). Counting in MWh instead of MW therefore allows for a better like-for-like comparison.

This metric is also particularly important as many governments have expressed publicly (most of the time as part of their COP engagements) that they wish renewable energy and/or solar to reach a certain percentage of the total national energy mix. Without a clear overview of how much electricity solar actually produces in a specific country, it is impossible to track whether those objectives are being met

Unfortunately, computing this metric comes with 1 major challenge: data about electricity generation in Africa is, at best, a good approximation of the reality. The figures computed for the weight of solar electricity in the overall energy mix of a country are therefore also approximations and must be considered with a critical look. For the overall electricity generation in a specific country, we rely on the data provided by AFREC, the African Energy Commission, a body of the African Union, with its wonderful database.

The AFREC database provides data about electricity generation from all sources, including solar. But the most recent data available is only up to 2021 and AFREC's data for solar vary to a certain extent with the AFSIA data. For solar, we are therefore using AFSIA latest data of installed capacities in each country, and apply an average national solar yield to calculate an approximate value for solar GWh per year.



Country	Electricity generation 2021 (GWh)	Solar capacity 2023 (MWp)	Average yield (kWh/kWp/yr)	Solar generation (GWh)	Solar % in energy mix
Central African Republic	141	40.11	1,600	64	45.5%
Mauritania	921	170.09	1,750	298	32.3%
Namibia	2,153	301.73	1,950	588	27.3%
Burkina Faso	1,608	183.20	1,600	293	18.2%
Niger	723	56.63	1,850	105	14.5%
Togo	701	60.40	1,450	88	12.5%
Somalia	461	27.94	1,850	52	11.2%
Lesotho	538	30.45	1,850	56	10.5%
Cape Verde	559	34.28	1,700	58	10.4%
Malawi	2,405	139.14	1,700	237	9.8%
South Sudan	560	32.20	1,600	52	9.2%
Madagascar	1,732	84.30	1,800	152	8.8%
Senegal	6,338	301.45	1,600	482	7.6%
Sierra Leone	415	21.33	1,450	31	7.5%
Comoros	85	4.26	1,400	6	7.0%
Seychelles	602	19.91	1,700	34	5.6%
Mauritius	2,969	112.74	1,450	163	5.5%



In this ranking, we notice that

- Many African countries are already performing extremely well in terms of solar penetration in their energy mix, with 20 countries already producing 5% or more of their electricity through solar
- With a very low installed capacity of conventional power plants and 2 large-scale solar plants commissioned in 2023, the Central African Republic reaches the top rank in Africa's most solar-powered country. Solar in CAR now contributes for almost half of all electricity generated and injected to the grid (this does not include independent diesel generators)
- Mauritania comes second with almost one third of its electricity being generated by solar. This excellent performance is mostly to thank to 2 new large C&I projects commissioned this year and which represent 84 MWp combined, half of all solar capacity installed in the country.
- Namibia comes at number 3 with more than 25% of its electricity coming from solar. The country is one of the "best in class for solar in Africa" has been present in in all Top 5 computed by AFSIA since 2020. With numerous large-scale projects commissioned several years ago and a growing C&I segment, it is not surprising to find Namibia once again in the top of this ranking.
- With 3 new large-scale plants adding 92 MWp to the grid in 2023, Burkina Faso significantly increases its solar generation and now reaches almost 20% of all the electricity generated in the country from solar.
- Niger makes a strong push in 2023 and completes the top 5 thanks to the commissioning of the 30 MWp Gourou Banda plant, which has doubled the solar capacity of the country.
- Just outside of the top 5, Togo achieves an honorable 12.5% contribution of solar to the national energy mix. This percentage has not changed much since 2021 and the commissioning of the 50 MW Sheikh Mohamed Bin Zayed plant in Blitta. But new projects of significant importance, both large scale and mini-grids, are in the pipeline and will soon make Togo further climb this ranking.

C&I FURTHER INCREASES ITS DOMINATION OF THE AFRICAN SOLAR ECO-SYSTEM

Out of the total 3.7 GWp which AFSIA managed to identify as being commissioned in 2023, the breakdown is as follows:

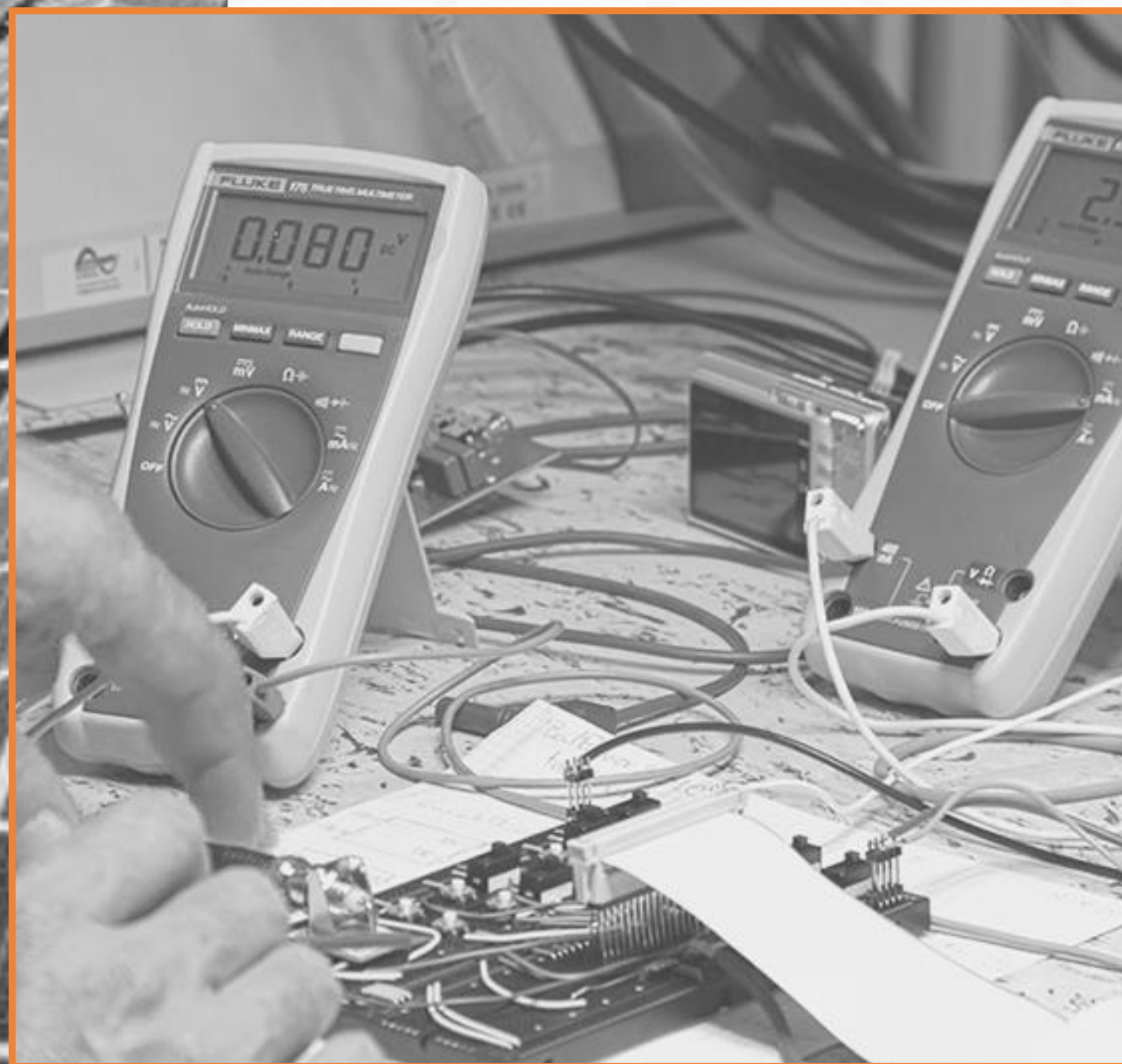
SEGMENT	2023	% OF 2023	2022	YoY GROWTH
C&I	2,429.5	65%	1,623.2	49.7%
LARGE-SCALE	1,213.8	32.4%	1,419.6	-14.5%
MINI-GRID	11.7	0%	7.1	64.8%
SHS	90	2.4%	86.9	3.6%
TOTAL	3,745		3,136.9	



After computation of revised 2022 capacities, C&I was already contributing to more than 50% of all new capacity installed in 2022 (52% with 1,623 MWp). In 2023, C&I has further increased its share to 65%. More importantly, this represents a 50% YoY growth compared to 2022. The growth of C&I in 2023 represents almost 80% of the total African solar growth in 2023.

New large scale capacities have decreased by almost 15%. Despite this reduction, the annual “large scale market size” remains above 1 GWp. However, in 2023, only 27 large scale projects were commissioned, together representing just below 1/3 of all new capacities added, the lowest it has ever reached in history. Without a stronger level of commitment from local governments, DFIs and private investors for large scale projects, this market share is likely to continue with a steady decrease. This is especially true as C&I is poised to continue growing very quickly as solar+storage is becoming economically viable for more and more C&I end-users.





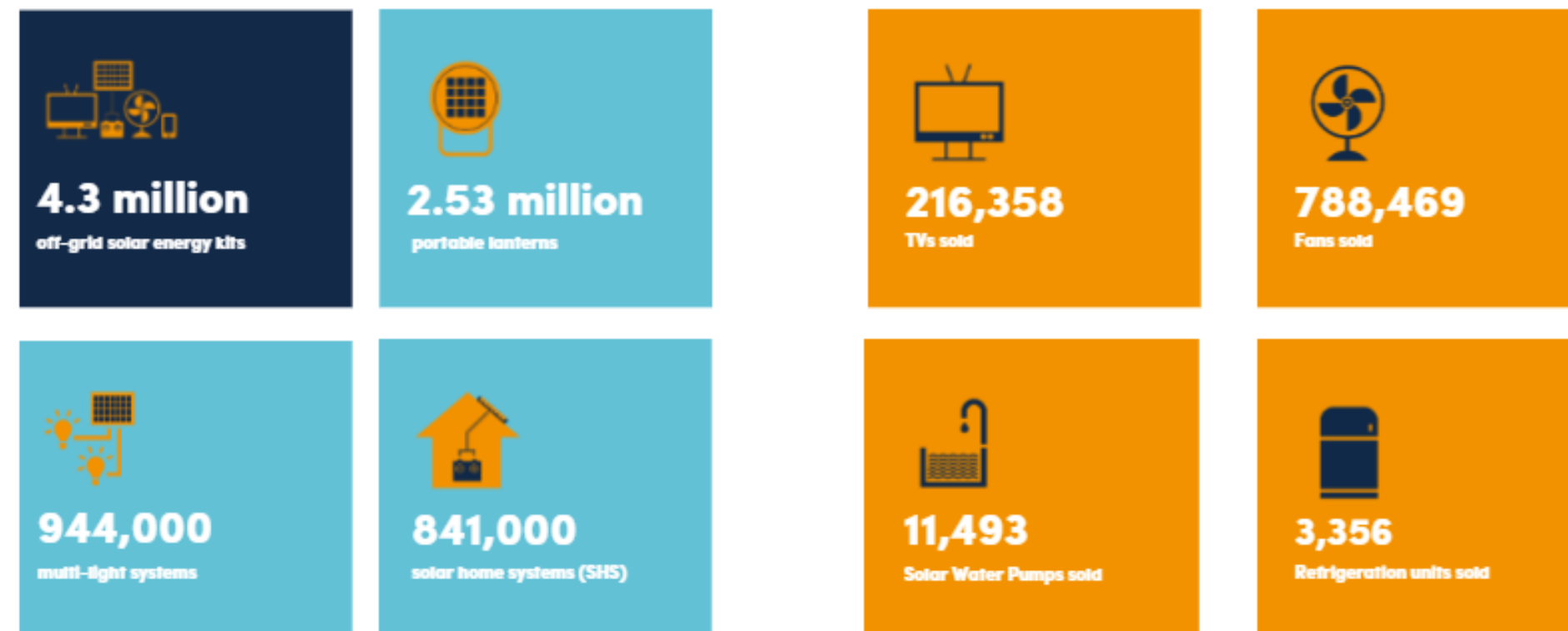
Percentage-wise, mini-grids have rebounded strongly in 2023 with a 65% YoY growth. The total capacity identified by AFSIA however remains marginal, approaching only 12 MWp. This number needs to be considered very carefully though, as the capacities for many MGs which have been declared commissioned in 2023 were not made public by the respective authorities and are therefore not computed in the total number presented in this report. This is particularly the case for the MGs commissioned in Nigeria, Togo and Tanzania for which the AFSIA team was unable to confirm precise capacities.

Finally, for SHS, we usually base ourselves on the great statistics collected and computed by GOGLA through their bi-annual report. This year, GOGLA has decided to switch to only 1 report per year which will be released in spring 2024. We are therefore only able to share our best estimates and these will be revised once the GOGLA are made available.

Some of the key highlights with regards to SHS and PUE are:

- 2022 H2 was stronger than anticipated and led to a total 2022 capacity of 86.9 MWp whereas our estimate for the year was 67 MWp
- Sales in 2023 H1 being fairly similar to those of 2022 H1, our new estimate for 2023 therefore is set at 90 MWp
- GOGLA anticipates that solar energy kits (comprising of pico-solar, multi-light systems and SHS) sales may plateau in 2023. 4.3 million kits were sold in 2023 H1, a level similar to 2022 H1
- More than 1 million appliances have been sold in 2023 H1 for the first time in history
- Fans represent almost 80% of sold appliances while refrigeration units and solar water pumps represent jointly only 15,000 units of the 1,000,000 appliances sold

Figure 1: Global Highlights from the January-June 2023 Data



PROJECTS UNDER DEVELOPMENT AND OPPORTUNITIES TO WATCH IN AFRICA

Next to projects already in operation, AFSIA also keeps track of all projects announced to be under development. Projects “under development” are all projects that have been announced publicly in one way or another, being developed through a government procurement process or as a private initiative.

This category needs to be considered with caution for various reasons.

First, there are many “stages of development” and a project at early-stage of development may not have the same probability of reaching operational stage as a Ready-To-Build (RTB) project. In our effort to track projects, we do not discriminate between projects and their probability of success, and we account for projects at any stage of development.





Second, developing solar projects is not an exact science and many projects die along the development cycle for multiple reasons. This means that only a fraction of the GWs presented in the tables below will eventually reach COD. As a result, the reader must maintain a critical look when comparing the 200 GW+ pipeline of projects and the 16 GW of projects in operation. But this pipeline figure provides an indication of how active the market is and in which direction it is evolving.

Third, projects that are “launched” are announced, but there rarely is a public communication when a government programme or a private development is ended without success. To avoid the risk of erroneously counting projects that are no longer progressing and have “died out”, AFSIA only takes into account projects where at least 1 progress announcement has been made in the past 3 years. Any project with no activity since 2021 is therefore excluded from our statistics.

Finally, not all projects are announced in the same way and the figures below may not fully represent the reality of projects currently being developed. Government-led projects, whether they are for large scale grid-connected projects or about the roll-out of dozens or hundreds of MGs, are generally abundantly advertised. On the other hand, C&I projects are often kept under the radar until the moment they are commissioned, as the C&I space is very competitive and developers do not want to inspire their competitors to approach their clients before the deal is done. Very few C&I projects are therefore being announced during development phase (with the exception of wheeling projects). There is therefore a risk that the below figures give more weight to large-scale and mini-grid projects, and underestimate the total capacity of C&I projects really being under development at this moment. Here again, the main purpose of sharing these figures is not to have the monopoly of truth, but rather to help the reader identify trends and get orders of magnitude.

	Africa	
Segment	Capacity	% Share
C&I - Captive	9,499 MW	4.9%
C&I - Wheeling	3,339 MW	1.7%
Larse scale	82,070 MW	42.7%
Large scale - green h2	95,650 MW	49.7%
Mini-grid	1,722 MW	0.9%
Total	192,281 MW	100%

	Green H2 dev	
Country	Capacity	% Share
Mauritania	57,000 MW	59.6%
Morocco	19,600 MW	20.5%
Egypt	13,000 MW	13.6%
Namibia	5,000 MW	5.2%
South Africa	1,000 MW	1.0%
Algeria	50 MW	0.1%
Total	95,650 MW	100%

These two tables provide 3 main insights:

1. Green hydrogen

The appetite for green hydrogen development in Africa has further skyrocketed in 2023. Whereas 52 GW of projects were announced by the end of 2022, this figure has almost doubled in is now reaching 95 GW worth of solar.

