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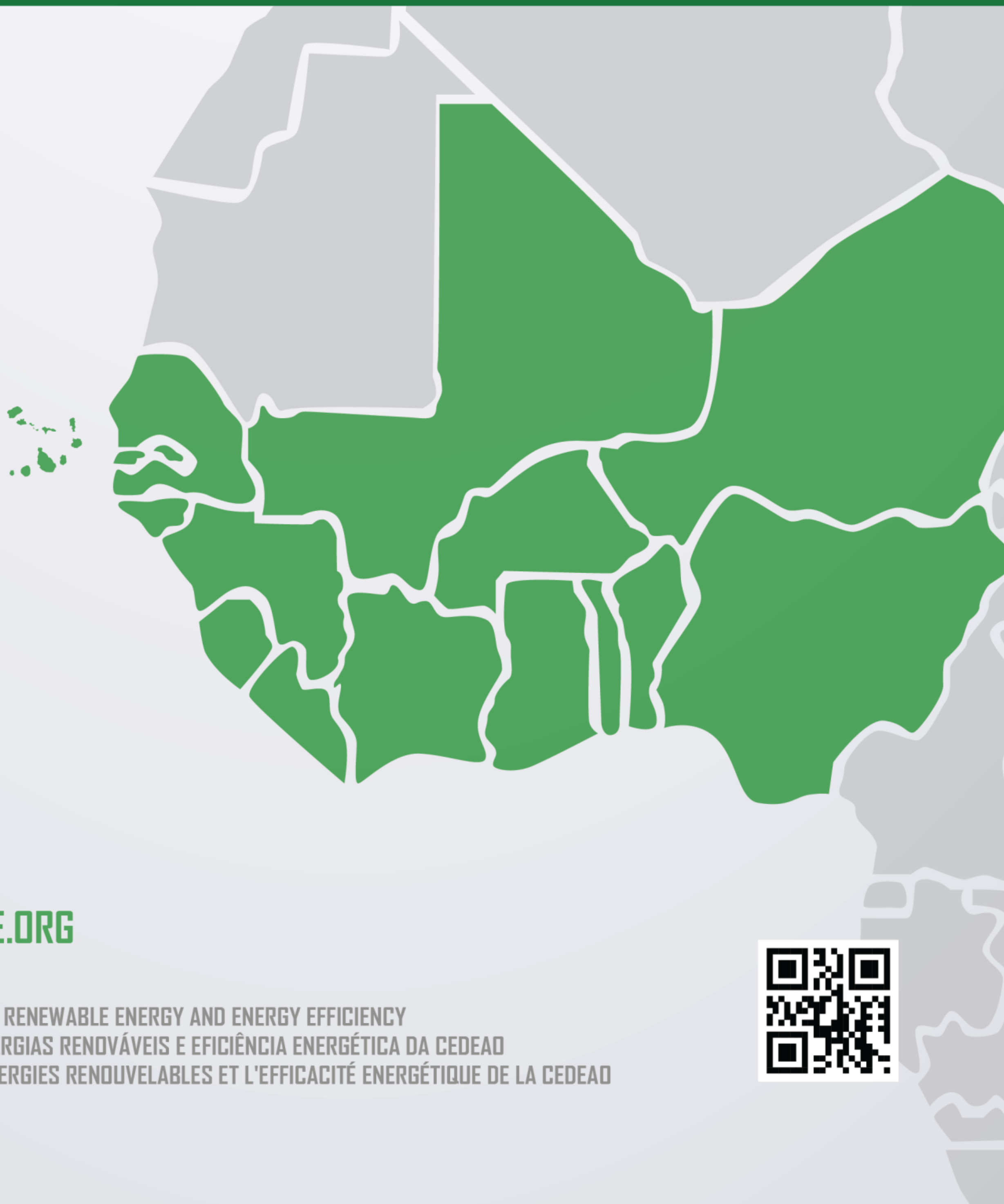
Towards Sustainable Energy

REGIONAL PROGRESS REPORT ON RENEWABLE ENERGY, ENERGY EFFICIENCY AND ENERGY ACCESS IN ECOWAS REGION

MONITORING YEAR: 2017



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ECOWAS CENTRE FOR RENEWABLE ENERGY AND ENERGY EFFICIENCY
CENTRO PARA AS ENERGIAS RENOVÁVEIS E EFICIÊNCIA ENERGÉTICA DA CEDEAO
CENTRE POUR LES ENERGIES RENOUVELABLES ET L'EFFICACITÉ ENERGÉTIQUE DE LA CEDEAO

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ABBREVIATIONS

ABREC-SABER	African Biofuel & Renewable Energy Company
ADEME	Agence de l'Environnement et de la maîtrise de l'énergie du Sénégal
AEME	Agence pour l'Économie et la maîtrise de l'énergie du Sénégal
AfDB	African Development Bank
AMADER	Agence Malienne pour le Développement de l'Energie Domestique et l'Electrification Rurale (Mali)
ARSE	Autorité de Reglementation du Secteur de l'Électricité du Togo
ASER	Agence Senegalaise d'Electrification Rurale
ASN	Agence Sénégalaise de Normalisation
BOAD	West African Development Bank
CEB	Communauté Electrique du Bénin
CEMG	Clean Energy Mini-Grid
CFL	Compact Fluorescent Light (bulbs)
CIE	Compagnie Ivoirienne d'Électricité
DFID	Department for International Development of UK
ECOSHAM	ECOWAS Standards Harmonization Model
ECOWAS	Economic Community of West African States
ECOWREX	ECOWAS Observatory for Renewable Energy and Energy Efficiency
ECREEE	ECOWAS Centre for Renewable Energy and Energy Efficiency
EE	Energy Efficiency
EEEP	ECOWAS Energy Efficiency Policy
EDG	Électricité De Guinée
EDM-SA	Énergie Du Mali
ELECTRA	Empresa de Electricidade e Água, SA
EREP	ECOWAS Renewable Energy Policy
EU	EU
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (Germany)
GRIDCo	Ghana Grid Company Limited
GW / GWh	Gigawatt / Gigawatt hour
HV	High Voltage
ICS	Improved Cook-Stoves
IEA	International Energy Agency
IP	Investment Prospectus
IPP	Independent Power Producer
kW / kWh	Kilowatt / Kilowatt Hour
LBC	Lampes de Basse Consommation
LCL	Low Consumption Lights

LEC	Liberia Electricity Corporation
LED	Light Emitting Diode
LMSH	Large and Medium Scale Hydro
LPG	Liquefied Petroleum Gas
LV	Low Voltage
MEPS	Minimum Energy Performance Standards
MoE	Ministry of Energy
MV	Medium Voltage
MW / MWh	Megawatt / Megawatt hour
NAWEC	National Water & Electric Company of Gambia
NEEAP	National Energy Efficiency Action Plan
NERC	Nigerian Electricity Regulatory Commission
NESP	Nigerian Energy Support Program
NIGELEC	Société Nigerienne d'Electricité
NPO	Non-Profit Organization
NREAP	National Renewable Energy Action Plan
PERACOD	Program for the promotion of renewable energy, energy efficiency and access to energy services
PPA	Power Purchase Agreement
PRODERE	Programme Régional de Développement des Energies Renouvelables et de l'Efficacité Energétique
PV	Photovoltaic
RE	Renewable Energy
RREP	Rural Renewable Energy Program
SBEE	Société Béninoise d'Energie Electrique
SEforALL	Sustainable Energy for All
SENELEC	Société Nationale d'Électricité du Sénégal
SHS	Solar Home System
SHP	Small Hydro Power
SME	Small and Medium sized Enterprise
SWH	Solar Water Heaters
ToR	Terms of Reference
UEMOA	Union Economique et Monétaire des Etats de l'Afrique de L'Ouest
UNDP	United Nations Development Program
WAPP	West African Power Pool
WB	World Bank

DEFINITIONS

Electricity access: Access to electricity is the share of households with electricity supplied by electricity grid (national grid and mini-grids), and the share of households with electricity supplied by stand-alone renewable energy systems. Conventional stand-alone systems such as diesel or petrol generators contribute also to provide access to electricity, but these are not taken into in this report.

