Off-grid renewable energy highlights

23 December 2024

HEADLINE FIGURES

11.1 GW

Global off-grid renewable power capacity at the end of 2023

Bioenergy	**5.1** GW
Solar	**4.1** GW
Hydro	**1.7** GW
Wind	**0.2** GW

155 million

People used off-grid renewable power at the end of 2023

33 million

People in households had under 8 hours of electricity per day using off-grid systems for basic lighting and entertainment purposes in 2023

2 098 thousand

Cumulative number of off-grid renewable systems used, by sector end-use in 2023

Public lighting	**1 296**
Agriculture	**511**
Health	**149**
Communication	**94**
Education	**46**
Tourism	**2**

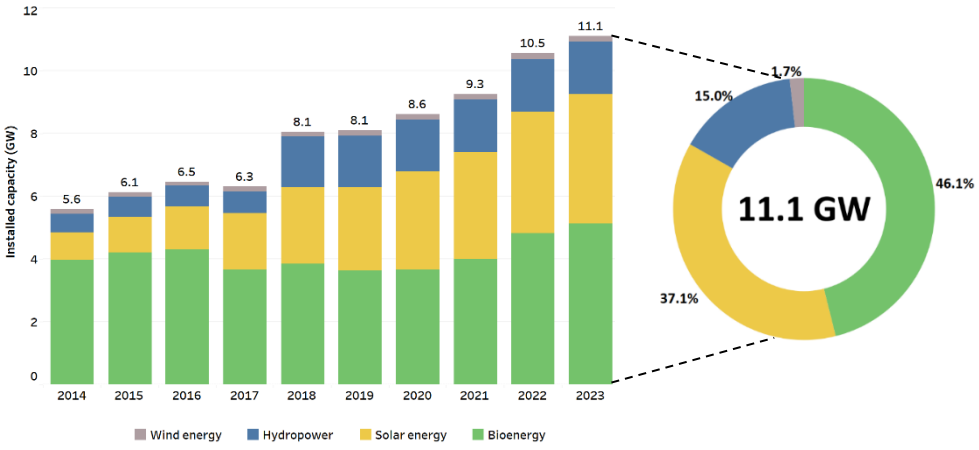
Introduction

IRENA defines off-grid renewable systems as renewable technologies that serve people in rural/remote areas that have no physical connection to the national power grid. Additionally, an establishment[1] with a physical connection to the grid that uses an off-grid system to provide backup power or reduce electricity bills is considered grid-tied and not off-grid.

The IRENA off-grid renewable energy statistics covers Asia, Africa, Central America & the Caribbean, Middle East, Oceania, and South America regions. Biogas statistics for Asia includes China but not its special administrative regions, while statistics for all other technologies exclude both China and its special administrative regions.

Off-grid renewable power capacity by technology

Global[2] off-grid renewable power capacity[3] amounted to 11.1 GW at the end of 2023, doubling since 2014. Bioenergy, predominantly solid biofuels used in off-grid cogeneration plants, dominated the off-grid renewable capacity mix since 2014 and accounted for 5.1 GW in 2023. Off-grid solar capacity grew almost five folds in the same period and contributed 4.1 GW to the capacity mix by the end 2023. Solar grew at a 30.0% growth rate from 2014 to 2018[4]; two and a half times more compared to the 11.8% growth from 2019 to 2023. Since 2014, off-grid hydropower[5] and wind energy experienced some growth but remained fairly constant, and each accounted for 1.7 GW and 0.2 GW respectively.



1 Constitutes people served in households, public institutions, companies, etc. unless otherwise stated.

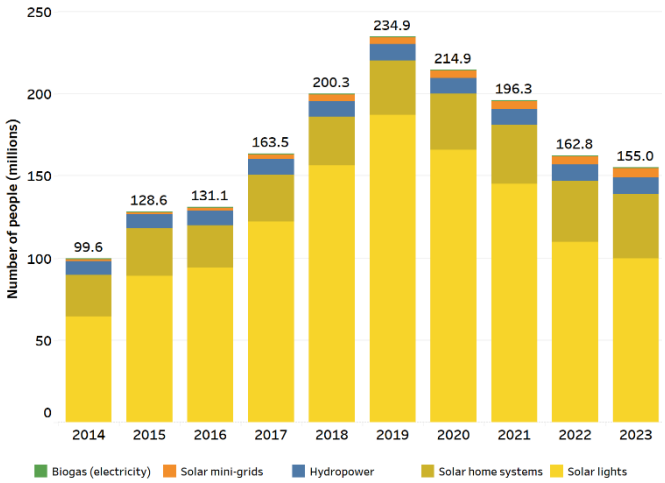
2 Off-grid renewable energy statistics covers Asia, Africa, Central America & the Caribbean, Middle East, Oceania, and South America regions. Biogas statistics for Asia includes China but not its special administrative regions, while statistics for all other technologies exclude both China and its special administrative regions. China and its special administrative regions, North America, Europe and Eurasia were excluded since these regions have achieved near to or 100% national electricity access.