As highlighted in last year's report, the global interest for hydrogen as a way to combat CO2 emissions (mostly driven by developed economies) remains very strong and a growing number of countries want to procure cheap and green hydrogen. And thanks to Africa's stellar solar irradiation, the continent offers some of the best features to produce the cheapest green hydrogen in the world. It is not surprising that the African countries with the most ambitious green hydrogen plans are precisely the countries with some of the best solar irradiation in the world (Namibia, Egypt, Morocco, Mauritania as main examples).

Several of these mega projects have made tangible progress in 2023. So while not all the 95 GW of announced projects may eventually be built, green hydrogen development in Africa seems on the right track. A first 100 MW project is already operational in Egypt ([see dedicated article later in this report](#)). And for the remaining projects, to repeat last year's report : "the combination of attractive economics of green hydrogen in Africa and developed economies pushing for these projects to be developed so they can import cheap green hydrogen for their own consumption back home, push us to believe that green hydrogen in Africa is based on solid fundamentals."

2. Green hydrogen in Mauritania

The second figure which jumps to the eye is the mega ambition of Mauritania with green hydrogen projects. With 57 GW of planned projects, Mauritania represents almost 60% of all African green hydrogen development and almost 30% of all solar being developed on the continent. With only 170 MWp currently operational in the country, this may look like a disproportionate plan. But Mauritania possesses unique features which places the country in an ideal position for taking full advantage of the green hydrogen production and export potential (excellent irradiation, access to the sea, proximity with Europe, presence of natural hydrogen,...)

3. C&I continues to grow, with big push from wheeling

C&I is spreading and growing across the entire continent. But the growth of the African C&I segment has been mainly driven by the South African market. In South Africa, the boom which started in 2022 has been further amplified in 2023. And as the load shedding issues in the country cannot be solved in the short or medium term, C&I is set to continue representing an important share of the new capacities installed in South Africa in the coming years.

The new element to consider is the rise of wheeling in South Africa. As highlighted in the [AFSIA online glossary](#), wheeling consists of an electricity to be sold between 2 private parties but without having the solar system installed at the facilities of the buyer. Usually the end-user of solar electricity installs the solar system on its roof or parking lot. But with wheeling, the solar system may be located anywhere, as long as the electricity can be “wheeled” through the grid (and with prior agreement of the grid operator). Wheeling is not possible everywhere, but it is allowed in South Africa. And many developers who had previously been developing large scale projects for the various government procurement rounds are now “recycling” these projects into wheeling projects. Wheeling offers great operational and performance advantages and there is no lack of demand for electricity in South Africa at the moment, so all parties win with wheeling. It is therefore very logical to witness more than 3 GW of wheeling projects currently being developed, all in South Africa.



ARTICLE

**BY JAN-ALBERT
VALK**

Founder and CEO
at Solarise Africa



NURTURING TALENT IN THE AFRICAN SOLAR INDUSTRY

STRATEGIES TO ATTRACT AND RETAIN EXCEPTIONAL HUMAN CAPITAL IN A HIGH- PRESSURE MARKET

In recent years, the African solar industry has witnessed an unprecedented surge in demand and innovation. This surge, driven by a collective consciousness towards sustainable energy and the pressing need to address power deficits (more prevalent in some countries than others), has created a burgeoning array of job opportunities across the continent.

At Solarise Africa, we believe that the industry will continue to expand in 2024, and the pivotal challenge remains not just in filling these roles but in attracting and retaining top talent amidst intense competition.



In order to navigate this landscape and nurture and maintain a skilled workforce, it can help to keep the following in mind:

Understanding the Landscape

The rapid expansion of the African solar industry transcends mere energy production; we believe it also symbolises a pivotal transformation in the continent's economic and social fabric. This growth isn't solely about harnessing a renewable resource; it's a catalyst for empowerment, community development, and economic resurgence.

The solar industry operates at the convergence of various disciplines, necessitating a diverse skill set. From cutting-edge technological innovation and engineering prowess to astute salesmanship, project management finesse, and astute policy development, the industry demands a multifaceted workforce.

Moreover, it's not just about generating power but also about creating resilient, self-sustaining communities. Solar initiatives foster job creation, boost local economies, and provide access to reliable energy, driving progress in healthcare, education, and industry.

Understanding this landscape underscores the imperative for Solarise Africa and other industry players to not merely seek talent but to actively cultivate a workforce equipped to tackle the multi-dimensional challenges of sustainable energy and community development.

Attraction and Retention Strategies:

1. Promoting Purpose-Driven Work

One of the most compelling ways to attract talent is by highlighting the industry's impact. As an industry, we should articulate our commitment to sustainable energy and the transformational effect it has on communities. Emphasising the opportunity for employees to be a part of this positive change can be a powerful recruitment tool, no matter the generational segment of your workforce:





- Baby Boomers (Born 1946–1964): Baby Boomers are often motivated by a sense of duty and a desire to leave a legacy. Highlighting the impact of solar initiatives on future generations and the opportunity to contribute towards a sustainable legacy can resonate with this group.
- Generation X (Born 1965–1980): Gen Xers value work-life balance and seek opportunities that allow for personal growth. Emphasising how working in the solar industry provides a chance to learn new skills, advance professionally, and maintain a healthy work-life equilibrium can be appealing.
- Millennials (Born 1981–1996): Millennials are often driven by a desire for meaningful work and a positive societal impact. Highlighting the contribution of solar energy towards environmental sustainability, social responsibility, and global change resonates strongly with this generation.
- Generation Z (Born 1997 onwards): Gen Z is highly tech-savvy and seeks purpose in their work. Emphasising the innovative and tech-driven nature of the solar industry, along with its potential to create a better future, can attract this generation.

By tailoring messaging and initiatives to align with these generational motivators, the industry can effectively communicate the purpose-driven nature of our work, making it more appealing to a diverse workforce across different age groups.

2. Creating Inclusive Work Cultures

Creating an inclusive work culture within the African solar industry is crucial for fostering a supportive environment where diversity is celebrated and every individual feels valued. To achieve this, we need to focus on diversity in hiring and leadership. Africa is home to diverse talent pools and by actively recruiting from within, through fair and unbiased recruitment processes, and by promoting leadership that reflects diverse backgrounds, we can set an example that diversity is valued at all levels within our organisations.

We also need to encourage open communication and feedback. Create channels for employees to voice concerns and suggestions regarding diversity and inclusion. Actively listen and take action, demonstrating a commitment to addressing issues and valuing every employee's input. By implementing these strategies, we can create an inclusive work culture that not only attracts diverse talent but also nurtures a collaborative, innovative, and supportive environment within the African solar industry.

3. Professional Development Opportunities

Offering continuous learning and growth opportunities within the organisation is key to retaining talent. Training, mentorship programmes, and career advancement pathways demonstrate a commitment to employee development and can significantly boost employee retention rates.

4. Cultivating a Supportive Work Environment

A positive work environment fosters employee satisfaction and loyalty. Encouraging work-life balance, providing flexible work arrangements, and prioritising employee well-being are pivotal in retaining talent, especially in high-pressure industries. At Solarise Africa, we live and breathe our company DNA, and it is clearly defined in our Culture Code. By ensuring that our employees feel supported, no matter what, we know we can all walk the extra mile together.

Conclusion

The African solar industry's expansion is an exciting prospect, but it also brings forth the challenge of securing and retaining top talent. Solarise Africa and other industry leaders have a crucial role in not only attracting, but also nurturing a skilled workforce. By focusing on purpose-driven work, inclusive cultures, professional growth, and a supportive environment, the industry can build a sustainable workforce capable of driving innovation and meeting the continent's energy needs.



BY EDITH JULLINESolar Sales Engineer
West Africa

FOCUS ON SOLAR TALENT

BOOMING JOB OPPORTUNITIES IN AFRICAN SOLAR: HOW TO ATTRACT AND RETAIN HUMAN CAPITAL IN A SOLAR MARKET UNDER HIGH PRESSURE.

A few years ago, I noticed that as the new year began, new names showed up in old mail threads. They were not “new” per se, I simply associated them with other solar companies or bodies. As time went by, I noticed more of this “shuffling” – which is very commonplace. Today, when people call to ask me about a service they know I can provide, they end the call by asking which company I am with so they can update their records. The solar sector is such a close-knit community - a growing family in which everyone has worked with everyone.

“Between 2011 and 2020, solar capacity in Africa grew at an average compound annual growth rate (CAGR) of 54%, two and a half times that of wind (22.5%), almost four times that of geothermal (14.7%) and almost 17 times that of hydropower (3.2%).” – IRENA, 2022.

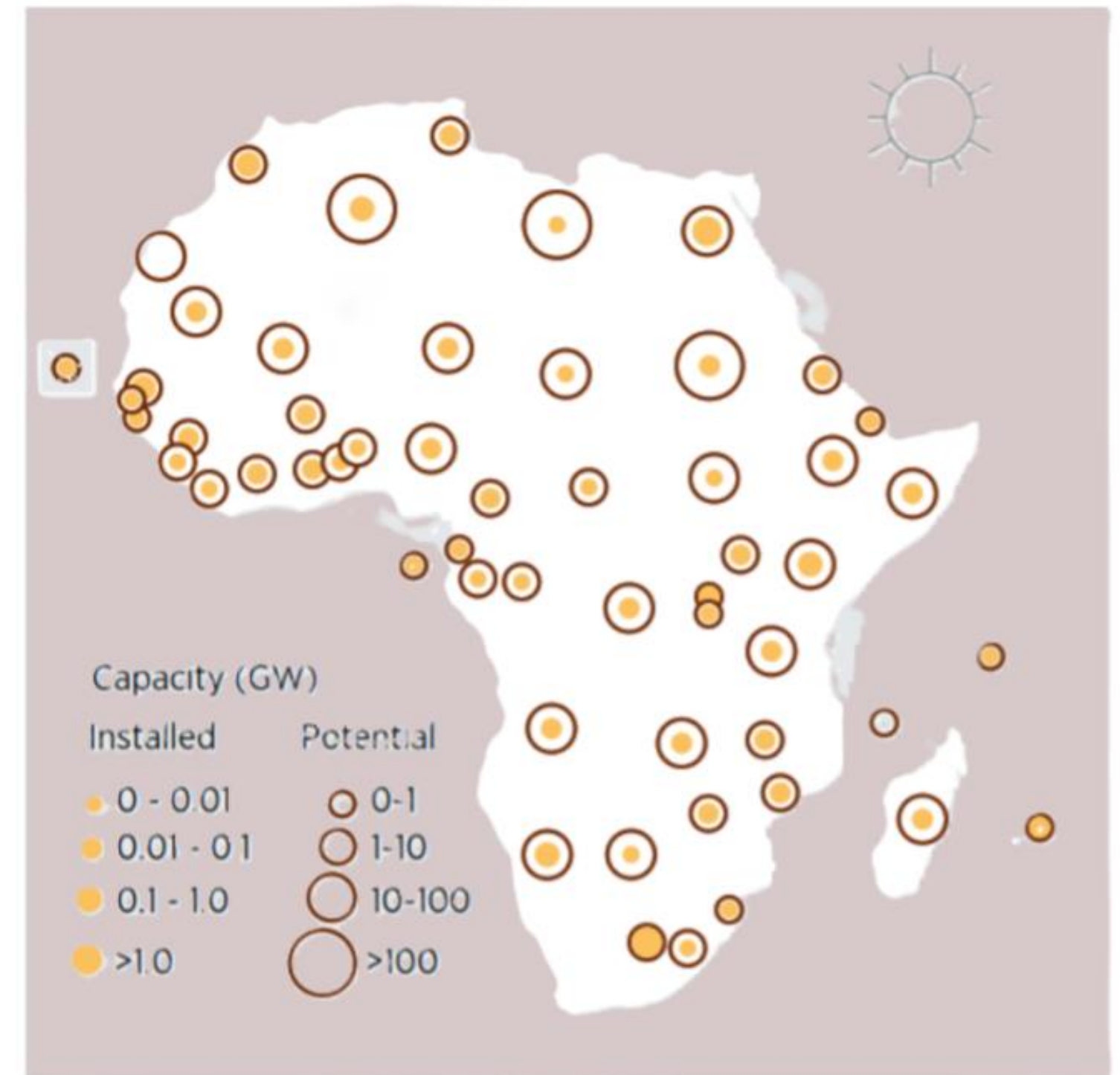


The growth in the last decade is seemingly nothing compared to future growth statistics – see below image which shows solar potential capacity in Africa

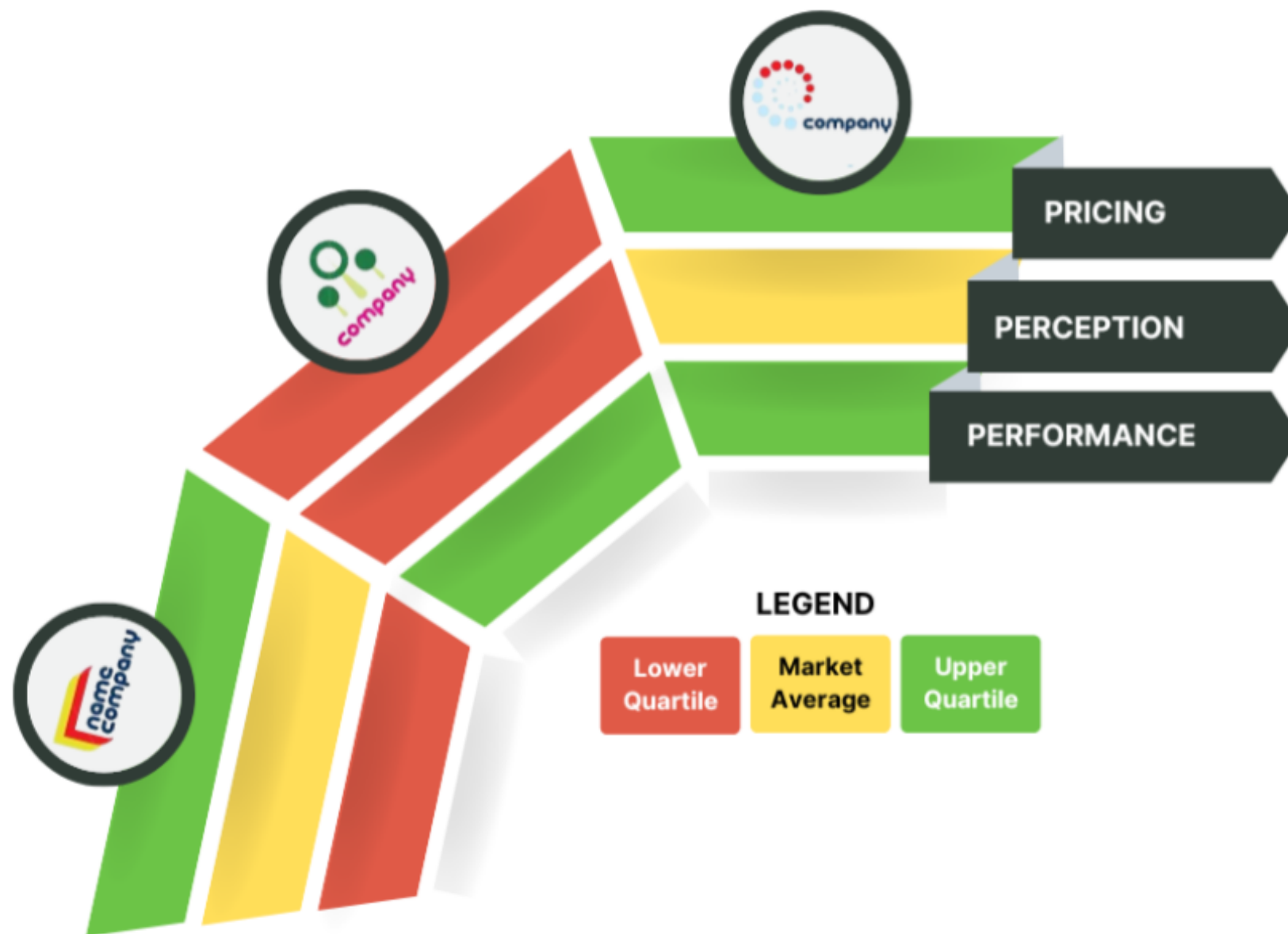
There are also statistics that show that by 2030, about 80% of the jobs created in the renewable energy space would be solar. Clearly, the need to attract more than our usual “shufflers”, and retain them, is paramount.