Energy-efficient building: An energy-efficient building is defined as a building that is designed and built in a way that minimizes demand for and consumption of energy/electricity for cooling. Buildings considered are old and new public buildings with a total useful area over 500 m2 having at least one energy audit conducted.

Household: A household is defined as a person or group of persons who normally live and feed together, and recognize a particular person as the head.

Improved cook-stove: An improved cook-stove is characterized by having a particular feature that reduces the amount of wood, charcoal, animal or crop residue used by the cook-stove. Their use in developing countries is been promoted based on two main advantages: reducing the negative health impacts associated with exposure to toxic smoke from traditional stoves (women and children are generally more affected) and reducing the pressure placed on local forests.

Losses in electricity supply: losses during electricity supply refers to the amounts of electricity injected into the transmission and distribution grids that are not paid by users. Total losses have two components: technical and non-technical. Technical losses occur naturally and consist mainly of power dissipation in electricity system components such as transmission and distribution lines, transformers, and measurement systems. Non-technical losses are caused by actions external to the power system and consist primarily of electricity theft, non-payment by customers, and errors in accounting and record keeping. These three categories of losses are sometimes referred to as commercial, non-payment and administrative losses respectively, although their definitions vary in the literature.

Medium and large hydro: According to the ECOWAS Small Scale Hydropower Program, medium and large hydropower plants are defined as hydropower plants with a capacity exceeding 30MW.

On-grid lights: On-grid lights are defined as lights connected to the national grid or mini-grids.

Penetration rate of efficient lights: penetration rate of efficient light is defined as the number of efficient lights sold or installed as a share of the total number of lights (efficient + inefficient) sold or installed.

RE mini-grid, hybrid mini-grid (or Clean Energy Mini Grid - CEMG): it is defined as a mini-grid where at least 10% of the total installed capacity is RE-based.

Small Hydropower Plants: according to the ECOWAS Small Scale Hydropower Program, small hydro plants are defined as hydropower plants with installed capacity between 1 and 30MW.

Stand-alone renewable energy systems: they are defined as off-grid RE systems for lighting and powering electric appliances. These should provide at the minimum, electricity services such as lighting and phone charging (tier 1 of the SEforALL multi-tier framework for access to electricity).[1] This excludes solar lamps that are for lighting only.

[1] Further information: World Bank/IEA (2014): SEforALL Global Tracking Framework.

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EXECUTIVE SUMMARY

This report is the second regional progress report within the framework of the Regional Monitoring and Reporting for the ECOWAS Renewable Energy and Energy Efficiency policies and the Sustainable Energy Country Action Plans (abbreviated as Regional Monitoring Framework).

In 2017, only 52.3% of the ECOWAS population had access to the electricity grid, which makes a concrete case for promoting the deployment of off-grid systems such as mini-grids and stand-alone technologies. These technologies will help to increase electricity access, in order to attain the 65% regional access target by 2020.

Medium and large hydropower plants play a significant role in the region's electricity supply. With more than five gigawatts of installed capacity, they contributed approximately 27.6% of electricity generated in 2017. Grid-connected renewable energy (small hydropower, solar PV, wind and biomass) contributed 1.8% of installed capacity. This goes to show that more effort is required in the short term to achieve the target of 10% by 2020.

Efforts are ongoing at various sectors towards improving the institutional and legislative framework in order to increase the rate of energy efficiency. These improvements include, for example, in the domestic sector - promotion of efficient lighting and efficient electrical appliances; in the public and industrial sectors - energy efficiency improvements in public buildings, energy efficiency in industrial processes; and the electricity sector - reduction of losses in transmission and distribution networks.

As electricity generation capacity increases, reducing the technical losses[2] in transmission and distribution networks is increasingly important. Although network losses have been decreasing overtime, 39.5% of the electricity produced was lost in the ECOWAS region, amounting to 26,611 gigawatt-hours (GWh) in 2017. This gap is far from the set target of 10% for 2020. Non-technical losses are a big burden on the financial viability of the utilities and undermine the development, maintenance and expansion of the transmission networks. Indeed, the regional weighted percentage of non-technical losses in 2017 amounted to 12.9% (2,554 GWh).

Increasing the market share of efficient lighting in the region played a significant role in energy savings. Over one million efficient on-grid lights and thousands of efficient public lights were sold and distributed in the region.

Some member states have not been able to provide quantitative data for some particular indicators. For example, data about the number of people served by stand-alone renewable energy systems in the region cannot be precisely estimated. This is because the relevant framework and processes are not yet in place in the member states, to help collect and access the penetration rate of such systems. The same applies to the penetration rate of improved cookstoves (ICS) and a number of energy efficiency indicators, like the market share of energy-efficient lighting. Where no quantitative data was available, qualitative analysis was used.

The individual countries and the region at large requires regular updates on renewable energy, energy efficiency and energy access in order to make effective decisions when planning. This Progress Report serves as an important tool for policy makers and other stakeholders by providing annual snapshots and trends along the three axes[3] covered.

[2] Technical losses occur naturally and consist mainly of power dissipation in electricity system components such as transmission and distribution lines, transformers, and measurement systems. Non-technical losses are caused by actions external to the power system and consist primarily of electricity theft, non-payment by customers, and errors in accounting and record keeping.

[3] Renewable Energy, Energy Efficiency and Energy Access

1 INTRODUCTION

1.1 Background on regional targets and the regional monitoring framework

The ECOWAS ministers in charge of energy have expressed their willingness to work towards the achievement of the SEforALL targets. In October 2012, they mandated the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE) to co-ordinate and implement the SEforALL initiative. In July 2013 the ECOWAS Heads of State adopted the ECOWAS Renewable Energy Policy (EREP) and the ECOWAS Energy Efficiency Policy (EEEP). A summary of the main targets in both policies are presented in Table 1 below.

Table 1: Main targets for ECOWAS region contained in EREP and EEEP

RENEWABLE ENERGY	**2020**	**2030**
Installed renewable energy capacity (excl. medium and large hydropower)	2,425 MW	7,606 MW
Renewable energy power generation (excl. medium and large hydropower)	8,350 GWh	29,229 GWh
Renewable energy in electricity mix (excl. medium and large hydropower)	10%	19%
Renewable energy in electricity mix (incl. medium and large hydropower)	35%	48%
Share of (rural) population served with off-grid renewable energy systems	22%	25%
Ethanol as share of petrol consumption	5%	15%
Biodiesel as share of diesel and fuel-oil consumption	5%	10%
Improved cook stoves penetration	100%	100%
Use of modern fuel alternatives for cooking *e.g.* liquefied petroleum gas (LPG)	36%	41%
Solar water heaters • Residential homes – new detached house price exceeding 75,000 Euros (EUR) • Social institutions • Agro-food industries • Hotels	At least 1 per house 25% 10% 10%	At least 1 per house 50% 25% 25%
ENERGY EFFICIENCY	**2020**	**2030**
Implement energy efficiency measures that free up 2,000 MW of power generation capacity	Measures implemented	Not specified for 2030
Distribution losses in 2020	10%	Not specified for 2030
Penetration rate of efficient bulbs	100%	100%
Energy efficiency in public buildings larger than 500 square metres (m^2) (new or renovation): implement energy efficiency measures and issue energy performance certificate	100%	100%

Source: EREP, EEEP

Between 2014 and 2015, following the adoption of the regional policies, all ECOWAS member states developed their National Renewable Energy Action Plans (NREAPs), National Energy Efficiency Action Plans (NEEAPs) and SEforALL Action Agendas[4], with support from ECREEE. Implementation of these plans is expected to contribute towards achieving the regional targets. In other words, the aggregated targets of each ECOWAS country as

[4] Collectively referred to as the Sustainable Energy Country Action Plans
ECREEE (2017).

expressed in the Sustainable Energy Country Action Plans mainly aligns with the regional targets declared in EREP and EEEP. At regional level, the electricity access target expressed through the SEforALL Action Agendas translates into approximately 90%. This corresponds to approximately 440 million people and needs to be viewed in the context of the declared universal electricity access goal.