3 Electrical capacity. Excludes solar cookers and ethanol cookers thermal capacity.

4 Compound annual growth rate

5 Hydropower (excluding pumped storage)

Population served by off-grid renewable power



In 2023, 155 million people[6] worldwide were served by off-grid renewable technologies of which almost 100 million people benefited from off-grid solar lights, an increase of around 56% since 2014. Africa alone accounted for 58.4 million beneficiaries in 2023. The use of solar lights from 2020 to 2023 declined by 40% despite year-on-year growth in the sales of solar lights since 2021. This stark contrast can be explained by accounting for repeat sales, losses and decommissioning[7] to account for the lifetime of solar products.

The use of solar home systems continued to grow steadily since 2020, from 34.1 million to 39.2 million beneficiaries in 2023 representing a 4.8% compound annual growth rate over the time period. Beneficiaries of solar mini-grids, hydropower and biogas electricity reached 5.8 million, 9.9 million, and 0.3 million respectively in 2023.

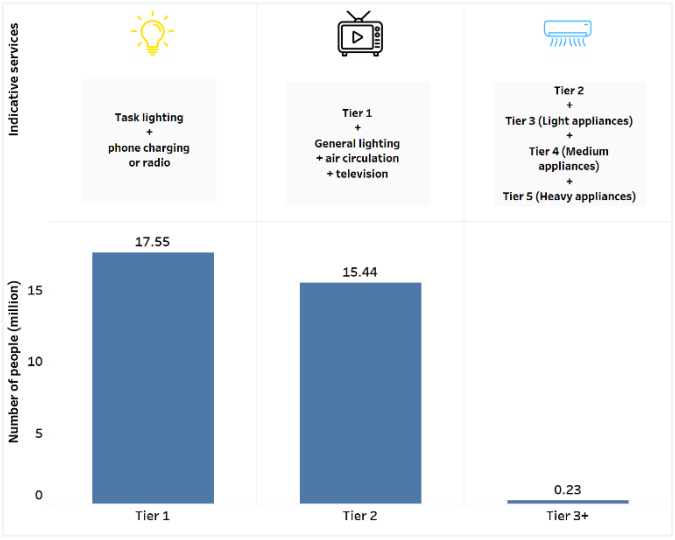
Africa experienced the largest combined year-on-year growth in the use of off-grid renewable systems in 2020 (+7.6%) and 2021 (+7.9%) compared to other regions but growth declined in subsequent years. Since 2021, Asia, and Central America and the Caribbean experienced falls in the number of people served by off-grid systems; the Middle East also had falls in recent years.

Year-on-year change in number of beneficiaries						
Region	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Africa	5.5%	7.3%	7.6%	7.9%	3.0%	0.8%
Asia	-0.4%	-0.4%	-0.8%	-0.8%	-0.8%	-0.5%
C Am & the Carib	0.4%	0.2%	-0.4%	-0.1%	-0.3%	-0.2%
Middle East	-3.5%	15.3%	-17.8%	9.3%	-18.4%	-10.1%
Oceania	7.9%	1.7%	2.2%	6.5%	50.1%	14.9%
South America	5.4%	0.1%	0.1%	0.0%	-0.1%	0.0%

People in rural households using off-grid renewable electricity by tiers[8]

At the end of 2023, over 2 million off-grid renewable systems were delivering energy services across agriculture, health, education, public lighting, tourism and communication end-use sectors.

An estimated 33.2 million people in rural households used Tier 1+ off-grid system in 2023 compared to 36.7 million people in 2022, indicating a decrease of 9.5%. The majority of people in rural households (99.4%) had under 8 hours of electricity per day using off-grid systems for basic lighting and entertainment (phone and radio) purposes in 2023. The same trend is observed in previous years depicting the slow progress of people in households moving up the energy ladder particularly from entry level access to higher access tiers. It indicates that many rural households do not have sufficient energy services to improve livelihoods.



6 Majority of people served by solar lights and solar home systems represents affiliate sales reported by GOGLA affiliate companies. These sales only represent an estimated 28% of the global off-grid solar market. See the Off-Grid Solar Market Trends Report 2024.

7 IRENA's methodology for estimating the number of beneficiaries accounts for the limited lifetime of solar devices. The number of lights sold or distributed in the last three years is taken as the current number of devices in operation. For solar home systems, only those deployed in the last five years are assumed to be operational unless there is evidence of a long-term maintenance and replacement programme. This methodology was adopted in consultation with GOGLA who conducted research and suggested that the average life of these products are approximately 1.5 times the guarantee period, which roughly equates to three years for solar lights and five years for SHS. Losses refer to solar products that were damaged/broken in storage, during transportation or during installation on site.

8 IRENA uses the Multi-tier Matrix for Measuring Household Electricity Consumption to estimate the tier levels. Tiers only indicate level of access but does not accurately reflect the diversity of appliances actually used or the exact number of hours of available electricity.

Other off-grid renewable energy information

The latest publication aims to report the most comprehensive and updated off-grid statistics, but data gaps still persist. Some of the data used in the report are calculated as IRENA estimates due to data unavailability or incomplete information at the time of data collection. IRENA makes historic revisions to improve the accuracy of previous year entries and continues to develop improved methodologies for estimating off-grid statistics. The methodology notes offers further explanation on off-grid data collection and estimation. The information presented should therefore not be considered exhaustive. The report also tracks biogas production for cooking as well as ethanol cookers, and solar cookers for a select number of countries.

For any inquiries or questions, please contact us at statistics@irena.org.