I personally believe that market/brand positioning is key to talent attraction – and to an extent, retention. By market positioning, I am referring to a customer/consumer’s perception of a company or brand in relation to competing companies or brands. It involves deliberately establishing an image or identity so that the company is perceived in a preferred way.

As a technical sales engineer, understanding the competitive landscape is my forte. I categorize companies in quartiles with respect to pricing, performance and perception, as shown below.



Source: Solar potential, Africa: IRENA; Installed solar capacity, Africa: IRENA, 2021a; Base map: UN boundaries



This categorization helps me visualize the market and easily navigate the waters.

- **Pricing:** competitive pricing of goods and services. How expensive are their products/services?
- **Perception:** how the company is viewed in the sector. Are they reliable? Do they have a good reputation?
- **Performance:** the quality of work. Are there issues with their installations/products? What type of projects do they execute well – residential, commercial & industrial or utility scale?

The truth is, potential employees also have similar considerations – performance, perception, and of course, payment. Although they would rely on word on the grapevine (often through personal connections) to help with positioning companies, corporate bodies can pay for an actual market survey to help understand the competitive landscape. A potential employee may enquire about a potential employer's position regarding, say, performance in the market or about how well they pay, before deciding to work with them. In this case, an upper quartile company with respect to payment/remuneration and performance, is more likely to attract this talent than a lower quartile company.

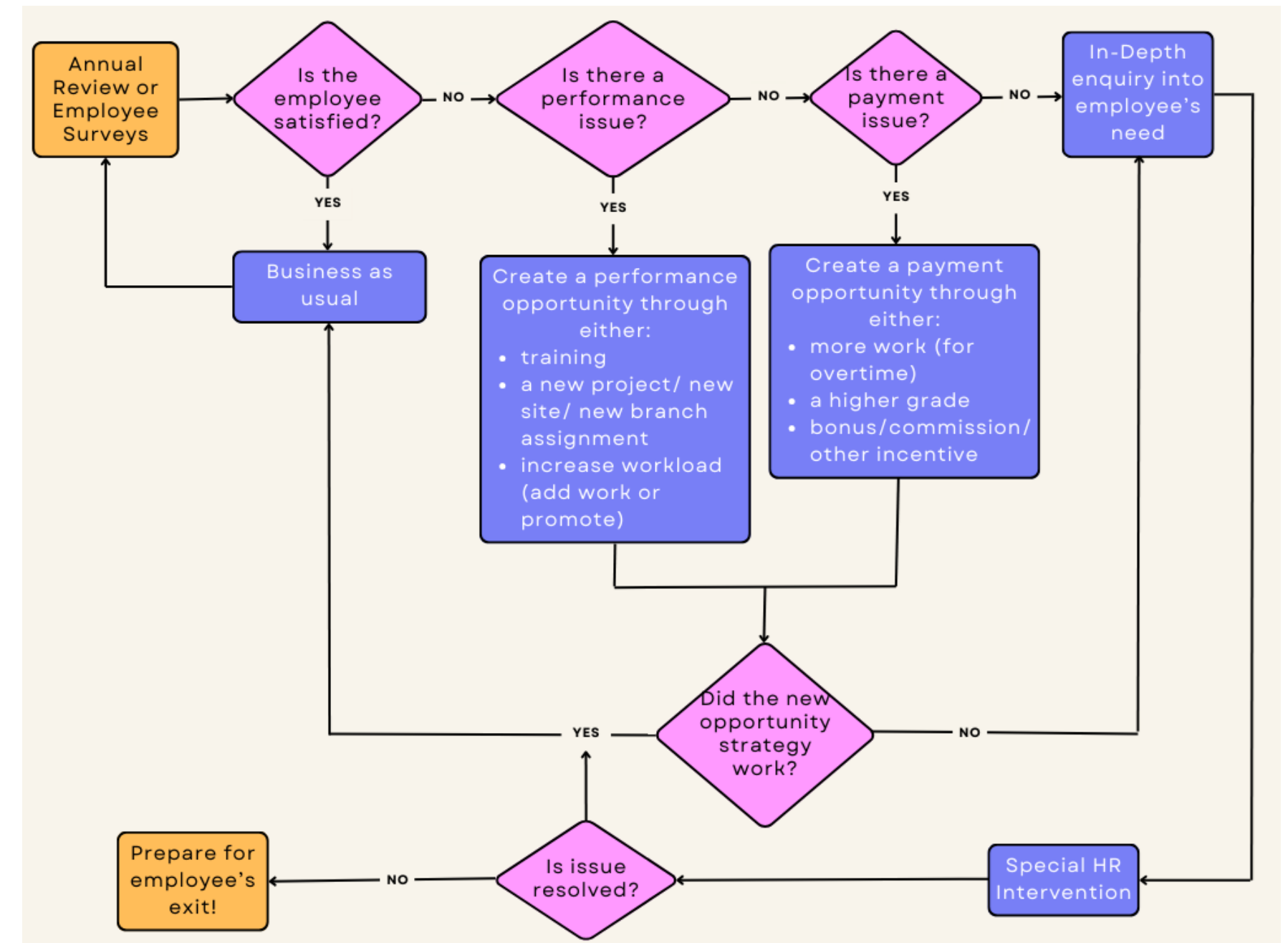
Obviously, this is an oversimplification of the assessment process, but it serves as a reliable framework to attract desired human capital.

Therefore, the key to attracting talent – as a company – is to strategically position yourself with respect to the factors that employees usually consider: payment, performance and perception.

To retain the attracted talent, let's consider what I call a “retention flowchart”.

Fun fact about me: I like to “predict” employees who are likely to switch companies, usually through casual engagement. It is a challenge I have with myself, plus it reduces the surprise element involved in “shuffling”. This way, a deal is never on hold because someone moved. Plus, it is a gain if they moved to a company I have been trying to find a way in. Win-win for everybody!

A good indicator of employee retention is [employee satisfaction](#) and [employee engagement](#). This is realized from employee surveys and special HR interventions.



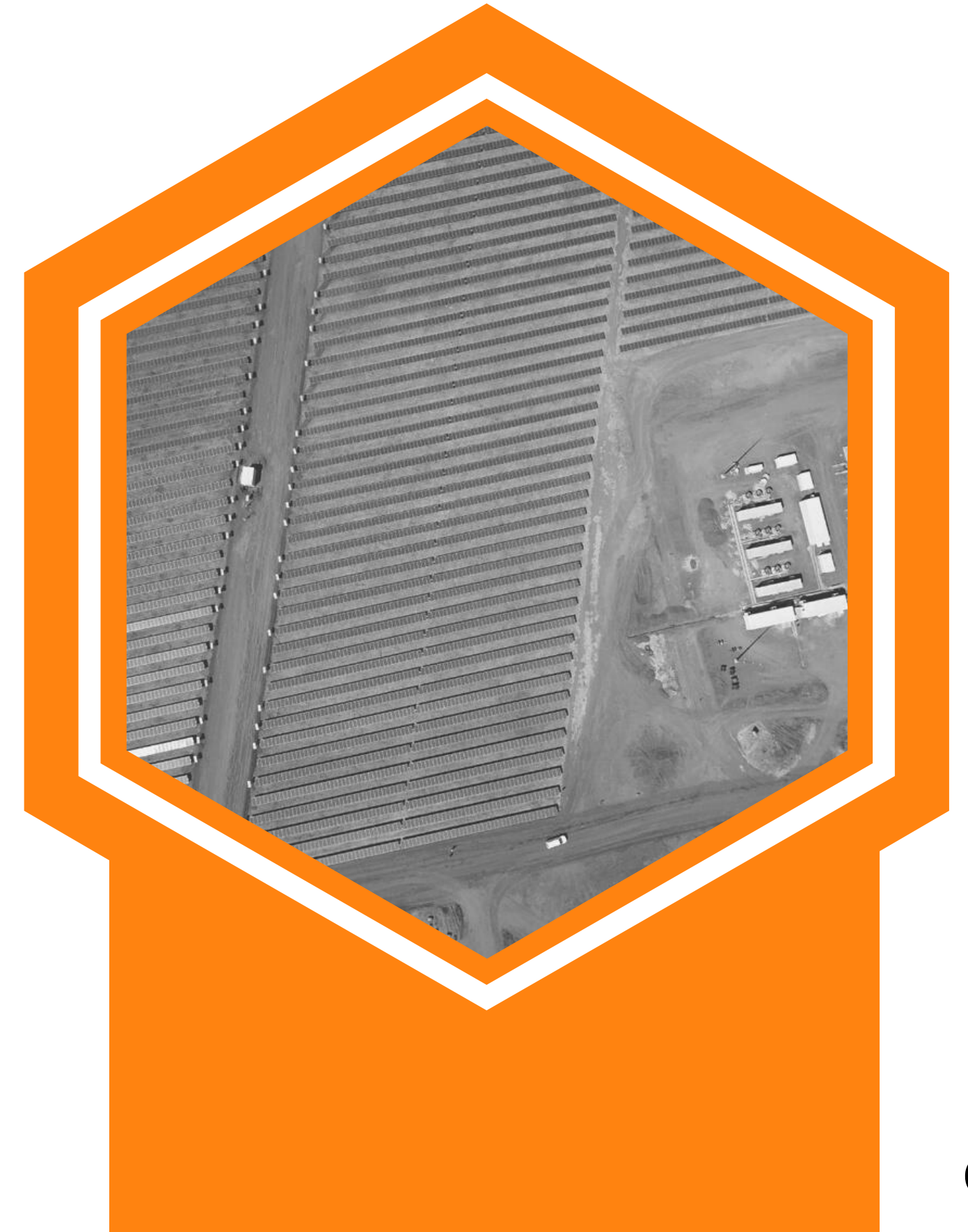
The above flowchart helps digest this. (Note: I modified it a bit for the purpose of this article.)

From the flow chart,

- **Performance** refers to the nature of the employee's work. Is the employee overwhelmed with work? Is the employee adequately challenged?
- **Payment** refers to remuneration for work done. Is the employee adequately compensated for work done?

Seldomly, there may be other factors affecting retention that are outside performance and payment, like the need to be with family in another location. These would require a “deep dive” to assess the specific issue and an understanding of the company's desire to retain said employee in light of the issue. A special intervention may be required but when all fails, it is prudent to prepare for the employee's departure and attract a replacement.

Attracting and retaining employees requires a lot of creativity as there may be nuances that require specific attention. However, in general, these suggestions should be able to tackle a significant portion of issues faced in this volatile solar family.



ARTICLE

**BY ROSE
PÉGUY
DIKONGUE**
President
APELCA

&

**BILLY
YARRO**
Associate
Director K&Y
Energy Advisors



PUE GROWTH IN CAMEROON

SHS STAGNATES WHILE PUE INCREASES SHARPLY, THE EXAMPLE OF CAMEROON

Access to electricity remains low in Cameroon, despite the latest infrastructural developments in the energy sector. If the injection of the first MW of electricity from the Nachtigal hydroelectric dam aims to contribute to the improvement of electrical service, it is clear that many localities by 2035 will remain poorly served by the electrical network as shown in the figure below taken from the Rural Electrification Master Plan (PDER).





Crédit photos : APELCA



Source: Plan Directeur d'Electrification Rurale - PDER (2016)

A reliable supply of energy is vital for significant growth and increased productivity. For farmers and entrepreneurs located in rural areas, access to fuel or electricity for operations, crop processing and preservation, cold storage and service delivery is limited and costly. In Eastern Cameroon for example, around 30 to 40% of crops are lost each year. This situation is the result of numerous challenges due to the absence of electricity not allowing: (i) the storage of foodstuffs; (ii) conservation using cold systems; (iii) local transformation. In addition, the isolation of agricultural production areas associated with the defective state of the road network does not facilitate the delivery of crops to urban centers.

PUE penetrating the off-grid market strongly in Cameroon

The off-grid electrification sector in Cameroon, as throughout Africa, is booming and mainly driven by the private sector. Many players are involved in the distribution of various energy solutions in order to reduce the energy deficit of off-grid populations.



Crédit photos : APELCA

During the first half of 2022, more than 47,000 solar kits were distributed, including nearly 1,378 units of key equipment including TVs, fans and solar pumps.

In 2020, during the production of the Productive Uses Catalog in Cameroon, nearly fifteen companies were identified distributing this equipment. Although the majority of companies were invested in the distribution of solar pumping kits, we noted a few which diversified their product range by integrating solar refrigeration systems, solar sprayers, egg incubators, solar dryers.

At the same time since then, there have been numerous company initiatives aimed at popularizing the use of equipment for productive uses, such as:

- Awareness workshops organized with the support of Alliance for Rural Electrification (ARE)
- Clean Energy Services, a local company developing a solar refrigerator production unit
- Finance law: APELCA with the support of GOGILA contributed to the decision to exempt solar lighting products and productive uses over two years
- MIFED-MPower partnerships to facilitate access to solar products in rural areas
- Oolu Solar and SOFINA partnership for the distribution of solar kits and equipment for productive uses
- Solarly, which raised funds from Investors and Partners (I&P) for the development of productive uses
- Partnership between Solkamtech and SODECOTON for the wide distribution of solar sprayers to cotton producers
- Renewable Energy Innovators Cameroon (REIc), which started with the integration of equipment for productive uses in the six operational mini-networks.

Latest developments and supporting policies for PUE growth in Cameroon

- Strengthening strategic partnerships with:
 - Agricultural/aggregator programs, such as: Livestock Development Project (PRODEL); Program for Agropastoral Consolidation and Sustainability (PCP-ACEFA); Livestock and Fisheries Value Chain Development Project (PDCVEP)
 - Local financial institutions
- Popularize productive use systems more widely within agricultural production areas
- Training of stakeholders and popularization of business models for the dissemination of PUEs
- Regulatory framework:
 - The finance law exempting the importation of solar systems is a major step forward in the diffusion.
 - Accelerate the publication of decrees for the execution of the law so that populations can benefit from the positive impacts linked to this decision to exempt customs duties.
 - Training/awareness raising of customs, tax and local financial institutions involved in the import value chain and the financing of private companies and end-users.

This analysis demonstrates that, although still lower than SHS sales, those of PUE are clearly growing in Cameroon. Indeed, sales of SHS have experienced stagnation, particularly in 2023. This could be explained by the fact that over the last ten years, the SHS market has developed significantly, reaching a volume of sales of 30,000 in 2022, compared to only 3,000 in 2017 in Cameroon, thus satisfying Tiers 1 and 2. The transition to Tiers 3 and 4 sufficiently demonstrates that the development of renewable energies meets growing needs; hence the rise in PUEs. In order to simultaneously maintain the SHS and PUE markets, the objective is to increase partnerships with local financial institutions and increase awareness to reach last mile populations.



ARTICLE

**BY LAURE
MIRUHO WENE**

Community
Manager



SOLAR FOR HEALTHCARE GETS MASSIVE BOOST IN DRC

As previously mentioned in this report, C&I continues to grow and dominate the African solar eco-system. Specific types of end-user's activity have been particularly active this year with installing solar for their consumption at their office or factories. Mines in various countries have represented a big share of the newly installed capacity for C&I in 2023. But one country and one end-user type have really stood out from all other C&I projects: healthcare facilities in the Democratic Republic of Congo.

In 2023, 964 healthcare facilities have been solarized in DRC for a total installed capacity of 2.5 MWp and 7.9 MWh of storage.