The Sustainable Energy Country Action Plans are based on templates validated by the member states. The Regional Monitoring and Reporting Framework was validated at the ECOWAS Sustainable Energy Workshop held in Dakar in April 2016, and adopted at the 11th Meeting of the ECOWAS Energy Ministers held in Conakry, Guinea, in December 2016.

In the resolution that adopted the framework, all member states were required to nominate national focal persons that is responsible for compiling and submitting annual national monitoring reports to ECREEE. These reports should present the most recent updates on achievement of the targets in their NREAPs, NEEAPs and SEforALL Action Agendas. They should also contain a summary of the main activities implemented in pursuance to the achievement of the targets during the previous year. It is on the basis of these national reports that ECREEE annually assess the status of implementation of the regional policies.

1.2 Implementation progress of the SEforALL initiative in the ECOWAS region

Following the mandate given to ECREEE by the ECOWAS authorities, to co-ordinate and implement the regional policies and the SEforALL initiative in West Africa, ECREEE has been supporting the ECOWAS member states in developing coherent and aligned roadmap processes. And between 2014 to 2016, ECREEE assisted each country in developing their National SEforALL Action Agendas, which outlines the main challenges and opportunities in achieving the SEforALL goals.

From 2016, ECREEE has been supporting the member states to develop its SEforALL Investment Prospectus[5], which helps to identify programmes and projects to set in motion the SEforALL Action Agendas and highlight potential investments to public and private investors. It was supported by key players, such as; the United Nations Industrial Development Organization (UNIDO), African Development Bank (AfDB), EU-TAF (European Union Technical Assistance Facility), and United States Agency for International Development (USAID). Thus far, Benin, Togo, Senegal, Côte d'Ivoire, Liberia, Niger, Sierra Leone, Nigeria, Guinea-Bissau and Cabo Verde have all developed an Investment Prospectus. Investment Prospectuses for Burkina Faso, Gambia, Ghana and Mali are under development.

As a global platform, SEforALL empowers leaders to broker partnerships and unlock finance to help achieve universal access to sustainable energy. For the ECOWAS region, ECREEE will continue to benchmark progress and connect stakeholders together. It will achieve this by helping governments and other stakeholders stay on track and ensure that financial commitments towards achieving universal access to electricity and clean cooking solutions, improve in the near future.

[5] All documents and information related to the SEforALL initiative in West Africa can be found on http://se4all.ecreee.org/

2 OBJECTIVE, METHODOLOGY AND DATA COLLECTION

The main objective of this report is to provide an assessment of renewable energy, energy efficiency and energy access in the ECOWAS region at the end of 2017. It also, in comparism with the set targets for 2020 and 2030 identify the gaps and trends as at 2017.

To assess the 2017 regional profile and track the progress along the three axes, data was collected from the 15 ECOWAS member states. The National Monitoring Report template was sent to the focal person in each member states and with support from ECREEE, they were validated. These validated reports was consolidated into the regional progress report. Subsequently, a regional workshop was organized in November of 2018 in Dakar,[6] to validate the draft 2017 regional progress report and to deliberate on the challenges in obtaining data that are lacking, for some indicators. These indicators concerns cooking energy, energy efficiency, solar water heaters (SWH) and off-grid renewable energy systems.

Two main types of data were collected; (i) quantitative data, such as the installed generation capacity or the population size, and (ii) qualitative data generated by surveys, such as the market penetration rate of efficient lighting or ICS. Wherever possible, primary data sources took precedence, but secondary sources were considered in circumstances where there was insufficient data. Examples include data from international organisations or reports published by other credible third-party institutions.

Each national focal person used the national statistical services to report about demographic data such as population size, number of households and average household size. Data for installed electricity capacity and electricity losses were obtained from utilities, regulators or ministries. Similarly, data on electricity generation capacity was primarily supplied by the utilities. Where necessary, data published by government institutions was preferred, such the Ghana and Nigerian Energy Commission and Nigerian Electricity Regulatory Commission (NERC) reports.

Data on electricity access was collected from the national utilities and mini-grid operators, as well as national censuses developed by the national statistics offices. These censuses are considered credible sources of information and cover the entire population of a given country. In general, the number of households served by the grid shown in the census does not match the number of connections to the grid. It would therefore be unrealistic to only count the number of customers connected to the electricity grid as those having access to electricity. The values reported in this report are very much in line with those reported by the International Energy Agency (IEA)[7] - the percentages of access in 2016 tend to work out at one or two percent higher, with the exception of Guinea-Bissau and Sierra Leone for which it reports lower percentages.

Clean cooking access was measured in terms of share of households using ICS and alternative fuels such as LPG. The use of alternative cooking fuels is usually included in censuses, which normally contain a question on primary household cooking fuel. In contrast, the censuses do not explicitly cover ICS. This means any available data is not a representation of the entire population and in many cases is only an estimate. To assess the ICS market, information from relevant distribution initiatives was collected along with related sales figures. Such data does not directly indicate the usage of ICS, which is a disadvantage. In addition, the framework mandates reporting on only ICS units with a minimum efficiency of 35%.[8] These data collection methods meant it was not possible to discern the minimum efficiency of ICS units.

It is the task of rural electrification authorities or private operators and companies to collect data on off-grid electrification. ECREEE requested from each focal persons, information on the number of stand-alone

[6] www.ecreee.org/event/ecowrex-regional-workshop-renewable-energy-energy-efficiency-and-energy-access-monitoring-and

[7] IEA (2017).

[8] EREP defines “improved cookstoves” as fuelwood or charcoal stoves with a minimum efficiency of 35%.

renewable energy systems distributed or sold. Alongside the efforts of each focal person, ECREEE tried to obtain the same kind of information from different sources including donor reports and distributors or installers. Data on the number of clean energy mini-grids (CEMGs) in the region came mainly from the Rural Electrification Authorities, private operators and donors.

In most countries, it was not possible to quantify the penetration rate of energy-efficient lights. Information was collected from reports of initiatives undertaken by various actors as well as sales of energy-efficient lights in individual countries. In addition, this report provides updates on initiatives launched by governments (e.g. legislation banning incandescent lamps, introduction of standards and labels). These updates keep each country accountable to ensure it meets regional and national goals. In a similar manner, energy-efficient buildings were identified and recorded, but not substantial enough for comparism within the region.

The same applied to SWH systems – another market segment lacking in facts. Given that the ECOWAS member states do have system for registering SWH sales and installations, the only data available came from relevant projects that cited in this report. A similar reporting and data collection approach was also used for biofuels production in the region. Finally, secondary data sources were used to compile information on industries that have implemented energy efficiency measures, because data from the primary sources are lacking.