While the average system size, and hence the total installed capacity, is relatively small, it is the portfolio size which is to be noted, especially in a country with such challenging logistics as the DRC. Before 2023, slightly over 900 health centers had been solarized in Africa. In 2023, through GoShop and partners, this number has more than doubled, giving access to essential health services to more African living in rural areas than ever before.

In 2023, GoShop Energy had the privilege of bringing to fruition several projects aligned with our values and mission. More than 1,000 solar systems have been installed in health centers (964), schools (100) and administrative buildings (28) across the 24 provinces of the Democratic Republic of Congo.

These installations were achieved through key partnerships with Sanru, Cordaid, UG-PDSS and Safricas. Each of these partnerships had a specific objective, whether it was the fight against HIV and tuberculosis, the improvement of the infrastructure of health centers, or support for the local development program PDL-145T, dedicated to the fight against poverty and social inequalities.

We have adapted our installations to the specific needs of each site, using various models of solar systems, ranging from 1200VA to 8000VA, with different configurations in terms of lithium and gel-acid storage with solutions of 25 kWh and 9 kWp of solar. We were able to achieve this thanks to our partner suppliers (Victron Energy, BYD, GoSolar, GoPower, Schneider, etc.).

The logistical challenges were significant, notably the supply of equipment and the deployment of systems in sometimes difficult conditions, including in conflict zones. Through careful planning, pre-testing in our workshops and innovative delivery strategies, we overcame these obstacles. Comprehensive training was provided to center managers to ensure efficient and sustainable use of the equipment.

The installation of these solar systems was warmly welcomed, paving the way for a substantial improvement in health and education infrastructure, especially in the most remote regions.

It is estimated that Africa counts around 100,000 public healthcare facilities (this includes facilities of all sizes, ranging from PHC, primary health centers, to large hospitals in cities). It is also estimated that only 25-30% of these facilities have access to reliable electricity, which is essential to deliver health services. Improving the electrification of health facilities in Africa has been identified for decades as one top priority for the development of the continent, and this topic was put back in the spotlight with the pandemic. It is often said and written that electrifying these 70,000 healthcare facilities in Africa will take decades. However, at GoShop, we managed to electrify 1,000 of them in just 1 year. We are convinced that there are other capable solar companies in other countries, as well as other motivated development partners to replicate all around Africa what has been achieved this year in DRC. With joint effort, it should be totally realistic to solarize all healthcare facilities in Africa in a matter of a few years.



ARTICLE

**BY LAMYA YOUSSEF
ABDEL HAKIM**

AFSIA Board Member & Freelance
consultant in private RE projects

EGYPT'S GREEN HYDROGEN REVOLUTION: LEGISLATIVE SUPPORT PAVES THE WAY FOR UNPRECEDENTED GROWTH

The green hydrogen sector in Egypt has witnessed a remarkable surge, beginning in March 2022 with a pivotal memorandum of understanding between the European Bank for Reconstruction and Development (EBRD) and Egypt's Ministry of Electricity and Renewable Energy and Ministry of Petroleum and Mineral Resources. This collaboration set the stage for an ambitious project aimed at assessing the potential of low-carbon hydrogen supply chains. The initiative encompassed mapping global hydrogen market dynamics, analyzing Egypt's hydrogen production capabilities, and evaluating the storage, conversion, and transportation of hydrogen and its derivatives



Stakeholder Collaboration and Project Setup:

From March 2022 to August 2022, key stakeholders, including the Egyptian Electricity Transmission Company (EETC), New and Renewable Energy Authority (NREA), the General Authority for Suez Canal Economic Zone (SCZone), and the Sovereign Fund of Egypt for Investment and Development (TSFE), engaged in strategic partnerships by signing 16 Memoranda of Understanding (MOUs) with various developers. The setup involved TSFE providing land for the hydrogen factory in the Gulf of Suez, NREA allocating land for renewable energy projects, and EETC facilitating the transfer of green energy through the unified grid





Innovative 100 MW Project and Green Ammonia Production:

A groundbreaking 100 MW project by the Scatec/Orascom consortium exemplified innovation through a swapping mechanism. This project drew grid electricity until renewable energy projects were completed, after which the generated green energy was scheduled for return to EETC. Notably, the project included the production of green ammonia, contributing to sustainable industrial applications. Completion before COP27 in November 2022 showcased Egypt's commitment to timely and impactful green hydrogen initiatives.

National Strategy Approval and Economic Outlook:

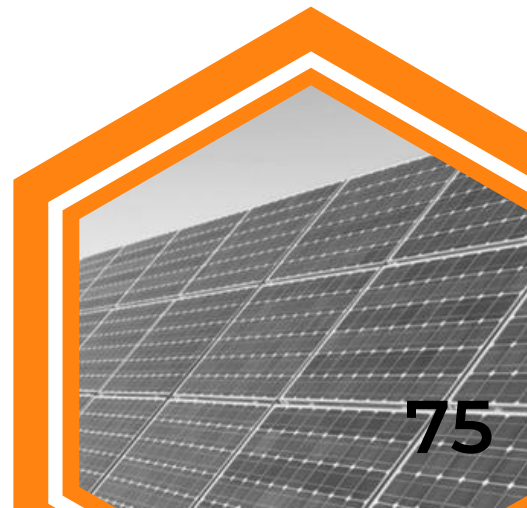
In a significant move on 22 November 2023, Egypt approved a national strategy for green hydrogen during a meeting of the National Council for Green Hydrogen, led by Prime Minister Dr. Mostafa Madbouly. This strategy targets 5-8% of the global hydrogen market, envisages the creation of 100,000 jobs, and aims to boost GDP by \$10-18 billion by 2040.

Legislative Support and Draft Bill Approval:

The momentum gained further support as Egypt's House of Representatives approved a draft bill on January 2, 2024, designed to incentivize green hydrogen production. While specific details were not immediately disclosed, the draft law aims to bolster the country's hydrogen industry by providing incentives during project implementation. Earlier Cabinet approval in May 2023 outlined incentives such as a cash investment equivalent to 33-55% of tax paid on revenues generated by green hydrogen projects, VAT exemptions on equipment and materials, and waivers on taxes, contracts, and land registration fees.

Conclusion:

Egypt's green hydrogen boom is not only marked by strategic collaborations and innovative projects but also by strong legislative support. The approved draft bill and incentives reflect a proactive approach by the Egyptian government, fostering an environment conducive to the rapid growth of the green hydrogen sector. As Egypt positions itself to become a key player in the global hydrogen market, this comprehensive strategy and legislative backing serve as a beacon for sustainable and prosperous economic development



ARTICLE

**BY HERBERT
FRIESE**

General Manager
Dutch & Co



SPECIAL FOCUS ON THE GHANA MARKET

Following a three-year period of suspension on issuing wholesale electricity supply licenses for renewable energy embedded generation projects, and the negative impact of COVID-19 the Ghanaian solar market now seems to reach pre-pandemic levels again.

A recent study, by Mordor Intelligence expects a 20% compound annual growth rate for the Ghanaian solar energy market in the next five years. Factors such as increasing demand for solar photovoltaic installations, increasing investments in ongoing and upcoming solar energy projects, and the government's efforts to reduce the reliance on fossil fuel-based power generation are expected to drive the market during the forecast period.

With regards to large-scale solar, Ghana further reaffirmed its commitment to renewable energy and SDG7 with the Bui Power Authority (BPA) planning to build 8 solar plants in the north of the country





Moreover, the Volta River Authority (VRA), performed a feasibility study and an environmental impact assessment regarding floating solar power plants on Lake Volta, the world's largest artificial lake, and the Kpong hydropower reservoir in Ghana. VRA, which is the main electricity supplier in Ghana, also completed the expansion of the Kaleo solar PV plant in 2023.

As grid electricity in Ghana is expensive, utilities facing financial strain and concerns around sustainability, electricity tariffs are expected to further rise. As a result, the residential and C&I segments in Ghana are witnessing a strong level of adoption for solar. This is further supported by rising environmental concerns, development of government policies, declining solar PV installation costs, and increasing panel efficiencies. With the launch of Ghana's Scaling Up Renewable Energy Program (SREP), funding opportunities will be unlocked to achieve an accelerated growth in the renewable energy sector with the implementation of mini-grids and standalone solar PV systems for schools, SME's and hospitals, energy services to rural lakeside and island communities, solar PV with net meters to public sector buildings and SME's.

Recently the Minister of Energy, Honorable Matthew Opoku Prempeh paid a courtesy visit to a new project site of what will be Africa's largest solar rooftop project. Owned by Helios Solar Company (Helios), part of LMI Holdings, and located in the Tema Freezone Enclave, situated just outside of Accra, the solar rooftop project will supply 16.82 megawatt of energy to Helios and its partners.





The innovative solar system is part funded by the International Finance Corporation (IFC) as part of an all-encompassing \$30 million clean power and water deal with LMI Holdings to support job creation and greener, more sustainable, and more competitive industrial development in the country.

The PV Solar project is designed and engineered by Ghana-based solar energy firm, Dutch and Co. who are the PV EPC and O&M contractor, and whose work involves the installation of the solar system using 29,261 solar panels of the latest N-type technology across a rooftop area of 92,000m² of the IWC Mega-warehouse located in the Tema Freezone is a great example of private sectors' contribution to infrastructural growth, job creation and industrialisation.

Solar offers Ghanaian C&I customers a strong value proposition by allowing them to lock in cheaper energy prices through power purchase agreements provided by IPP solar developers as well as through lease to own agreements. The residential segment presents a compelling opportunity for developers to tap the mass-market. However, several market barriers persist such as financing issues and risk of currency devaluation and continue to limit solar reaching its full potential in Ghana. Ghana is on its way to evolve from what is perceived to be a modest opportunity, to a growing and well-organized solar market. And in parallel to this solar growth, battery storage and electric mobility solutions are also being developed quickly and will represent another major set of opportunities for electricity professionals in Ghana.

ARTICLE

**BY TERJE
OSMUNDSEN**

CEO, Empower
New Energy



DECREASING MODULE AND STORAGE PRICES

CHEAPER PANELS PLUS BATTERIES – A GAME-CHANGER FOR AFRICA’S SOLAR MARKETS.

In 2009, when I first travelled to South Africa for Scatec Solar to develop the market for solar PV, the price of a solar panel was \$2,2 per watt. In the 12-year period to 2021, we saw a remarkable solar revolution: The cost of the PV panel fell to about \$ 0,20-0,25 per watt, driven by an unprecedented growth in the global PV market that expanded from about 10 GW in annual installation to close to 200 GW in 2021. But then, in 2021 and 2022 in the aftermath of the pandemic, the cost of PV equipment and logistics suddenly started to rise.





Due to shortage of polysilicon and bottlenecks in the supply chain, the cost of solar PV panels increased by about 15 %. Combined with higher cost of shipping and other costs, developers saw the costs of installing PV in Africa and elsewhere increasing by 20 %. This unforeseen cost increase was one of several reasons why PV investments on the continent excluding South Africa, actually fell in the years 2021 and 2022. Has the downward trend in PV costs reached its bottom?

The answer, we see now, is no. In 2023 the module price of solar modules amazingly dropped 40 % to less than \$0,15 per watt, mainly because of cheaper polysilicon but also because of technology improvements. Experts predict solar module prices will approach the threshold of \$0.10/W by 2025, and to reach \$ 0,07-0,08 per watt by 2030.

What effects will the staggering fall in module prices have for Africa's solar market? Modules typically represent about 20-25 % of the total PV system cost. The balance of system (BOS), construction and permitting – have generally not become much cheaper the last years, with the partial exception of inverters. We should expect the 40 % decline in solar PV module costs seen in 2023 convert to a 7-10 % drop in the overall cost of solar PV installation. By the time module prices fall below the \$0,10 per watt threshold, solar PV systems will be about 10-15 % cheaper than it is today, assuming the balance of system and construction costs follow the general inflation

So, what will a module price of \$0,10 per watt mean for the levelized cost of electricity (LCOE) from solar PV? The answer depends on several factors, including your cost of capital.



Speaking from an equity impact investor with a special focus on Africa, Empower New Energy estimates that a 7-10 % decline in system cost would translate to a tariff reduction- in projects with a 15–20-year PPA or similar- of about 5-9%. In other words: Module prices dropping to \$0,10 per watt will certainly help to stimulate the market, but is not in itself a game-changer, mainly because solar in most cases already is cheaper than the alternatives.

However, if we look for a game-changer, we should hunt elsewhere: Cheaper PV in combination with less expensive batteries.

Let me illustrate with an example I believe is representative for the solar PV market across Africa. Our company recently signed a Power Purchase Agreement in Kenya, with Abyssinia Iron and Steel. The company wanted a 4 MW solar PV plant to cover as much of the daytime demand as possible with clean energy, but because of load fluctuations, holidays, etc a 4 MW plant would result in considerable losses due to electricity produced but not consumed. Contrary to the situation in industrialised countries, energy users in Kenya and most of Africa are not allowed to sell excess electricity to third parties or to the grid company via net-metering.(or if net-metering is allowed, the revenue is unsustainably low) This is a very important barrier to unlocking the huge potential for C & I solar market in Africa, and is equally important for the growth of utility-scale, mini-grid and off-grid markets. The solar plant therefore needed to be scaled down to 2,5 MW.

Now let's look at the potential effect of batteries, using the Kenya PPA as an example.

Let's assume a battery system designed to deliver electricity to the factory at a constant load of say 2 MW for 5 hours per day, ie a 10 MWh of storage capacity.

This would require an increase in the size of the PV plant from 2,5 to 9 MW, equal to an additional investment of about \$ 3,5 million. The cost of the battery system, however, is more difficult to benchmark and predict. As an example, quotes to Empower in 2 H 2023 revealed a total cost of decentralized lithium BESS systems in Sub-Saharan Africa in the range \$400 -600 per kWh, causing a total investment of \$ 4-6 million for 5 hours of 2 MW storage.

Fortunately, prices are about to fall. Following a spike in battery prices in 2022, BloombergNEF now reports that price of lithium-ion battery packs for stationary storage fell 14% to a record low of \$139/kWh in 2023. Especially the growth in lithium iron batteries (LFP) contribute to the significant cost decline. When you can buy a complete battery pack for about \$150 per kWh, the total BESS cost including installation should approach \$200 per kWh, which is about 50-60 % less than currently offered to developers in Africa. There are many reasons why BESS is much more expensive in Africa than elsewhere; the most important being small, immature markets and lack of competition.

Figure 1: Volume-weighted average lithium-ion battery pack and cell price split, 2013-2023



Source: BloombergNEF. Historical prices have been updated to reflect real 2023 dollars. Weighted average survey value includes 303 data points from passenger cars, buses, commercial vehicles, and stationary storage.



As the battery costs continues to fall by an expected 10 % or more per year, the competitiveness of solar PV plus storage will improve radically, especially in Africa where so many businesses are relying on expensive diesel or a mostly fossil fuel-powered and often unreliable electricity grid. Let's go back to the Abyssinia example cited above, and assume a BESS cost of \$200 per kWh instead of about 500 as quoted today. The revised 9,5 MW PV + 10 MWh BESS investment – ca \$10,5 million - for Abyssinia would convert to an average cost of electricity in the range of \$ 0,12 – 0,13 per kwh, equal to about 15 % below the grid tariff and still offering a payback-time of 8- 9 years. In addition, because of the investment, the energy user would benefit not only from being greener but also being more in control of its energy supply. The total estimated CO2 savings from the investment would double to about 10 000 tons per year. In situations where the solar plus battery plant replaces power from diesel gensets, the financial and carbon savings would be significantly bigger.

In other words: Cheaper PV modules are welcome, but what first of all will help to unlock Africa's solar future is the bright prospect of more competitively priced battery systems.



ARTICLE

**BY NICK
LUSSON**

VP of Huawei Digital
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Region



FOCUS ON SAFETY

LITHIUM-ION BATTERIES: FUELING THE SOLAR REVOLUTION, AND UNDERSTANDING THE RISKS

The sun has become a beacon of hope for a sustainable future. Solar energy, once a niche player, is now basking in the sunlight, fueled by advancements in renewable technology. At the heart of this revolution lies a small, powerful hero: the lithium-ion battery. These compact titans store the sun's bounty, powering homes, businesses, and even entire communities off the grid.

But, as with any great new technology, potential risks lurk beneath the surface. Lithium-ion batteries, while reliable and efficient, have their risks. The main risk associated with lithium ion batteries is thermal runaway. This is when the internal processes have some problem that causes the energy within to be dispersed through the battery material as heat. Due to all the energy within, the batteries' temperature can start to rise higher and higher and result in a fire.





And lithium ion fires are not your common fire, lithium ion fires are extremely difficult to extinguish. Often firefighters have no choice but to create a perimeter around the lithium-ion fire and let it burn itself out over the course of several days, resulting in disastrous loss of property and a real threat to loss of life.

The headlines paint a vivid picture of this potential danger. In July 2023, a massive fire ripped through a Tesla Megapack facility in California, USA. Just months later, in October 2023 a blaze sparked by an e-bike battery ravaged a New York City apartment building. This tragic incident claimed three lives and injured several others, highlighting the dangers of improper storage and charging of lithium-ion batteries in living spaces. In July 2020 A series of fires in high-rise apartments in South Korea were linked to faulty lithium-ion batteries used in household energy storage systems, leading to several injuries and property damage. This incident sparked concerns about the quality and safety of certain battery brands and models. In March 2018 A fire broke out on the Maersk Honam container ship in the Indian Ocean, which was later attributed to improperly declared and stowed lithium-ion batteries. The fire raged for several days and ultimately led to the sinking of the ship.

These incidents, though rare, serve as stark reminders of the need for a cautious and proactive approach to lithium-ion battery safety. Overall, lithium-ion batteries are very stable with high energy density and deep discharge capability, and long useful life. To dismiss this by throwing shade on lithium-ion batteries altogether would be like turning our backs on the sun, and would cripple the solar revolution. Instead, we must navigate the potential storm with a multi-pronged approach. Here are 4 approaches that the solar industry is taking and should continue to take, in order to maximize the benefit and mitigate the risks of lithium-ion batteries

1. Innovation

The industry is not sitting idle, and within lithium-ion batteries there is advancing technology that helps to increase efficiency and reduce safety risks. An example of such is using lithium iron phosphate chemistries (LFP). LFP batteries utilize iron phosphate (LiFePO_4) as the cathode material, which has stronger phosphate bonds compared to the cobalt oxide or manganese oxide used in conventional lithium-ion batteries. This translates to higher inherent thermal stability, making LFP batteries less prone to overheating and thermal runaway.

Additionally, internal safety features like pressure relief valves and automatic fire suppressants are becoming standard, providing additional layers of protection. Top manufacturers, such as Huawei, are now integrating advanced detailed monitoring with AI diagnostic tools, that can monitor temperature and voltage and current at a more granular level, and can detect anomalies and respond within seconds, effectively preventing thermal runaway, overheating and catastrophic fires. These advanced batteries can also automatically isolate batteries that are connected in series to prevent over charging and over heating. Though not yet common, features like these are leading the way to a safer future of ESS technology.

2. Regulations

Stringent regulations are being implemented worldwide, which mandate proper ventilation, enhanced temperature monitoring, and fire containment systems for battery storage facilities. As the industry continues to grow and develop, we will need more accurate and relevant regulations to ensure minimum safety standards are kept around the world. This will eventually include advanced safety and monitoring features inside every battery pack.





3. Knowledge

Thorough training for installers, technicians, and even first responders is paramount. Understanding proper handling procedures, early detection of thermal anomalies, and effective emergency response protocols can be the difference between a minor blip and a catastrophic event. Empowering personnel with knowledge is the best line of defense against potential hazards to prevent improper installations and to recognize potential safety hazards early.

4. Awareness

Consumers play a vital role in the safety equation. Consumers must be properly educated of the risks, and the options available on the market. As public awareness continues to grow, consumers can make the choice for the safest equipment with the most advanced features, which will encourage all manufacturers to improve the safety of their products.

While lithium-ion batteries present certain safety considerations, they are not an insurmountable obstacle. Instead, let's view these challenges as opportunities to innovate, collaborate, and build a safer, more sustainable solar infrastructure. By embracing innovation, implementing robust safety protocols, and fostering a culture of awareness, we can harness the power of these batteries not just for energy storage, but to light up a brighter future. Remember, the sun provides enough energy to power our civilization many times over. Let's ensure we harness it responsibly, navigating the occasional solar storm with wisdom and foresight. Only then can we truly bask in the warmth of a sustainable, sun-powered tomorrow.

ARTICLE

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EMPOWERING SUB-SAHARAN AFRICA: A MULTI-TECHNOLOGY APPROACH TO BRIDGE THE ENERGY DIVIDE

As of today, 590 million people in sub-Saharan Africa (SSA) lack access to electricity, with a concerning trend projected to 2030. The challenge is exacerbated by rapid population growth, strained household incomes due to the recent pandemic, and a need for innovative solutions tailored to the region's unique challenges.

To address the diverse energy needs in the region, a multifaceted approach is imperative.

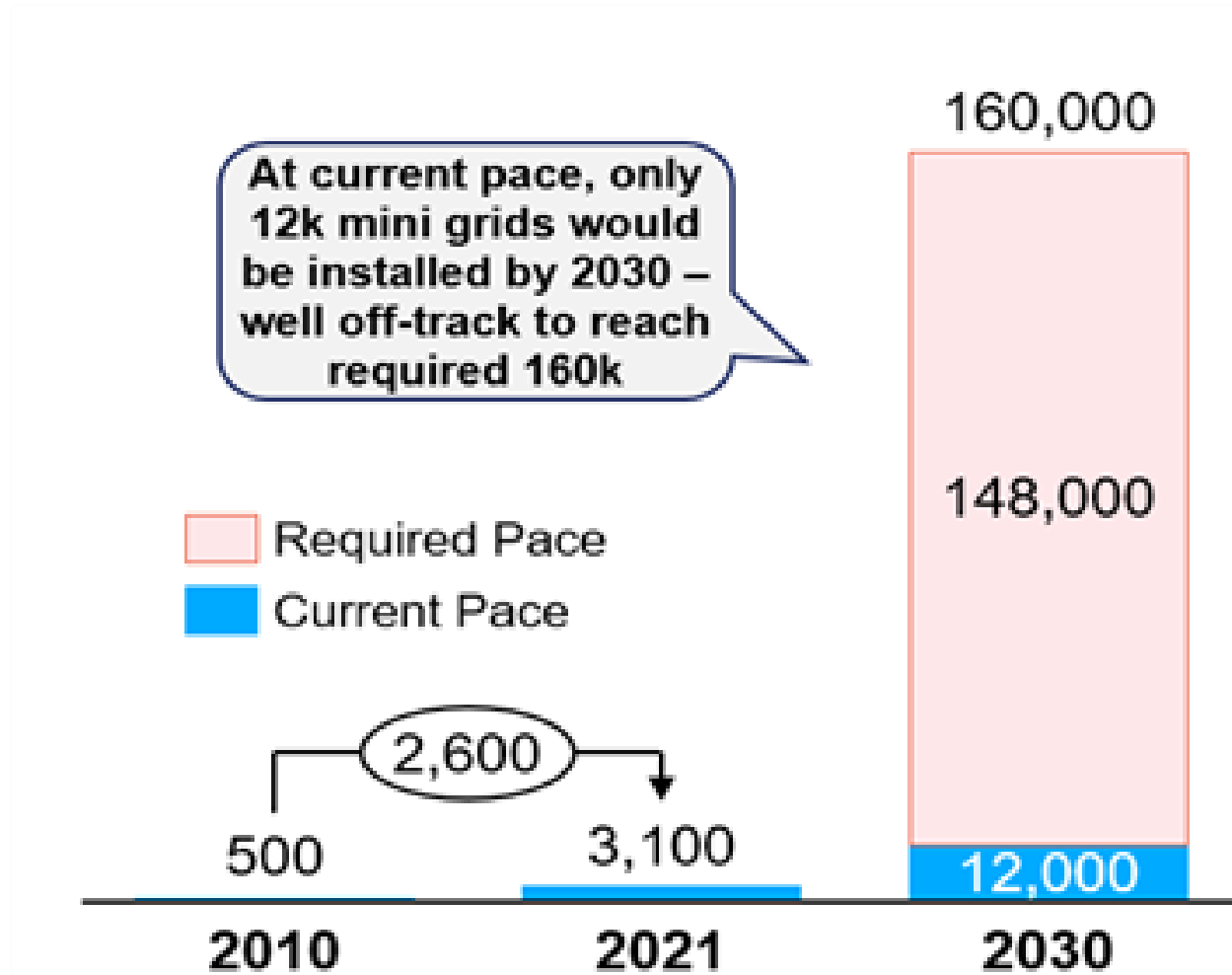


The three main strategies each play a crucial role in addressing the varied energy needs in regions with differing infrastructure development and resource availability.

- **Grid Extension:** Expanding the existing national electricity grid is the primary focus, particularly in urban or peri-urban regions closer to existing infrastructure with higher energy demands.
- **Mini-Grids:** These small-scale, localized power networks operate independently or in conjunction with the main grid, making them ideal for remote areas.
- **Standalone Systems – Solar Home Systems (SHS) and Solar Business Systems (SBS):** Tailored for households or small enterprises and vital in areas with low population density or where traditional grid connections are unfeasible.

Nonetheless, achieving SDG7 requires more than just deploying these renewable energy technologies—it requires an impact-driven approach that precisely delineates the intended impacts, goals, and unique needs of the communities involved. By emphasizing these objectives, developers have the flexibility to propose innovative, bespoke solutions that align with the unique needs of each community, while leveraging the synergies of various technologies. This comprehensive strategy enhances affordability, cost efficiency, competition, and local empowerment.

Mini-grids have an important role to play in accelerating access to clean and affordable energy, as well as boosting local economies. The recent publication "Mini-Grids for Half a Billion People," highlights the importance of mini-grids to stimulate economic activities, job creation, and ultimately, sustainable development. However, with the current pace of mini-grids development, the 2030 ambitious goals will not be met. Indeed, a 2022 ESMAP report emphasizes that of the 160,000 mini-grids needed to electrify 380 million people in SSA by 2030, only 3,100 have been installed in 2021.



As summarized in Figure 1, these numbers are alarming and prove the need to implement innovative business models, tailor a stronger regulatory framework, advocate for a more inclusive stakeholder involvement.'

Although mini grids hold significant promise and there is strong industry interest in expanding them on a larger scale, numerous challenges hinder their commercial viability. Among the challenges that we believe can be addressed in the short term, the following have been shortlisted:

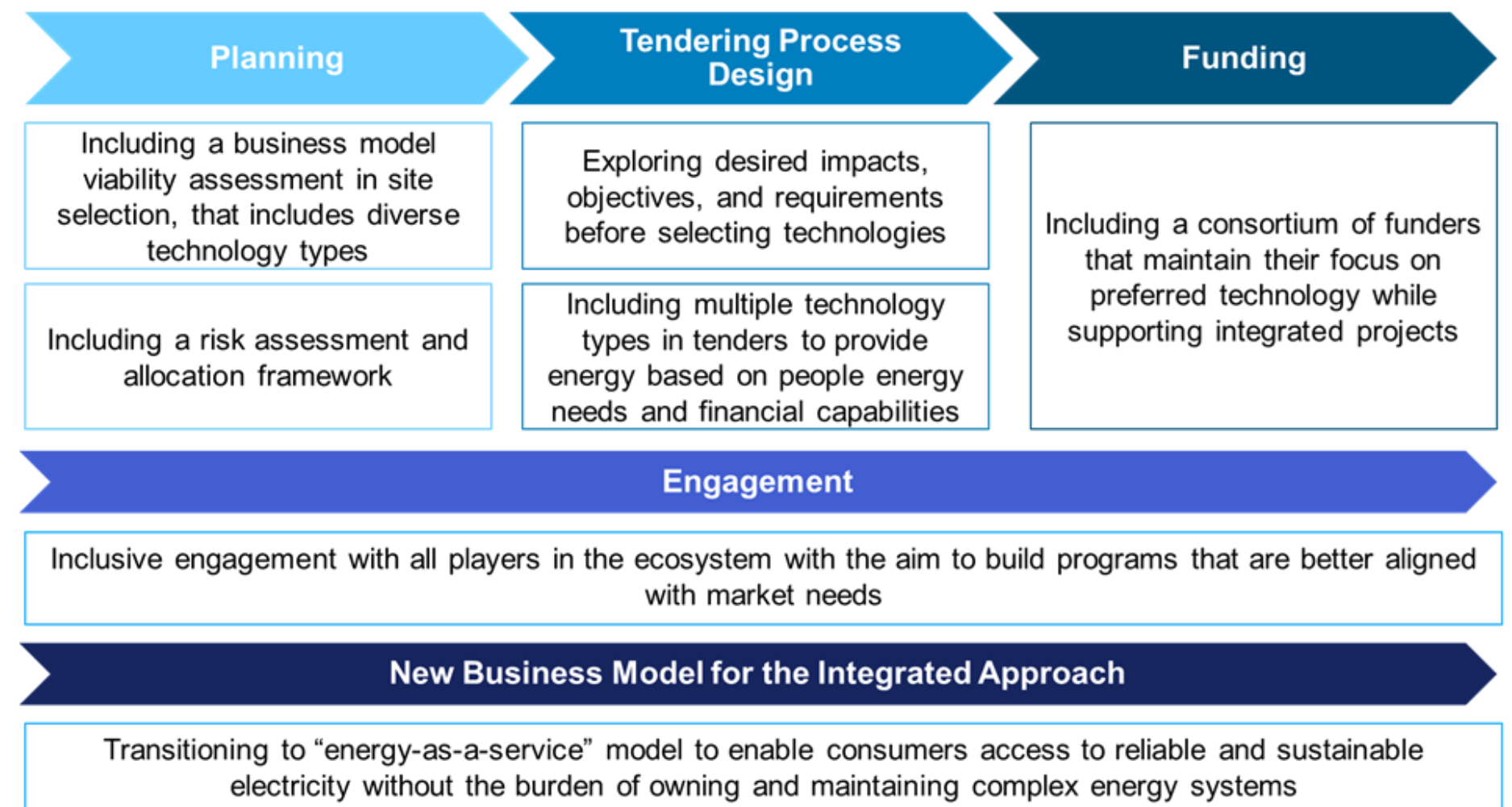
- **Separate tendering designs** often favour distinct technologies, neglecting populations unable to afford the chosen solution, thereby hampering the economic viability of mini grid projects.





- **Funder preferences** limit the scope of funding and hinder the development of integrated solutions, as international funders often favour specific energy technologies.
- **Integrated business model viability assessment** gaps result in uncertainties and higher risks for investors. Current assessments lack thorough financial planning and overlook a crucial aspect: conducting research to assess the financial viability of the chosen technology in its intended location.
- **Inclusiveness in project design** is lacking, with project design predominantly led by the public sector, neglecting the crucial involvement of the private sector and diverse stakeholders.

To address the challenges mentioned above, ENGIE Energy Access has identified a way forward with clear solutions to enable the multi-technology approach in a mini-grid environment. Figure 2 below gives the steps and requirements to enable the multi-technology approach.



We strongly believe that the multi-technology approach within the mini-grid environment offers a distinct opportunity that necessitates the active engagement of a broad range of industry stakeholders and the development of a well-tailored business model across different technologies. The way forward presented above to address current challenges in the short term would require concerted and inclusive work among industry players to move toward implementation.

With only six years left to achieve the United Nations' Sustainable Development Goals for energy, the task of providing universal energy access in sub-Saharan Africa is becoming increasingly difficult. We need an impact-driven, integrated approach using multiple technologies, centered on the energy needs of millions. As solar mini-grids are prominent, our industry needs to actively work to improve their effectiveness and profitability. Success depends on collaboration among stakeholders, and immediate next steps involve engaging the industry to consider practical aspects of implementing a multi-technology approach in mini grids.