3 STATUS OF ENERGY ACCESS, RENEWABLE ENERGY AND ENERGY EFFICIENCY IN THE ECOWAS REGION

3.1 Energy access

Access to energy is based on electricity access and use of modern cooking solutions. Electricity access is considered as connections either to the electrical grid (national grid and mini-grids)[9] or to stand-alone renewable energy systems. The indicators used to monitor electricity access includes share of households connected to electrical grid, share of households connected to renewable energy mini-grids[10] and share of households served by stand-alone renewable energy systems. Access to modern cooking solutions is measured according to share of households using efficient cookstoves and alternative cooking fuels.

3.1.1 Access to electricity

Access to electricity is calculated as the share of households with electricity supplied by electricity grid (national grid and mini-grids), and the share of households with electricity supplied by renewable energy stand-alone systems.[11] In theory, aggregating all these types of access should provide each country's total rate of access to electricity. Finally, electricity access is also measured in terms of number of connections to the national electricity grid, to CEMGs, and to stand-alone renewable energy systems.

3.1.2 Access to electricity grid

The regional target for electrification access in terms of population is 65% by 2020.[12] In 2017 the overall population of the ECOWAS region was approximately 371 million people living in 70 million households. The average household size varies by country. Cabo Verde shows the lowest value at 3.5 people per household while Senegal comes highest at nine people per household. Just over half the population (52.3%) and 54% of households had access to an electrical grid, which represents an increase of 2.6% and 2.8% respectively compared to 2016.[13]

There were considerable differences in the population's electrification rate across the region in 2017 (Figure 1). Figure 1 also shows its comparisons with the 2016 access rates and the 2020 national electrification access targets.

[9] Isolated grids or mini-grids refer to electrical grids not connected to the national grid. The term does not consider the origin of the energy and includes all conventional and renewable energy sources.
[10] In this report, renewable energy mini-grids, hybrid mini-grids and CEMGs use the same definition.
[11] Conventional stand-alone systems such as diesel or petrol generators contribute also to electricity access but these are not covered in the monitoring framework.
[12] ECREEE (2017).
[13] ECREEE (2018).

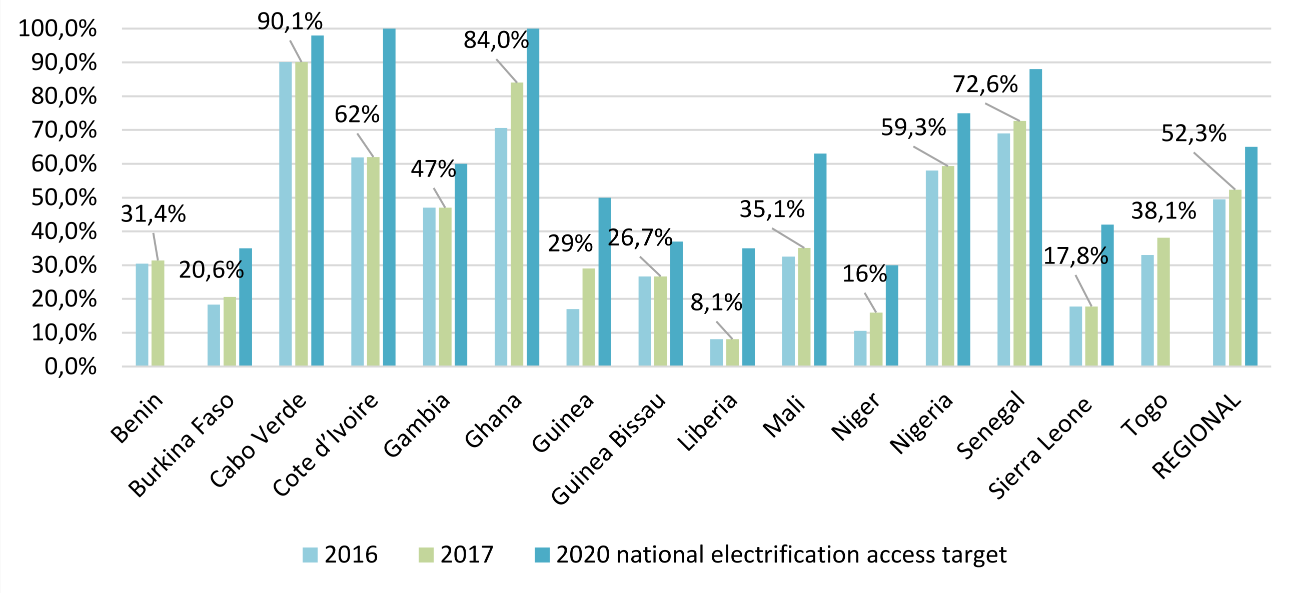


Figure 1: Share (%) of population connected to an electricity grid in 2017 and 2016

Source: national monitoring reports 2016 and 2017 (based on data reported by the national directorates of energy and national energy information services, national statistics services and annual utility and electricity regulator reports for 2016 and 2017); ECREEE (2017).

Notes:

Electricity access is presented in terms of population, in order to be consistent with the national electrification targets established by the ECOWAS countries in the national action plans. Benin and Togo have not specified national electrification targets for 2020 but both countries specified 100% access by 2030.

Benin: national access increased to 32.6% if access to off-grid solutions is also considered.

Liberia: national access increased to 17.7% if access to off-grid solutions is also considered.

Countries that have increased the rate of access to their electricity grid compared to 2016 includes: Benin, Burkina Faso, Ghana, Guinea, Mali, Niger, Nigeria, Senegal and Togo. For the most part, these increases can be attributed to new connections to the national grid. In Ghana and Guinea, updated censuses with updated statistics on household energy access explains this increase. In Liberia, an official updated census confirmed the access rate.[14]

The access rate in terms of number of households reported by the national focal persons does not necessarily match the rate derived from only considering the number of residential customers reported by the national utilities. Table 2 presents this comparison.

Table 2: Share (%) of households connected to an electricity grid in 2017

Country	Column A Number of households	Column B Number of residential electricity customers	Share of households connected to electrical grid (%)	
			Official rate reported by country	Rate considering only number of residential customers reported by national utilities (Column B/column A) x 100
Benin	2,023,416	601,700	31.4%	29.7%
Burkina Faso	3,272,025	627,903	20.6%	19.2%
Cabo Verde	152,544	137,328	90.0%	90.0%

[14] Liberia Institute of Statistics & Geo-Information Services (2017); access in 2016 is assumed to be identical to official censuses in Liberia before 2016, which estimated access at around 4%.

Côte d'Ivoire	4,506,056	1,893,409	62.0%	42.0%
Gambia	254,077	164,659	47.0%	64.8%
Ghana	7,240,000	3,466,423	81.4%	47.9%
Guinea	1,668,907	300,403	29.0%	18.0%
Guinea-Bissau	257,143	49,651	26.7%	19.3%
Liberia	990,966	46,554	8.1%	4.7%
Mali	2,377,177	600,828	35.1%	25.3%
Niger	2,828,732	170,078	16.0%	6.0%
Nigeria	39,600,000	7,476,856	59.3%	18.9%
Senegal	1,814,197	1,197,226	67.9%	66.0%
Sierra Leone	1,321,678	150,000	17.8%	11.3%
Togo	1,470,400	366,749	38.1%	22.4%
Regional	**69,777,318**	**17,249,767**	**54,0%**	**24.7%**

Sources: national monitoring reports 2017, national statistics services and annual reports 2017 of the national utilities.

Notes:

The number of residential electricity customers includes connections to the national grid and mini-grids operated by the national utilities. When available it also includes the connections to CEMGs (as reported by private operators, donors, utilities or other stakeholders).