Furthermore, as we continue our journey toward universal energy access, it is crucial to address the multifaceted challenges that lie ahead. ENGIE Energy Access will publish subsequent reports that will delve into these issues, offering insights and solutions to navigate the intricate landscape of energy access in sub-Saharan Africa.



ARTICLE

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HOW MINIGRIDS IN NIGERIA IMPROVE POWER RELIABILITY AND UTILITY REVENUES FOR COMMUNITIES

The town of Toto, located in the central Nigerian state of Nasarawa, is wired for electricity. Though poles and wires dotted the landscape, the area's residents still lived without electricity.

Like many African communities, Toto's power supply was poor to nonexistent. Though the town had a power grid, the infrastructure was in shambles, impaired by lack of maintenance and widespread theft. People living in these grid-connected communities, or "under the grid," often struggle with unpredictable blackouts, power rationing, affordability and lack of power.





In a win-win-win arrangement, microgrid developer PowerGen Renewable Energy used HOMER Pro to design a minigrid for Toto that supplies reliable power during the daytime, and the Abuja Electricity Distribution Company (AEDC) delivers electricity from the grid at night. The collaboration is an all-around success, providing the community with reliable power, the utility with new revenues, and PowerGen with revenue from operating and maintaining the minigrid and new distribution system.

PowerGen Microgrid Engineer Elisha Chesir has designed dozens of African minigrids. He used the software to create simulations of the new Toto system, determine optimal solar and battery system sizes and find the levelized cost of energy (LCOE) for customers. However, the Toto minigrid presented additional challenges, including modeling the contribution of grid power from the distribution company (DisCo) and predicting loads for new electricity users. To calculate electrical loads to model with the software, PowerGen's customer acquisition teams conducted site studies and surveys, starting with estimates of the largest loads from businesses, hospitals, schools and government buildings.

Extensive experience in Africa enables the company to estimate residential electricity use and growth rates using survey data. PowerGen will implement electrification in phases, using early project data to inform the next phase.



The graphs show HOMER Pro's comparison of production from different energy resources and varying electrical consumption, as well as the total load met by renewable energy.



Phase one of the Toto minigrid is providing a new local distribution system connecting about 1,600 households consisting of 8,000 people to a new local distribution system with 400-kilowatt (kW) peak power demand, 375-kW photovoltaic solar, one-megawatt hour of energy storage and new backup diesel generators.

The impact of the Toto minigrid could establish a precedent for the estimated 200 million undergrid households worldwide*.

The system:

- Delivers reliable 24/7 power
- Supports the financial stability of the regional distribution utility
- Uses new smart meters to provide remote monitoring that helps reduce theft and vandalism while improving revenue collection
- Provides new economic opportunities, enables students to study at night and supports critical social services

* Graber, Sachiko, Patricia Mong and James Sherwood. Under the Grid: Improving the Economics and Reliability of Rural Electricity Service with Undergrid Minigrids. Rocky Mountain Institute, November 2018. www.rmi.org/insight/under-the-grid/

ARTICLE

**BY XIN
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BEST PRACTICES FOR LARGE-SCALE SOLAR IN AFRICA: INTEGRATING PANELS, TRACKERS AND STORAGE SOLUTIONS

The African region benefits from ample sunlight, leading to a surge in solar power generation. Solar capacity in the region has witnessed a growth of over 50% in recent years, with the potential for solar power generation reaching up to 1100 gigawatts.

As the demand for clean energy continues to rise across the African continent, The region's utility-scale solar landscape continues its transformation, fueled by technological advancements and driven by social and economic development. The optimization of large-scale solar installations becomes vital for ensuring reliable and sustainable power generation.





Trina Solar recognizes the importance of integrating cutting-edge technologies to enhance efficiency. In this article, we delve into the latest optimization practices for large-scale solar projects in Africa, focusing on the integration of panels, trackers, and storage solutions.

1. Benefits of high-power panels in utility PV power plants

Cutting down LCOE has always been a key driver in the rise of PV installed capacity and remains the supreme goal of technological innovation in the PV industry. A better LCOE translates into an improved return on investment (ROI), one of the main forces driving the financial viability of a utility-scale solar project, incentivizing future deployments, attracting more investors, and accelerating project financing.

Reducing initial investment in PV power stations and increasing total power generation are crucial in bringing down LCOE. The heart of any solar project lies in its photovoltaic panels. Trina Solar adopts an LCOE-oriented principle in its approach, that reducing LCOE in PV power stations with high power, high efficiency, high reliability and high energy yield.

N-type solar panels employ innovative materials, cell design, passivation techniques, and manufacturing processes, resulting in unparalleled conversion efficiencies, enhanced reliability, and better performance. These features make n-type panels an increasingly attractive option for optimizing energy output, reducing costs, and accelerating deployments of utility-scale solar projects.



Deploying the latest generation of 210mm n-type i-TOPCon panels equipped with the latest technological advancements is the way to maximize energy production. N-type panels have excellent characteristics such as high efficiency and bifaciality, low temperature coefficient and degradation. Based on the 210mm product technology platform, the advantages of high power, efficiency, power generation and reliability will be further amplified, which are designed to reduce the levelized energy cost of electricity (LCOE).

In addition to efficiency gains, the durability and reliability of panels are crucial for long-term performance in Africa's diverse climates. From the scorching heat of the Sahara to the coastal humidity of the Atlantic Ocean, utility-scale solar industry must proactively address the challenges posed by rising temperatures to ensure the long-term viability and sustainability of solar projects. By embracing n-type PV panels, developers and EPCs can significantly lower LCOE, maximize energy production, and improve project performance during extreme heat. The enhanced temperature coefficients, higher efficiencies, and superior reliability of n-type panels offer a reliable path to navigate the threats of rising temperatures while achieving higher financial returns.

BOS analysis

Taking a 100MW utility power plant in Accra, Ghana for example.

Situation 1: 210mm n-type 700W panels + 2P fixed structure vs. 182mm n-type 585W panels + 2P fixed structure



Compared with reference solution that combines regular n-type panels and fixed structures, BOS of the solution that uses 210mm n-type panels and fixed structure is 0.0072 \$/W lower.

Situation 2: 210mm n-type 700W panels + 1P trackers vs. 182mm n-type 585W panels + 1P trackers

Compared with reference solution that combines regular n-type panels and trackers, BOS of the solution that uses 210mm n-type panels and trackers is 0.0083 \$/W lower.

2. Benefits of trackers:

In the African context, where sunlight conditions vary widely, solar trackers offer a flexible and adaptive solution. By aligning panels with the sun's position, trackers ensure optimal energy generation, especially during peak demand hours. This not only increases the overall efficiency of the solar project but also contributes to grid stability.

And that's just what TrinaTracker accomplishes.

The TrinaTracker's patented spherical bearing mechanism makes installation easier, which helps control labor costs. Even though TrinaTracker delivers long-term reliability with no incidence of failure during a ten-year period, its innovative spherical bearing mechanism allows for rapid repair to mitigate the risk of potential downtime. Additionally, this unique mechanism gives the TrinaTracker more flexibility to deploy in complex terrains, opening the door for developers and EPCs to be creative with land-use opportunities.

TrinaTracker has widespread compatibility with most major PV panels. But unlike other panel original equipment manufacturers (OEMs), Trina Solar is the only panel OEM that also makes a reliable, high-quality solar tracker.

Trina Solar maximizes PV project value by bringing these two major utility-scale solar components together under one roof. When pairing TrinaTracker and Vertex N 700W+ panels in system design, a utility solar project will require fewer Vertex N panels than those using panels with 182mm solar cell tech. This corresponds to reduced costs for panels, installation, and transportation.

At the same time, TrinaTracker's SmartCloud algorithm gives operators the sitewide O&M control solution for guaranteeing improved power gains to offset the cost of the steel, lower LCOE, and boost ROI.

Trina Solar delivers integrated 67.5MWp module + tracker PV solution to Project Blue in Albania

Full suite of Vertex modules, Vanguard 1P trackers and software of 67.5MWp system-level PV project in Topoje, Albania
Located in the Southwestern lowlands of Albania, in Sheq – Marinas Fier, one of the regions with highest solar radiation in the country, this ground-mounted array named Project Blue is developed and executed by Albanian firms Blessed Investment and Matrix Konstruktion. Trina Solar provided a full array of Vanguard 1P trackers, combined with Vertex DEG21C.20 dual-glass bifacial PV modules in 650W and 655W configurations, with an installed capacity of 67.5MWp. The power plant has a projected energy yield of 108,000 MWh per year.



3. Benefits of Energy Storage Solutions in utility PV power plants:

The rise of solar energy in Africa is a significant and transformative trend that holds great promise for the continent's sustainable development. However, intermittency poses a significant obstacle to the large-scale solar deployment process. Energy storage solutions play a pivotal role in addressing this issue because they store extra energy produced during the hours of maximum sunshine for usage in low- or no-sun, high-priced, or times of power scarcity.

Without energy storage solutions, the growth of renewable energy is limited. Energy storage is all about balancing power supply and demand. Until now, storage has been the missing piece of the energy transition puzzle.

The African Approach to Sustainable Energy by Trina Solar

Ensuring the success of large-scale solar projects is imperative as Africa transitions to a greener energy future and has to meet the increasing demand for power. Trina Solar, with a strong dedication to sustainability and innovation, steps in at this point. Our belief is that the performance and dependability of solar projects across Africa may be enhanced by utilizing cutting-edge photovoltaic panels, creative solar tracking systems, and efficient energy storage solutions.

By adopting these modern best practices, we are actively influencing Africa's energy environment in addition to improving solar efficiency. Beyond technology, our goal is to provide dependable, sustainable energy solutions that promote environmental protection and encourage economic growth. As leaders of this revolutionary journey, we at Trina Solar are honored to be breaking down barriers and laying the groundwork for an increasingly sustainable and better future throughout Africa.



IMPACT OF FUEL SUBSIDY REMOVAL IN NIGERIA

Since colonial era, Nigeria has faced a serious debt crisis resulting in the inability to fund its development plan. For instance, one of the national daily news published in 2023 recorded that the Nigerian Federal Government owes the Nigerian National Petroleum Company Limited (NNPCL) the sum of ₦2.8 trillion spent on petrol subsidy and being owed these large sums were no longer sustainable as it impedes the company from financing its core businesses. The NNPCL being the state-owned oil company (although recently privatized), has since been sole importer of petroleum products in Nigeria and has consequently been responsible for financing the petroleum subsidy on behalf of the Government.





Not surprisingly, the fuel subsidy was removed following President Bola Ahmed Tinubu's announcement during his inauguration on May 29th, 2023, leading to an over 200% increase in Premium Motor Spirit (PMS), from ₦190/liter (\$0.25/liter) in May 2023 to a ₦600/liter (\$0.8/liter). Earlier in 2022, subsidy was also removed for Automotive Gas Oil (AGO) - popularly called "Diesel" leading to an over 200% increase in its price and directly impacting the most on businesses that are heavily reliant on diesel generators as a substitute for the epileptic electricity grid supply. The fuel subsidy removal has had both positive and negative impacts on Nigerians; the most immediate negative impact has been a rapid increase in inflation stemming from the sharp rise in transportation cost, while the most immediate positive impact is the apparent savings of over ₦1 trillion on a bimonthly basis, after the fuel subsidy removal.

According to a study, fuel subsidy was introduced in the 1970s when the government launched it to make consumers pay less for the price of fuel because of the 1973 oil crisis. The fuel subsidy was partially removed by the Government in 1986 but it was put back until 2012 when it was removed again under the Goodluck Jonathan Administration which led to huge protests calling on the government to reinstate it, which they did eventually. From that moment on, the payment of fuel subsidy had grown extensively, fuel subsidy reached ₦4 trillion totaling 23% of the national budget of ₦17.126 trillion in 2022. Consequently, Nigeria had found it unsustainable to continue with the fuel subsidy, leading to its complete removal in June 2023.

The removal of fuel subsidy brings both challenges and opportunities. There has been a sharp rise in inflation. Also, Micro, Small and Medium-sized Enterprises (MSMEs) are now facing difficulties in accessing affordable power

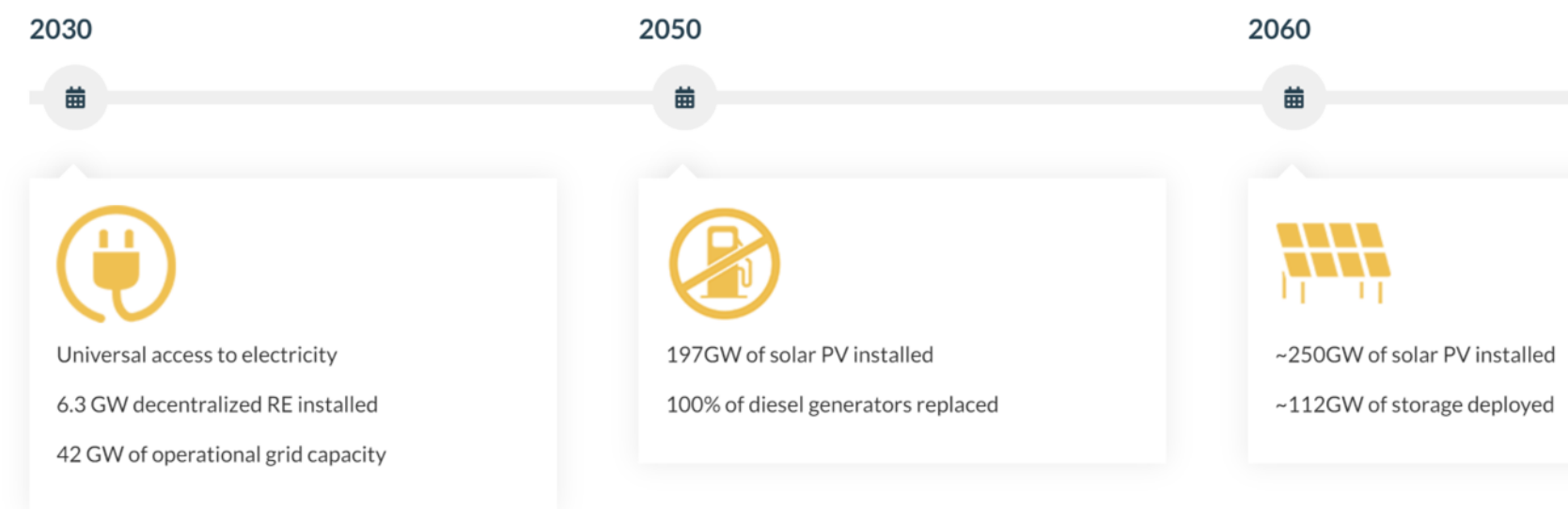
However, individuals, businesses & the government now have a stronger reason to see opportunities in clean energy by embracing cleaner options like electric vehicles, biofuels, or solar-powered technologies. The prevailing increased cost of petrol will undoubtedly stimulate investments in affordable renewable energy infrastructure, leading to a greener economy and sustainable transportation systems, contributing to the net zero target by 2050 set by the United Nations.

For instance, the Government confirmed that the subsidy removal led to an increase in government revenue from about ₦786 billion in May 2023 to about ₦1.9 trillion in June 2023. According to President Bola Ahmed Tinubu, some of the savings from fuel subsidy removal will be channeled into economy-driving activities such as low-interest loans for MSME businesses as well as acquiring mass transit CNG buses to promote cleaner transportation (Nigeria's 209.5 trillion cubic feet (TCF) of proven gas reserves being capable of powering vehicles which reduces operating cost by 30% and carbon footprints by 95%). Furthermore, Nigeria recently unveiled her energy transition plan, putting in place concrete action steps towards decarbonization such as the deployment of decentralized renewable energy (DRE) infrastructure; the expansion of transmission and distribution network; the upgrade of central generation capacity to achieve 42GW of operation capacity in 2030; and the post-2030 deployment of a centralized RE - solar PV infrastructure and corresponding storage with hydrogen starting in 2040.



Nigeria Energy Transition Plan (Power)

Milestones:



Nigeria Energy Transition Plan. (2022). Milestones [JPEG].
<https://www.energytransition.gov.ng/power/>

In conclusion, the removal of fuel subsidy in Nigeria - although coming with immediate challenges - opens myriads of opportunities that can drive Nigeria's Energy Transition Plan. With the Nigerian Government's bold policy direction in engendering cost reflective energy pricing system, Nigeria is fast becoming a central hub for investors & businesses alike in the renewable energy space in Africa.



E-MOBILITY BREAKTHROUGH IN AFRICA AND ITS IMPACT ON SOLAR DEVELOPMENT POTENTIAL

As the world grapples with the need to rapidly decarbonise, it is clear that solutions for the transport and energy sectors are intrinsically linked. As Africa's e-mobility sector grows, demand for clean power to charge vehicle batteries is mounting. E-mobility holds great promise for reducing emissions and cutting air pollution, whilst enabling people to continue to travel for education, healthcare, employment, and trade. However, if the sector is to realise this promise, access to affordable, clean energy will be key. Energy access is also crucial if those same students are to study into the evenings, those clinics are to provide safe healthcare to patients on arrival, and those businesses and traders are to reliably power their businesses to promote sustainable economic growth.



With this increased demand for energy, we are seeing more opportunities to develop new renewable energy infrastructure – both on and off-grid. With high solar irradiation levels, African countries are particularly well-placed to capitalise on the falling costs and faster deployment capabilities of solar.

African Sun: Why Solar Not Gas Offers Continent the Best Economic Opportunity in the Transition - Carbon Tracker Initiative

Solar also has enormous potential to complement existing hydro power generation, with larger hydro dams exploring the installation of floating solar or enabling the use of hydro as a ‘battery.’ The two technologies can complement each other by smoothing the intermittency of solar – enabling utilities to switch to using hydro during the evenings – and helping to mitigate against the vulnerability of hydro power stations to the impacts of climate change on their water levels and power generation capacity.

E-mobility and solar power - it makes sense to combine our efforts.

In rural and remote areas, installing battery charging stations such as those being rolled out across Zimbabwe by Mobility for Africa, not only enables drivers to charge the batteries of their three-wheeler ‘Hambas,’ but, in the future, will enable nearby communities to access solar power, often for the first time. The vehicle batteries themselves also hold the potential to act as storage for excess renewable energy which can be used during the evening or overnight, powering vital medical equipment, computers and refrigerators that require consistent access to electricity.

In urban areas, companies such as Zembo Electric Motorcycles are installing new solar infrastructure to charge batteries for their two-wheeler ‘boda bodas.’



Such installations also boost the stability of the wider grid, reducing the use of diesel generators, and improving urban air quality. Generating energy from the sun also cuts out the additional costs and emissions connected with transporting fossil fuels to where they are needed and protects consumers from exposure to fluctuating global oil prices.

Growing the wider ‘green economy.’

Expanding the availability of charging infrastructure in urban and rural areas not only enables e-mobility businesses to expand their offering, becoming profitable and accelerating the transition to electric vehicles, but it also builds a workforce of skilled technicians. These trained individuals not only build and maintain the vehicles themselves but are also able to refurbish batteries – extending their useable lifespan – and maintain the solar mini-grid infrastructure itself. These skills are transferrable to other solar installations, building a skilled solar sector workforce and creating jobs in the green economy for Africa’s youthful population.

There are also exciting opportunities for solar to play a role in the marine transport sector. The latest Waterbus passenger ferry – the MV Malcolm – launched from Kisumu, Kenya in December 2023 with pioneering solar-boost technology incorporated during the vessel build to maximise its fuel-efficiency. Here again, the development of green jobs is happening, the vessel was wholly built in Kenya and the skills acquired in its construction will inform work to incorporate solar technology on future vessels as well as equipping those individuals with skills that are transferrable to the wider solar and e-mobility sectors.

With the right investment and support to build local capacity, the future of both e-mobility and solar power in Africa is bright!

Young People’s Potential, the Key to Africa’s Sustainable Development | Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States



ARTICLE

**BY SVET
BAJLEKOV**

Co-Founder and CEO
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BENEFITS OF WHEELING IN THE AFRICAN CONTEXT AND THE EXAMPLE OF SOUTH AFRICA

The concept of “energy wheeling”, a relatively new approach to energy distribution, is rapidly gaining traction in Africa, with South Africa leading the way. At its core, wheeling refers to the process of transmitting electricity through a grid from an independent power producer (IPP), to a consumer in a different location. This model has far-reaching implications for energy markets, especially in regions like Africa where energy availability and reliability are critical concerns. This article explores the transformative power of wheeling in the African energy sector, with a focus on recent developments in South Africa.





The South African context is characterized by three related factors:

- Outdated energy infrastructure, where 80% of energy is still generated from coal
- Structural energy supply shortages, leading to frequent power outages (politely referred to as “load shedding”)
- Energy price volatility

These factors have driven many energy users – in particular commercial and industrial off-takers – to look at alternative energy sourcing approaches. While in a number of cases installing on-site (rooftop) solar generation is a good solution, it is not always a suitable option – for example due to site-specific conditions.

Wheeling allows an off-taker to procure renewable energy from a solar plant in a different location. Historically such plants have often been operated by dedicated IPPs who serve individual off-takers under bilateral power purchase agreements (PPAs). Recent advances in regulation and business models, much more flexible schemes are opening up.

Before diving into specifics, it’s worth reflecting on why wheeling is such a ground-breaking development, especially in the African context:

1. Accelerated Adoption of Renewable Energy:

By enabling direct transactions between renewable energy producers and consumers, wheeling can facilitate a quicker transition to a greener energy portfolio – especially relevant in a region with abundant solar resource.

2. Flexibility in Energy Sourcing:

Consumers gain the flexibility to choose their energy sources, potentially prioritizing sustainability, cost, or reliability as per their needs. In addition, overall energy supply is diversified, and reliance on traditional generation is decreased.



- **Economic Advantages:** Wheeling allows businesses and industries to secure more competitive electricity prices by directly negotiating with IPPs. This cost-efficiency can be a significant driver for economic growth and industrial competitiveness.
- **Enhanced Energy Security:** Reliance on centralized national grids, often plagued with issues of reliability and capacity, can be mitigated through wheeling. By diversifying the sources of electricity, wheeling enhances energy security and reduces the impact of grid failures and price volatility.
- **Support for Local IPPs:** Wheeling opens up markets for local and regional IPPs, fostering a more dynamic energy sector and promoting local economic development. Apart from supporting IPPs, it also provides other renewable energy generators with the flexibility to sell their excess power to other consumers.

Given these benefits, a number of notable wheeling arrangements are emerging in South Africa. The level of sophistication and inclusivity is also continuing to advance. It's worth calling out three different types:

Bilateral wheeling is the traditional approach mentioned above. Energy is wheeled over Eskom's transmission and distribution grid from one producer to one consumer. A notable example of this is the [arrangement between Amazon Web Services and SOLA Group](#), whereby AWS's data centers are supplied with clean energy from SOLA's 10MWp solar plant. The two are not co-located, but Eskom's grid is used to transport the energy.

Multi-point wheeling is a novel arrangement that's been successfully piloted on the municipal grids in Cape Town ([article](#)) and George ([article](#)). This allows the participation of a multitude of generators and consumers. The energy transactions are usually managed by an independent energy trading entity, essentially playing a "matchmaking" role between generators and consumers.

This matchmaking does not only happen in terms of setting up the commercial arrangements for selling and buying energy, but also happens in terms of matching real-time supply and demand between sellers and buyers.

At AMMP Technologies, through our partnership with Open Access Energy, we were fortunate to have a front-row seat in the successful implementation of the George pilot. Specifically, AMMP's meter reading and data management software is being used to aggregate the consumption and generation data that underpins energy matching and the commercial implementation and wheeling arrangements.

It's worth noting that while these initial pilots have been implemented within municipal grids, South African regulations now allow the wheeling of energy across municipal grid boundaries, to and from the Eskom transmission network, and potential into/from other distribution grids.

Finally, **virtual wheeling**, as introduced by Eskom – and so far primarily used by Vodacom – marks a new frontier in terms of flexibility. This system is designed for buyers with multiple offtake sites that may be geographically dispersed (and connected to different distribution grids). It employs an automated process to aggregate and report time-of-use data, providing a refund to the buyer for wheeled energy delivered to all its offtake sites. This innovation makes wheeling accessible to a broader range of consumers.

Overall, the future of wheeling in Africa, as exemplified by South Africa, is promising. With continued policy support, infrastructure development, and stakeholder engagement, wheeling can play a pivotal role in transforming the African energy landscape. It offers a path towards a more sustainable, secure, and economically beneficial energy future for the continent.



ARTICLE

**BY JAY
LURIE**

Head of Investments,
Odyssey Energy Solutions



WHEELING AS A PRIVATE SECTOR SOLUTION

**TO ADDRESS WIDESPREAD LOAD
SHEDDING IN SOUTH AFRICA AND BEYOND:
ASSESSING THE MARKET POTENTIAL
ALONG WITH TECHNOLOGICAL AND
POLICY HURDLES TO OVERCOME**

Wheeled power has the potential to transform South Africa's energy sector and serve as an example for less developed markets in Africa.



Shifting generation responsibility from a state-owned utility to the private sector

If a utility is not able to meet customer demand with its own generation and other IPP-supplied grid-tied power, it is the responsibility of policymakers and regulators to open up alternatives for energy supply and delivery. Throughout Africa, economic growth is set to increase energy demand from both increased household consumption and business expansion. Keeping up with such demand, which is projected to grow by one third between 2020 and 2030, is a challenge that requires market innovation.

Odyssey has played a central role in the growth of onsite distributed generation across Africa, and we have seen the sector benefit from technological improvement, cost reduction, and innovative blended finance schemes to spur growth. These projects tend to be small in nature, limited to onsite availability to develop (i.e. a rooftop, or ground-mount on adjacent land). Unlike onsite, or embedded generation, wheeled energy is supplied to a private offtaker via an offsite private generation plant. The power is “wheeled” (i.e. transmitted and distributed) via the utility, and as such the buyer pays the private generator for energy and pays the utility for its delivery.

South Africa as the Wheeling Model?

South Africa is showing promise as the model market for wheeling thanks to: a) an 8-10 GW energy deficit causing load-shedding affected businesses and households to desperately seek alternatives; b) policy relaxation of distributed energy sources which initially were capped at 1MW, then 100MW, and since 2022 have been fully liberalized;



c) ESKOM's ailing balance sheet, further exacerbating the need for supply to come from quick-to-build (and quick-to-finance) IPPs; and d) corporate net-zero targets led by international mining and technology companies, which may only reach such targets through a combination of onsite and wheeled renewable energy offtake.

Traditional wheeling connects large IPPs with high-voltage users in a bilateral trade (i.e. one generator to 1-2 large corporate buyers via a PPA and amended electricity supply agreements). Many businesses, however, operate low-voltage sites across various locations, and municipal grids may only participate if they have wheeling frameworks in place (i.e. limited to munis in the Western Cape). A swath of the market is thus left out and subject to the debilitating load shedding crisis.

Democratizing production and consumption of renewable energy

We are encouraged by wide-reaching moves in the wheeling market by both ESKOM and ecosystem innovators in South Africa. ESKOM piloted its virtual wheeling platform (VWP) with mobile phone operator Vodacom, which operates more than 15,000 low-voltage sites across 168 municipalities.

Virtual wheeling moves electricity from a generation source to a consumption site, often through the existing grid infrastructure, without the physical transfer of the electricity itself. Electrons and costs are virtually allocated and reconciled through billing and accounting processes, aggregating generation and consumption data in hourly intervals vs. the traditional model which is only reconciled monthly.





Virtual Wheeling



The VWP, once officially launched later this year, endeavors to open up the market for both suppliers and offtakers, including smaller generators and low- to medium-voltage users, through multilateral offtake. Meanwhile, several firms have launched energy trading businesses in the last 1-2 years. Some have captive generation (e.g. Etana Energy) and thus would seek multi-offtake arrangements, while others deploy risk capital (e.g. Africa GreenCo) by serving as the offtaker on one side and the energy seller on the other side. Private trading enables increased site sizing, solar power to seasonal businesses, and diversification of offtake income.



While the market is buoyed by such innovation, South Africa's aging grid infrastructure and limited capacity remain significant bottlenecks to growth in wheeling in key geographic nodes. While South Africa has liberalized electricity generation, further liberalization of transmission (e.g. via Public-Private Partnerships) and distribution (e.g. via privatization or operations agreements) would allow the private sector to work toward alleviating these bottlenecks.

Bankability will depend on policy visibility

Notwithstanding the additional offtake opportunities presented by wheeling projects, the merchant power market (i.e. short-term or partially contracted offtake) in the Southern Africa Power Pool is still nascent. South Africa, as a deficit supply market, is ripe for expansion of financing to merchant power given the limited near-term risk of oversupply (i.e. limited downward pressure on prices). That said, bank financing and market activity suffer from a chicken-and-egg dilemma as the market would need to experience significantly more volume to interest financiers. For now, banks require standard documentation and water-tight PPAs.

Even fully contracted wheeling projects, however, rely on policy visibility. Banks will look to protect against transmission fee changes through more onerous debt service coverage buffers in debt sizing and/or covenants incorporating such changes to standard "Change in Law" provisions. Either way, less predictable and standardized policy impacts project viability.

How to grow from here?

The management of wheeled generation and multilateral transactions requires precise coordination between the generator and ESKOM to ensure that supply of power to a particular offtaker is tracked in a consistent manner and thus billed accurately.

For the past six years, Odyssey has been building technology tools for the distributed energy sector. Some areas where we've pioneered solutions that will be critical for VWP include:

Site data tracking production and consumption across meters:

Reliable tools for all stakeholders to understand exact production and consumption use at scale. Such data allows for real-time performance evaluation and reconciliation of financial flows.

Customer journey: Clear paths for electricity consumers to seek out a renewable energy solution, link up with a project proponent, and access a repository of standardized documentation have the potential to expedite transaction workflow and transparency.

Multi-stakeholder reporting: Transmitting the single source of truth to various customized reports (i.e. for offtakers, suppliers, and financiers) requires analytics capabilities and a team that brings experience across the ecosystem to be able to provide user-friendly periodic reports for financial, commercial, technical, and impact KPIs.

With South Africa's towering energy deficit also comes tremendous opportunity to transform its energy sector, reduce carbon emissions, foster economic development, entrepreneurship, and technological innovation, and perhaps even serve as a catalyst for a more efficient buyer-seller relationship to scale renewable energy across Africa and beyond.



ARTICLE

**BY BABALWA
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Deputy Africa Market
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UNLOCKING THE ASCENDING FUTURE: RESIDENTIAL ENERGY STORAGE BOUNDLESS POTENTIAL

The segment of residential energy storage has emerged as a pivotal sector in the broader landscape of sustainable energy solutions. With a forecasted market size set to reach \$2.8 billion by 2030 and an 18.0% Compound Annual Growth Rate (CAGR), the prospects for this segment remain robust and promising.

One of the primary drivers propelling this growth is the increasing reliance on solar photovoltaic (PV) modules and energy storage systems. These technologies play a crucial role in ensuring uninterrupted power supply, especially during instances of grid instability or power outages, which are becoming more frequent in today's landscape.





The surge in the adoption of residential energy storage systems is intricately linked to the escalating demand for solar PV systems. These integrated setups not only aid in curbing energy expenses but also align with governmental initiatives aimed at fostering sustainable energy practices while ensuring a consistent electricity supply during outages.

An influential factor contributing to the growth of this market is the prevalence of power outages, especially in developing nations. Incidents of severe weather often disrupt power lines and infrastructures, resulting in prolonged periods of power unavailability. Furthermore, the aging electrical grids in numerous countries, notably in developing nations, necessitate substantial upgrades, thereby emphasizing the necessity for domestic energy storage systems to mitigate these challenges.

To tackle these issues, renewable energy companies have introduced innovative solar power solutions specifically tailored for markets grappling with frequent power outages. These solar installations, when paired with hybrid inverters, offer an extensive power range, providing users with a diverse selection of power models to meet their specific requirements. The latest hybrid inverters come with enhanced features that contribute significantly to residential electricity self-sufficiency, thereby distinctly reducing electricity bills.