Using total number of residential customers to calculate access to the electrical grid in terms of households would not give the full picture of grid electricity access. Indeed it is inaccurate to use metered residential electricity customers to compute electrical grid access given that a single connection does not necessarily equate to an individual household. It is common practice in almost all of these countries for a single grid connection (connection in cascade) to serve two or more households. Moreover, in some cases known as compound houses more than one household lives in the same house but in different rooms. This discrepancy is more apparent in Côte d'Ivoire, Ghana and Nigeria. In Gambia the higher percentage of electricity access derived from the number of the National Water & Electric Company customers has not been officially confirmed yet by a national census.

3.1.3 Share of ECOWAS population served by clean energy mini-grids

In 2017, 186,804 rural households were connected to 327 operational CEMGs, with a total installed capacity of 37.95 MW. These numbers were generated from the best available data collected from the private operators and companies, donors, rural electrification authorities and other relevant energy institutions. Updated information on the existing CEMGs is provided on ECOWREX[15] (Figure 4). In addition, country highlights of 2017 are presented in Box 1.

Table 3 displays the number of existing and operational CEMGs in 2017; their installed capacity; the number of residential connections or estimated number of households with electricity access; and the estimated number of people with access to electricity through the CEMGs. Existing CEMGs in 2017 amounted to 443, falling far short of the regional target promoting 60,000 CEMGs by 2020. As this target seems to be unattainable, the region will need to make enormous progress in the coming years to drive the deployment of CEMGs for rural electrification, in order to the 2030 targets.

[15] ECOWAS Observatory for Renewable Energy and Energy Efficiency: www.ecowrex.org

Table 3: Existing and operational CEMGs in 2017

Country	Existing/installed CEMGs	Operational CEMGs	Installed capacity (MW-only operational CEMGs)	Column A Number of residential connections or households served by the operational CEMGs	Column B Estimated number of people served by operational CEMGs (Column A x average number of people per rural household)
Benin	67	6	0.15	174	957
Burkina Faso	18	17	1.39	2,706	21,236
Cabo Verde	7	7	0.33	355	1,250
Côte d'Ivoire	7	7	0.47	698	3,790
Gambia	1	1	0.06	n/a	21,746
Ghana	13	13	0.48	563	2,252
Guinea	3	3	3.62	23,364	163,553
Guinea-Bissau	2	2	0.7	1,069	9,580
Liberia	11	10	8.16	15,507	66,682
Mali	77	77	18.64	120,998	943,787
Niger	2	2	0.07	n/a	n/a
Nigeria	44	41	1.2	4,033	35,479
Senegal	131	131	2	16,420	148,142
Sierra Leone	56	6	0.075	n/a	n/a
Togo	4	4	0.6	917	4,127
Regional	**443**	**327**	**37.95**	**186,804**	**1,442,581**

Sources: national monitoring reports 2017; private operators; donors; rural electrification agencies and ECOWREX.
Notes:
The number of residential connections is based on the available number of connections provided by the private operators, donors and/or rural electrification agencies. The values in the table could be less than reality because they are based only on data available.
Gambia: value shown in Column B is based on 2013 census data. However, it is probably overstated as not all households in the community of Kauur are connected to the PV mini-grid system.
Ghana: operational capacity and connection values are less than reality because no information is available on the eight projects implemented by the company Black Star.
Guinea: values on connections are less than reality because reports were only supplied on connections to Tinkisso.
Nigeria: values for installed capacity and connections are based on available information and are probably understated because of a lack of information on all operational projects implemented by the private sector.

The number of operational CEMGs in 2016 in Senegal and Mali is remarkable compared to the other countries.[16] In 2017 Sierra Leone considerably increased its number of installed CEMGs due to the completion of phase one of the UK Department for International Development (DFID) Rural Electrification in Sierra Leone project. The first phase installed Solar Home Systems (SHS) in 54 clinical health centres in different communities in the country. In parallel, distribution grids were also installed in order to expand installed capacity to provide electricity to the rest of the consumers in each of these communities. In 2017 only four of the 54 CEMGs installed were operational. Benin continued with a high number of existing CEMGs compared to other countries. However only six projects implemented by the Programme Régional de Développement des Energies Renouvelables et de l'Efficacité Energétique (PRODERE) were operational while 61 renewable energy mini-grids installed by Projet de Valorisation de l'Énergie Solaire (PROVES), have yet to be put in service.

[16] ECREEE (2018).

In Nigeria, the number of operational CEMGs has increased considerably due to the combination of both private and donor funded projects.[17] The number of operational renewable energy mini-grids in the country is supposed to be higher but exact data is unavailable due to a lack of official data collection on activities implemented by the different private operators.[18] The remainder of the increase in the number of operational CEMGs in the region is explained by the implementation of private projects such as those in Ghana (eight CEMGs implemented by a company called Black Star) or donor-funded projects in Burkina Faso (EU), Liberia (EU) and Togo (PRODERE), for example.

Mali, Senegal, Guinea and Liberia have the highest numbers of operational installed capacity. For Mali and Senegal, this is explained by the higher number of CEMGs in operation. For Liberia, this is because the figures include the Firestone hybrid small hydropower power plant.[19] Similarly, in Guinea the diesel component in the Tinkisso hydropower mini-grid elevates total installed capacity shown.

Figures 2 and 3 present the number of CEMGs by technology and installed capacity by technology for the 327 CEMGs in operation. These consisted mainly of PV and PV-diesel, amounting to 115 and 172 respectively. Biodiesel-biogas and PV-biodiesel were the next most used technologies.

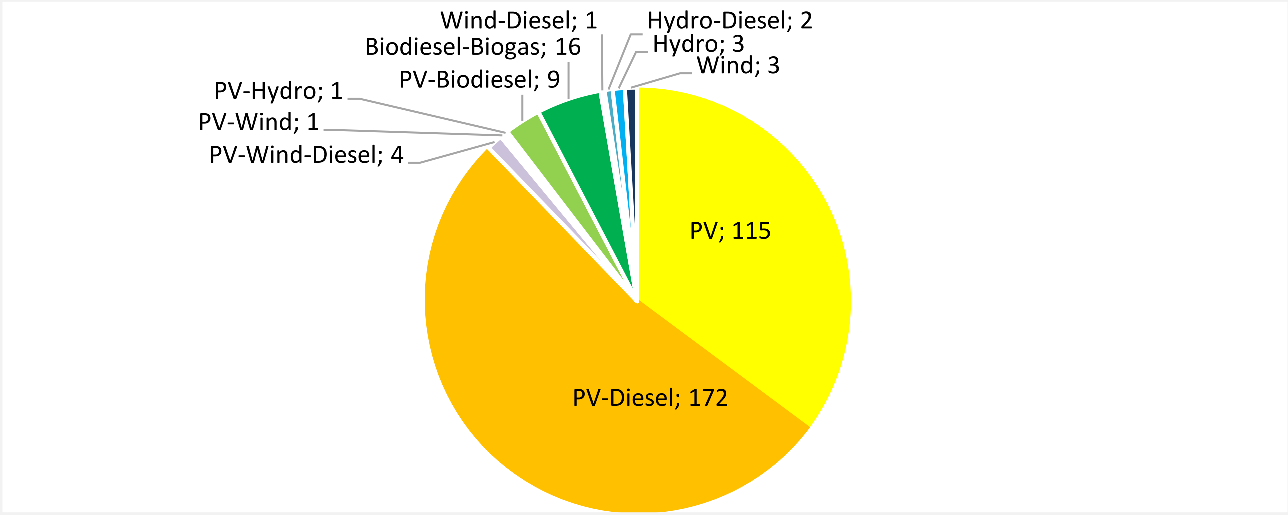


Figure 2. Number of CEMGs by technology in 2017

Source: national monitoring reports 2017, private operators, donors, rural electrification agencies and ECOWREX.