Looking ahead, McKinsey & Company projects a substantial increase in residential installations, estimating around 20GWh by 2030. This optimistic growth forecast is rooted in the potential for innovation and differentiation across various facets of residential energy storage, spanning from traditional home setups to the creation of microgrids in remote communities.



Tailored products like hybrid inverters play a pivotal role in enabling residential customers to achieve their objectives, including self-sufficiency, optimized self-consumption, and reduced peak power consumption.

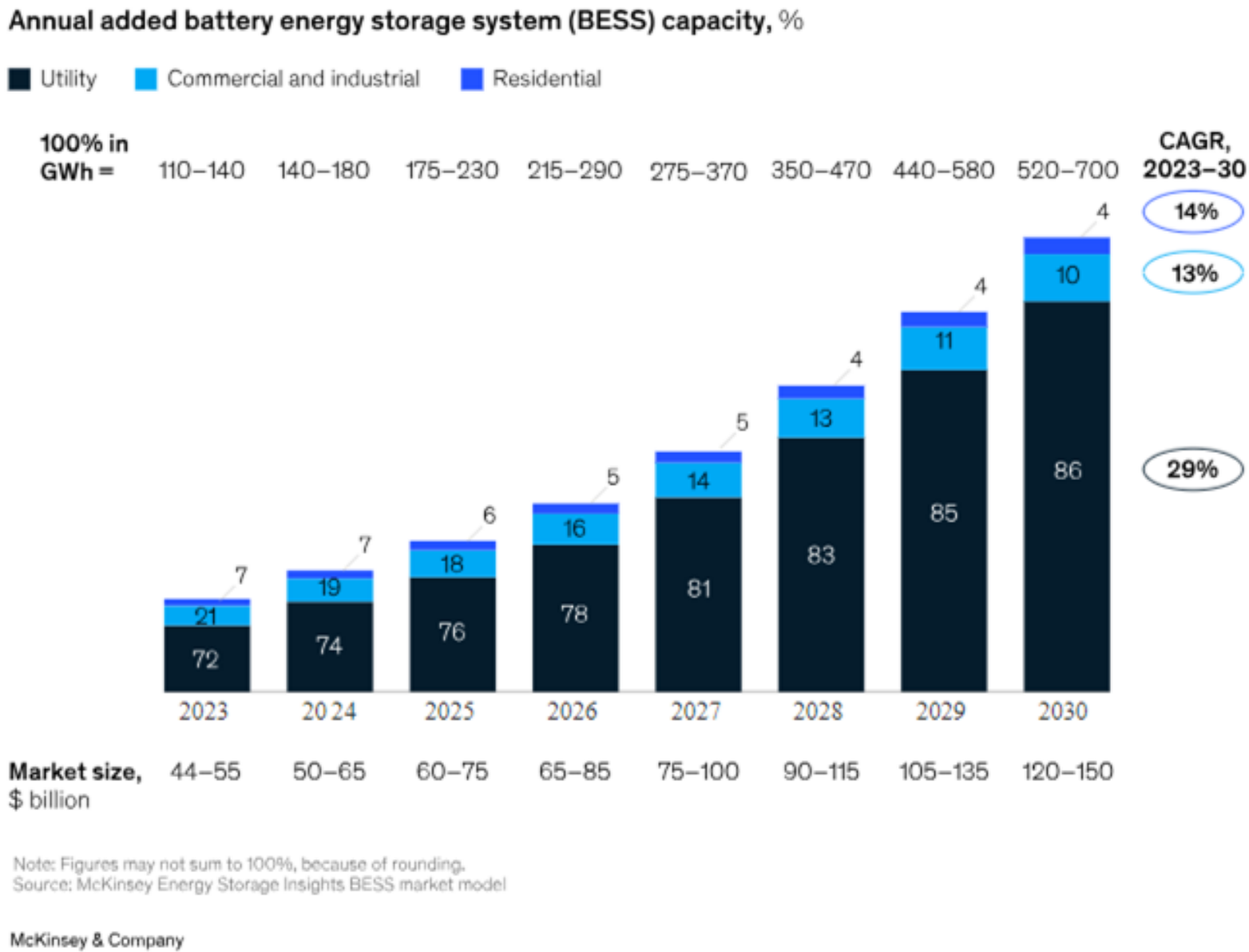


Image credit: McKinsey & Company

In conclusion, the trajectory of residential energy storage showcases immense promise and potential, driven by technological advancements, increasing demand for sustainable energy solutions, and the pressing need to mitigate the impact of frequent power outages. As innovations continue to evolve and cater to diverse consumer needs, the landscape of residential energy storage stands poised for substantial growth and transformation in the coming decade.

ARTICLE

**BY ANA
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CEO of Africa
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AFRICA GREENCO IN ZAMBIA

NEW BUSINESS MODELS UNLOCKING UTILITY-SCALE MARKETS IN AFRICA: THE CASE OF AFRICA GREENCO

Unlocking utility-scale markets for reliable and affordable renewable energy in Sub-Saharan Africa confronts multifaceted challenges, including structural weaknesses, non-cost reflective tariffs, and financial vulnerabilities within the power sector. Without comprehensive power market reforms and innovative business models, many nations will find themselves compelled to allocate substantial funds to support power purchase agreements between state utilities and private sector developers, thereby exposing heavily indebted countries and state utilities to significant fiscal risks through sovereign guarantees. Beyond the primary goal of meeting electrification targets, African countries increasingly recognize the imperative to leverage the expansion of renewable energy as a catalyst for industrial development.



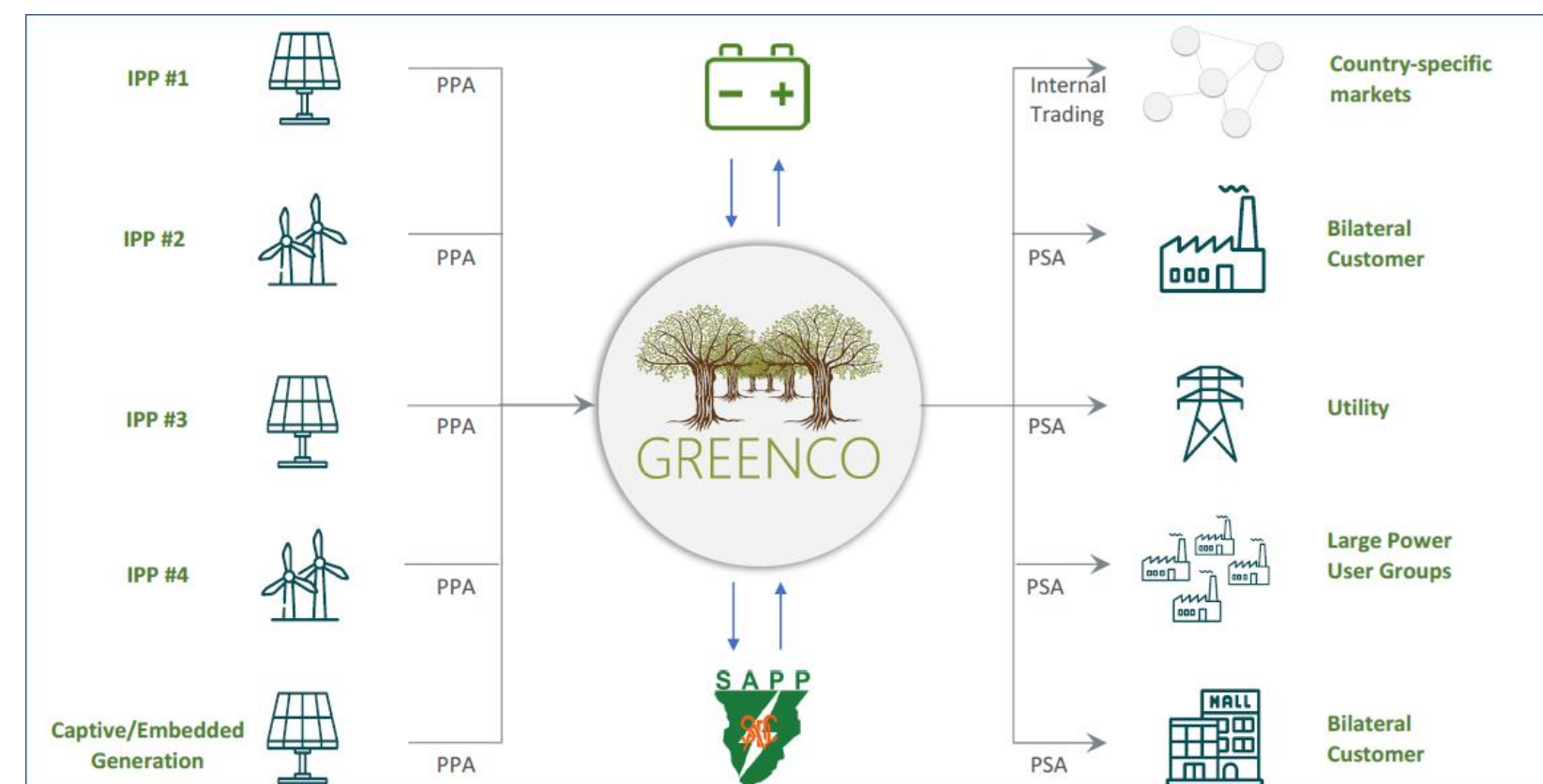


The private sector in Africa has taken strides towards aligning with global climate change-induced market shifts by addressing the dual challenge of ensuring security of supply while complying with international sustainability standards, emphasizing the need to "green" sectors for market access. However, Africa's meager 0.6% share of the global USD 434 billion investment (BNEF, 2022) in renewable energy underscores the urgent need for innovative business models to attract further funding. GreenCo stands out as a market reshaper, functioning as the first regional renewable energy buyer and trader in Southern Africa. Procuring electricity from Independent Power Producers (IPPs), GreenCo distributes power across utilities, municipalities, direct customers, and competitive Southern African Power Pool (SAPP) markets (day ahead, intraday, weekly etc). Engaging in regional electricity spot market trading and diversifying supply and customer bases, GreenCo effectively mitigates risks, fostering a more dynamic power market. Through their services GreenCo mobilizes private sector capital, and supports the optimal integration of renewable energy while aiding consumers in de-carbonizing their operations for enhanced security of supply and market competitiveness.

GreenCo's business model aligns with the ongoing power market changes in the Southern African Development Community ("SADC"). Across the region, there is a transition away from single-buyer, vertically integrated or monopoly market structures, and towards open access, third party wheeling, trading, independent power production and direct-to-customer sales. These shifts, particularly observed in countries like Zambia, Namibia, South Africa, and Zimbabwe, are driven by the fiscal challenges outlined above and increased energy demands arising from population growth and industrialization.



Such market reform also responds to urgent climate change concerns, necessitating a move toward sustainable energy sources. Additionally, the region faces a supply deficit due to decommissioning coal-fired plants and a shortfall in establishing new generation facilities, resulting in significant load shedding, especially in South Africa and Zimbabwe. This capacity gap of 12,002 MW, coupled with South Africa's plans to phase out nearly 14 GW of coal power plants by 2031, emphasizes the urgency for prompt action to manage the consistent 3% yearly capacity growth.



In the process of transitioning to renewable energy and reducing carbon emissions, the role of energy traders and aggregators like GreenCo is essential for optimum integration of new renewable energy capacity and ensuring system balance and stability. GreenCo is currently operational in Zambia, Zimbabwe, South Africa and Namibia, and is the first Market Participant (trading) member of the SAPP since 2021.

GreenCo facilitates deeper regional market integration, enhancing power system flexibility and reducing credit risk for Southern African IPPs whilst providing additional security of supply for consumers in countries linked to the SAPP. By broadening the market scope beyond individual country limitations, GreenCo contributes to a strengthened total market, allowing assessment of credit based on the combined system. GreenCo's access to the SAPP facilitates the utilization of an increasingly liquid regional power market, fostering a positive cycle of heightened market depth while enhancing GreenCo's credit risk profile and elevating its credit rating. GreenCo's current daily SAPP competitive markets trading amplifies its power trading credibility and expertise and solidifies their position in the market as a bankable renewable energy buyer and trader.

GreenCo, as an energy trader and aggregator, offers specialized services to its customers, including both supply (IPPs) and demand customers (industrial, commercial, and municipalities). The company efficiently manages wheeling and formulates grid adaptation strategies through technical agreements entered into with transmission system and market operators across the region. These agreements pave the way for utilities to monetize assets by boosting supply volume through third party access to their grids and gaining compensation for wheeling, balancing, banking and other system operations services – making utilities the key partners in GreenCo's growth. Additionally, the company advocates for compensating national utilities for energy balancing, recognizing their crucial involvement in managing irregular generation and consumption patterns due to intermittent renewable energy resources and consumption behaviors. GreenCo has successfully championed these market arrangements, introducing them as precedents in collaboration with utilities across the SADC.



GreenCo has to date acted as the pathfinder for other traders to come – ensuring the market's proper development and driving regulatory change across its countries of operation. The company places significant importance on engaging with and supporting national power sector market liberalization, such as South Africa's Electricity Regulation Amendment Bill and Namibia's recent introduction of the modified single buyer model. GreenCo's provision of energy trading services, with a focus on anticipating future market changes, is crucial for mitigating risks for all participants, including the company's own sustainability. Additionally, GreenCo actively advocates for updated wheeling and energy balancing rules in each operational country, specifically considering imports and exports. This advocacy aims to provide access to the SAPP competitive markets for generators, traders, and customers, thereby enhancing project bankability through risk mitigation via regional diversification resulting in capital mobilization for new energy supply.

In 2024 GreenCo will focus on providing tailored services to their customers (both supply (IPPs) and demand customers (industrial, commercial and municipalities) by providing bankable power purchase agreements for IPPs whilst increasing consumer's security of supply through their power sales and helping adapt consumer's operations to the evolving electricity markets- including mitigating price risk by aligning energy consumption patterns with renewable energy availability. GreenCo's trading deck is equipped to do so with a customized Energy Trading and Risk Management system (ETRM) developed and customized for the company by leading global consultants. This system enables comprehensive execution of energy trades, including portfolio energy aggregation—a vital factor in managing intermittent energy technologies.



The trading desk is led by an experienced and service-oriented team, operating with best international practices in risk management and workflows. GreenCo leverages these capabilities with deep market knowledge across the SADC region and data analytics to offer unique energy solutions.

Since obtaining their initial funding from IFU and PIDG (via InfraCo Africa) in October 2020, amid the COVID-19 pandemic, GreenCo has attained noteworthy milestones. Notably, its GreenCo IPP procurement portal, accessible via its website, has garnered over 5GW of IPP interest and substantial industrial customer attention across the SADC region since its launch last year. Becoming the inaugural Market Participant member of the Southern African Power Pool in October 2021 marked a significant achievement. Moreover, GreenCo's expansion from Zambia to Zimbabwe, South Africa, and Namibia, coupled with finalizing two Power Purchase Agreements (PPAs) in 2023—supported by lenders such as Standard Bank and FMO—will directly draw over \$120 million in Foreign Direct Investment (FDI) to Zambia and South Africa.

GreenCo's innovative business model not only serves as a catalyst for advancing renewable energy adoption but also plays a pivotal role in attracting increased investment into new renewable energy generation. By streamlining the region's journey towards decarbonization, GreenCo ensures that this transition is delivered as affordably as possible for governments, utilities, and end-users whilst fostering growth and development in the process.



SPECIAL APPRECIATION TO OUR VALUED PEER REVIEWERS

At the core of AFSIA's mission is the commitment to establish networks and knowledge-sharing platforms that enable all solar stakeholders to swiftly connect with partners and information, fostering more effective and efficient business practices.

AFSIA expresses heartfelt gratitude to the exceptional group of experts scattered across the continent, who generously accepted our invitation to review and enhance the information presented in this report.

We take immense pleasure in spotlighting these individuals and extend a warm invitation for you to directly reach out to them if you seek additional expert insights on specific countries. Once again, thank you for your invaluable contributions.



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