It is interesting to compare the previous graph with the installed capacity per technology. Figure 3 shows the main technologies as PV-diesel and hydropower-diesel CEMGs as far as installed capacity is concerned. PV-diesel and PV had the highest installed capacity because these types of renewable mini-grids were the most predominant in the region. Moreover, the installed capacity of the hybrid PV-diesel systems is higher due to the diesel capacity installed, which sometimes just works as a back-up system. The two operational hydropower-diesel CEMGs have the second largest installed capacity in terms of technology because both projects were planned to provide electricity to industrial activities and thousands of people.

[17] Different private companies have developed CEMGs under the favourable framework created by the Nigerian Rural Electrification Agency. In addition, donor-funded projects, such as the Nigerian Energy Support Program funded by Deutsche Gesellschaft für Internationale Zusammenarbeit (German International Agency for Co-operation) (GIZ), contributed to the increase in the number of operational CEMGs.

[18] Nigerian Economic Summit Group (2018); since 2010 the number of commercial developers has grown to at least nine active members in the Nigerian chapter of the Africa Mini-Grid Developers Association (AMDA).

[19] This power generation unit, which is isolated from the national grid, consists of a hydropower generator of 4,800 kilowatt-peak (kWp) and a diesel system of 3,000 kW. The plant provides electricity to approximately 60,000 people in the surrounding area.

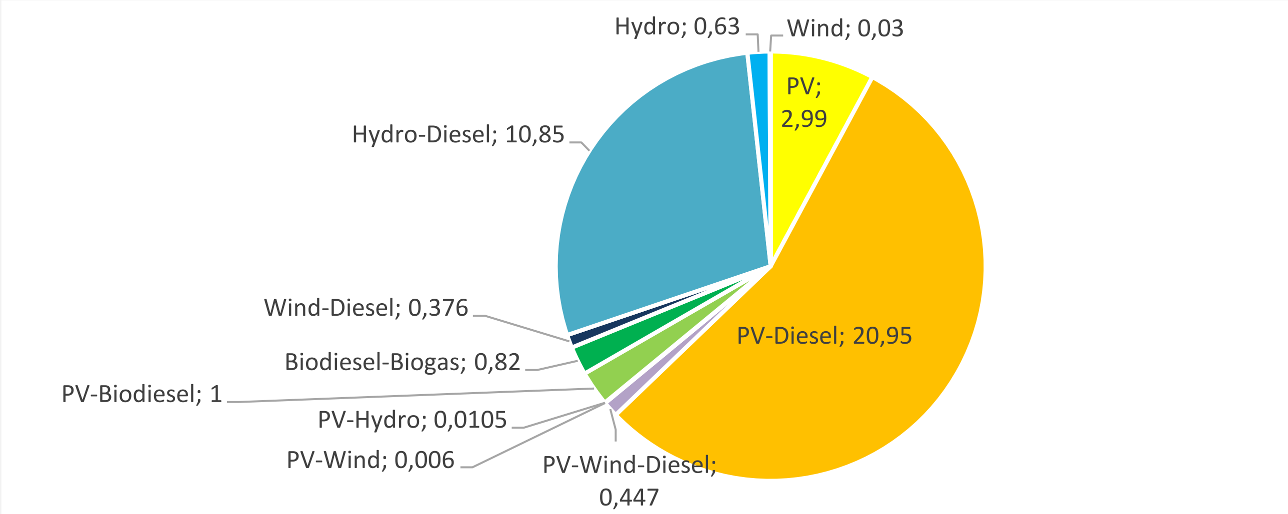


Figure 3. Installed capacity (megawatts) by technology of the operational CEMGs in 2017
Source: national monitoring reports 2017; private operators; donors; rural electrification agencies and ECOWREX.

Box 1: Country highlights on renewable energy mini-grids

Gambia
The Government of Gambia developed a feed in tariff model and an institutional and regulatory framework on green mini-grids with the support of AfDB. In addition, the Public Utilities Regulatory Authority (PURA) and Ministry of Energy designed a feed-in tariff regime for all technologies eligible under the country's Renewable Energy Act.

Guinea
The national grid's contribution to increasing energy access is limited. Therefore, the Government of Guinea launched a decentralised rural electrification project entitled Projet d'Électrification Rurale Décentralisée (PERD) under the framework of the development policy letter of the energy sector (Lettre de Politique de Développement du Secteur de l'Energie) (LPDSE[20]). This project had the financial support of the World Bank and the Global Environment Facility. It aims to electrify small rural villages out of reach of the national grid through micro-concessions granted to small private operators.

Mali
Different projects will expand the capacity of the current operational CEMGs and develop new installations as follows.
Projet Systemes Hybrides d'Electrification Rurale (SHER) aims to expand the current installed capacity of 4.8 megawatt-peak (MWp) of the existing and operational CEMGs served by solar installations. The goal is to expand the capacity with new projects in 50 villages before 2020.
Projet de Production Hybride et Access Rural a L'Electricité is organised into three components: hybridisation of currently isolated diesel plants; extension of existing operational mini-grids and establishment of new connections; reinforcement of the capacities of the Agence Malienne pour le Développement de l'Energie Domestique et l'Electrification Rurale (AMADER). The project aims to implement 60 hybrid diesel-solar CEMGs, install 3.6 MWp of solar capacity, build 840 kilometres of medium and low voltage network, and connect 22,000 new clients.
Rural electrification of 32 villages using hybrid diesel-solar CEMGS (PERSHY-32 project).[21]

[20] www.invest.gov.gn/document/lettre-de-politique-de-developpement-du-secteur-de-l-energie
[21] www.amader.gouv.ml/portfolio/lelectrification-rurale-par-systemes-hybrides-de-32-localites-rurales-du-mali-pershy-32/

Niger

A component of Niger Solar Electricity Access Project (NESAP), which is funded by the World Bank, is the hybridisation of 30 selected isolated diesel plants that provide electricity to rural communities. The aim is to install PV production capacity in order to reduce the operational costs. The locations were selected on the basis of distance from the national grid and residential connection costs. The number of locations selected per region of the country where they are located is as follows: seven in Agadez, five in Tahoua, five in Diffa, five in Tillabéry, four in Maradi and four in Zinder.

A feasibility study implemented by GOPA-International Energy Consultants started in 2017 and was due to be finalised by May 2018. During the feasibility study it was necessary to select 20 locations for detailed draft design and tender documents for procurements of works.

Nigeria

The World Bank is working with the Government of Nigeria to develop a five-year electrification project. This would be implemented by the Rural Electrification Agency and would require an estimated contribution of 350 million US dollars (USD). From this budget, USD 150 million will be allocated to about 1,200 mini-grids that are expected to serve 200,000 households and 50,000 local enterprises.

With an enabling environment, continued cost reductions and targeted finance, the Nigerian mini-grid market can scale up to over 10,000 sites by 2023, powering 14% of the population with capacity up to 3,000 MW. It would create an investment potential of nearly USD 20 billion and annual revenue opportunity exceeding USD 3 billion.

The country is also providing an enabling environment for off-grid market growth through the development of the mini-grid regulation by the Nigerian Electricity Regulatory Commission and the identification of several promising sites. This is based on public demand, population and energy density, and existence of productive uses of energy.

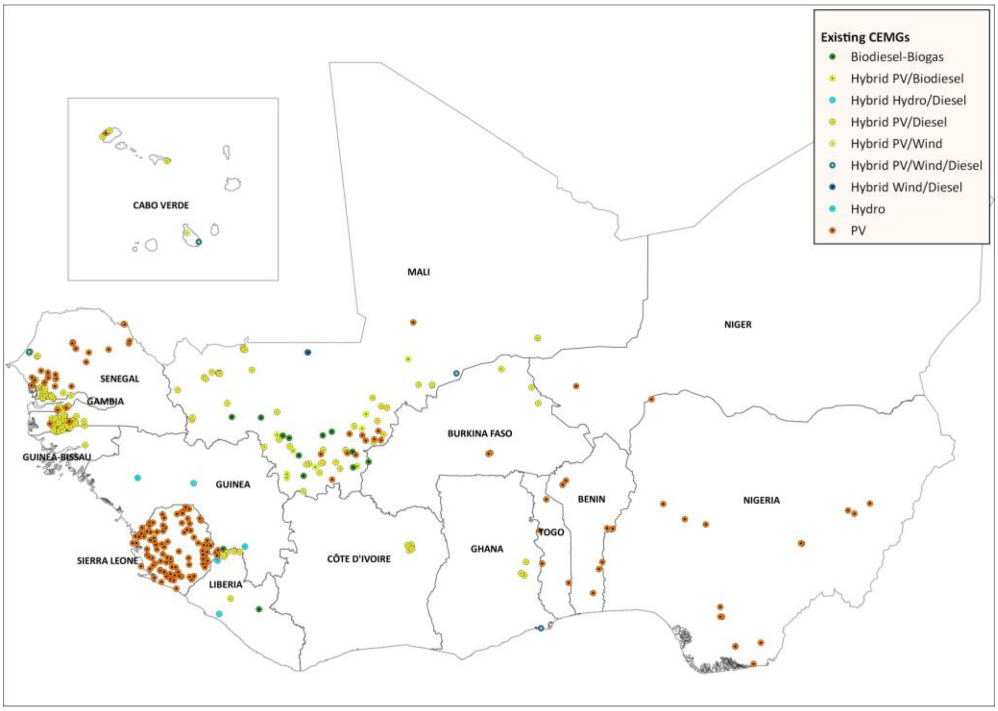


Figure 4: Existing CEMGs in the ECOWAS region in 2018

Source: ECOWREX

Notes:

The image shows existing CEMGs at the end of 2018 for which location is available.

3.1.4 Access to renewable energy stand-alone systems

Renewable energy stand-alone systems such as Solar Home Systems (SHS) are a significant way to provide rural populations with access to electricity services. Access to these systems has been provided through the market or programmes supported by governments and donors. For example, several SHS have been distributed in Benin, Guinea-Bissau, Mali, Burkina Faso, Côte d'Ivoire, Niger and Togo under the PRODERE framework.

Table 4 gives the share of households connected to renewable energy stand-alone systems.

Table 4: Number and share of households connected to stand-alone renewable energy systems in 2017

Country	Reported share of households with stand-alone renewable energy systems (%)	Estimated number of stand-alone renewable energy systems
Benin	1.44	220,600
Burkina Faso	n/a	232,220
Cabo Verde	0.02	n/a
Côte d'Ivoire	2.16	54,600
Gambia	n/a	580
Ghana	n/a	185,260
Guinea	n/a	n/a
Guinea-Bissau	1.8	3,130
Liberia	n/a	35,900
Mali	0.34	131,920
Niger	n/a	3,810
Nigeria	n/a	493,830

Senegal	8	132,970
Sierra Leone	n/a	61,940
Togo	n/a	7,470
Regional	**n/a**	**1, 564, 230**

Source: national monitoring reports 2017 (based on data provided by national directorates of energy, donors, rural electrification agencies, national statistical services, "Global Off-Grid Lighting Association (GOGLA) 2017" report and private operators)

In 2017 six countries reported the share of households with electricity access through stand-alone renewable energy systems. The lack of available information on the penetration rate shows there is no systematic way to collect relevant data and thus assess the share of access from these systems.

Senegal is noteworthy among the four countries that reported a penetration rate. In Senegal, the rural electrification concessionaires installed several SHS with financial support from Agence Senegalaise d'Electrification Rurale (Senegal Rural Electrification Agency, ASER). These systems are owned and maintained by the respective concessionaire. The user pays a fixed monthly service fee.

The estimated number of stand-alone renewable energy systems was based on available data and may over- or understate the real number. The estimation was the sum of the values provided by different sources such as relevant official institutions in charge of energy and national statistical services; regional and country programmes (PRODERE, GIZ Energizing Development Program); the Global Off-Grid Lighting Association (GOGLA) 2017 market report; and private operator and donor activities. In addition, the Foundation Rural Energy Services (FRES) reported 3,365 SHS customers in Burkina Faso with 240 KWp of total installed capacity, 2,041 in Guinea-Bissau with 262 KWp installed, and 6,314 in Mali with 859 KWp installed.[22]

The West African market for pico-PV products (<=10 Wp) and SHS (11-100 Wp) is nascent and volatile in complete contrast to the East African equivalent (Table 5). Many companies are using Pay-As-You-Go (PAYG) business models. Although these are widespread in eastern and southern Africa, they are new to West Africa. Such models allow users to make a down payment followed by regular payments over a given period (often using mobile money). These companies usually sell plug-and-play systems with small capacities. Several companies, such as Azuri, FRES, PEG Africa and Nova Lumos are using this model in West Africa.[23]

GOGLA and the World Bank's Lighting Global programme publish semi-annual market reports with sales data from major companies distributing pico-PV products (<=10 Wp) and SHS (11-100 Wp).[24] Table 5 presents the information collected in 2017.

Table 5. Pico PV and Solar Home Systems sold or distributed in 2017

Region/country	Products sold 2016 (units)	Products sold 2017 (units)	Cash sales revenue (USD millions) 2016	Cash sales revenue (USD millions) 2017
EAST AFRICA	**2,878,531**	**2,546,109**	**87**	**54**
WEST AFRICA	**717,019**	**722,949**	**16**	**14**
Benin	175,434	15,949	1.5	0.5
Burkina Faso	54,006	170,526	1	4

[22] https://www.fres.nl/

[23] The Global Off-Grid Solar Market Report, Semi-Annual Sales and Impact Data reports from GOGLA contain a list of the companies and distributors operating in the region and/or worldwide.

[24] The report from 2016 estimates that they captured 50% of the total pico-PV and SHS market. In 2017 they estimated that the data reported represented about 30% of all sales of pico-PV products and SHS. About 70 companies and distributors participated in the data collection.

Cabo Verde	n/a	n/a	n/a	n/a
Côte d'Ivoire	29,538	24,893	0.1	0.1
Gambia	576	n/a	n/a	n/a
Ghana	51,006	63,652	2	0.7
Guinea	n/a	n/a	n/a	n/a
Guinea-Bissau	n/a	n/a	n/a	n/a
Liberia	13,989	15,251	0.2	0.5
Mali	41,601	73,211	1	3
Niger	n/a	3,640	n/a	n/a
Nigeria	278,251	215,575	7	3
Senegal	47,582	85,386	1	0.8
Sierra Leone	24,240	33,471	0.4	0.4
Togo	296	4,588	n/a	0.1

Source: GOGLA 2017

The reports from 2017 shows that West Africa is moving forward with 722,949 units sold and over USD 14 million in revenue but this is still far from the market level in East Africa.[25] The West African market remains untapped and still subject to sales volume volatility due to relatively small fluctuations in sales patterns that do not reflect bigger market trends. For example, it saw a reported increase of 31% in sales volumes during the first half of 2017. This consisted of Burkina Faso and Senegal, the two countries with the highest increase in products sold. However, these countries experienced a 70% decrease in units sold in the second half of the year. Nigeria continued to be the country with more regularity in number of units sold. Ghana and Mali registered sales increases of about 40% in the second half of 2017. In the same period, Côte d'Ivoire and Sierra Leone appeared as two new rising markets.

Country highlights on stand-alone renewable energy systems are presented in Box 2.

Box 2: Country highlights on stand-alone renewable energy systems

Ghana

The country has set a target of deploying 50,000 SHS in a new programme under development. The private sector companies also have large plans and aim to deploy another 120,000 SHS (100,000 by Azuri and 20,000 by PEG) in the short term.

The Energy Commission and the regulatory agency have licensed 19 renewable energy companies to install and maintain renewable energy systems, the vast majority of which are active in SHS markets through direct sales as well as under the government programmes. The key private players in the SHS market are Azuri, Deng, Persistent Energy Ghana, Wilkins Engineering and Toyola Energy.

Nigeria

The Nigerian Energy Support Program (NESP) produced a preliminary rural electrification modelling plan for the Government of Nigeria that will enable the country to deliver electricity to almost three million people through SHS.

Togo

Different projects reported by Direction Générale de l'Énergie (General Energy Directorate) (DGE) provide access to electricity in 664 rural communities through SHS. Moreover, project CIZO, which was launched in

[25] GOGLA 2017

2017, aims to provide energy access to about 500,000 rural households by 2022. It has signed an agreement with the private companies BBOX and Greenlight Planet for delivery of the stand-alone solar systems.

Guinea, Liberia and Sierra Leone
By the end of 2017 the Energising Development (EnDev) programme for energy access implemented by GIZ had installed the following renewable energy systems:

Table 6: Stand-alone renewable energy systems installed by GIZ EnDev in Guinea, Liberia and Sierra Leone in 2017

Country	SHS installed in public institutions (clinics, schools)	SHS for productive uses (banks, businesses, charging centres, energy hubs, financial services, forest guard posts, guest houses, offices, radio stations)	Solar fridges in clinics and health centres	Solar pumps
Guinea	134	0	9	0
Liberia	427	3	25	0
Sierra Leone	308	209	1001	1
Source: GIZ EnDev				

3.1.5 Access to modern cooking energy

Access to modern cooking is assessed in terms of household penetration rates for modern fuel alternatives for cooking and ICS. These indicators show the living conditions prevailing in a typical household. Numbers of units sold and distributed are also presented for countries with data available. Although the volume of units sold may not necessarily align with the reported penetration rates, it provides an additional layer of information about the overall health of clean cooking market trends.

3.1.5.1 Share of ECOWAS households using modern fuel alternatives for cooking (*e.g.* LPG, biogas, solar cookers, kerosene, ethanol gel fuel)

Modern cooking fuel alternatives, such as LPG, are promoted as a cleaner and more efficient way to cook. The national monitoring reports provided the information from the latest censuses or surveys conducted by the national statistical offices. These analyses the household use of LPG, kerosene and electricity for cooking purposes. Table 7 displays census or survey results from the ECOWAS countries conducted in different years between 2008 and 2017.

Table 7: Share (%) of households using modern cooking solutions in ECOWAS countries

Country	LPG	Electricity	Kerosene	Census/survey year
Benin	5.0%	0.3%	2.8%	2013
Burkina Faso	1.3%	0.7%	0.1%	2014
Cabo Verde	76.5%	0.3%		2017
Côte d’Ivoire	22%			2014
Gambia	3.4%		0.6%	2013
Ghana	22.8%	0.5%	0.5%	2013
Guinea	0.8%	0.6%	0.5%	2014
Guinea-Bissau	5%			2011
Liberia	0.95%	0.9%	0.4%	2008
Mali	28.9%			2017
Niger	0.5%			2012

Nigeria	0.9%	0.2%	25%	2008
Senegal	43.5%			2014
Sierra Leone	0.8%	0.5%	0.7%	2015
Togo	2.76%	0.08%	0.37%	2010

Source: national statistical services
Notes:
The percentage was not disaggregated according to technology in Guinea-Bissau, Mali and Senegal.

The national censuses report that over the years wood and charcoal use has gradually shifted to LPG or a combination of LPG and traditional fuels. LPG was mainly used in urban areas. For instance in Cabo Verde the national statistics service reported that 90.7% of urban households used LPG compared to 43.9% in rural areas. This was probably identical to the other ECOWAS countries. In addition, some sources report an access rate of 2% in Niger. However, these refer to clean cooking solutions without specifying technology or including improved cookstoves. In Sierra Leone 0.1% of households were using solar cooking systems.

Country highlights on modern cooking solutions are presented in Box 3.

Box 3. Country highlights on modern cooking solutions

Burkina Faso
According to the Ministry of Energy, 10,307 biodigesters and 800 solar cooking systems were distributed in 2017.

Cabo Verde
The National Action Plan for domestic energy is undergoing an update. It will define the strategy to increase the use of LPG for cooking principally in rural zones. This document will take into consideration the ECOWAS strategies for LPG use.

Ghana
The sector ministry targeted 50% penetration of LPG by 2020 but this is unlikely to be achieved if there is no change to the limited number of distribution outlets nationwide. This target can, however, be achieved by implementing measures outlined in the Energy Sector Strategy and Development Plan, as well as the LPG Policy Paper, to support and accelerate the supply and use of LPG. These measures include government policy targeted at ensuring LPG produced is available for local consumption rather than export; removal of price distortions; and recapitalising Ghana Cylinder Manufacturing Company (GCMC) to expand production capacity concentrating on small-sized cylinders that would be portable and affordable to households in rural communities. The latter is in progress in 2019 and GCMC took delivery of new equipment expected to boost its daily production of 1,500 to almost 4,000 cylinders. The final measure is to construct LPG storage and supply infrastructure in all regional and district capitals in the long term.

Guinea
In 2017 less than 1% of households in 21 of the country's prefectures accessed cooking energy through 65 biodigesters.

The Lettre de Politique de Développement du Secteur de l'Energie[26] planned a 10% household penetration rate for LPG by 2017. However, no recent household survey is available to evaluate current status. In addition, a national programme funded by the United Nations Development Programme (UNDP) to build 2,000 biodigesters is under development for 2016-2019. Finally, a national LPG programme is envisaged

[26] www.invest.gov.gn/document/lettre-de-politique-de-developpement-du-secteur-de-l-energie

that is at the financing research phase. This will popularise gas stoves in the eight regional capitals and in Guinea's four mining cities.

Liberia
The Department of Energy of Liberia conducted a short survey of LPG distribution and estimated that over 10,000 LPG cylinders are currently in use in the capital, Monrovia.

Mali
Since 2009 the share of households using LPG for cooking has significantly improved. Between 2004 and 2016 AMADER distributed approximately 130,000 LPG stoves. In 2017 consumption of LPG was expected to amount to 15,625 tonnes though 18,264 tonnes were actually consumed. This amounted to 3,734 tonnes more than the 14,530 tonnees consumed in 2016. In addition, around 24,000 gas stoves were placed on the market in 2017.

3.1.5.2 Share of ECOWAS households using improved cookstoves

The penetration rates of ICS in the region ranged from 0.9% in Cabo Verde to 66.8% in Mali. Table 8 presents the penetration rate for all countries that reported information.

Table 8: Share of households with improved cookstoves in the ECOWAS countries

Country	Share (%)	year
Benin	10.7	2017
Burkina Faso	23.0	2016
Cabo Verde	0.9	2017
Guinea Bissau	2.0	2010
Mali	66.8	2017
Niger	2.0	2016
Senegal	13.5	2014

Source: national monitoring reports 2017 (based on the national statistical services, national directorates in charge of energy and national rural electrification agencies)

Clearly, the reference year was not the same in every country. In Niger, access to clean cooking solutions appears as 2% but technology is not specified. Cabo Verde has the lowest value because most households use LPG for cooking. At regional level, most countries did not report the penetration rate of improved cookstoves. A possible reason is that, unlike LPG, ICS was not generally included as an indicator in national surveys on household living conditions carried out periodically by the national statistical services.

EREP, the ECOWAS renewable energy policy, includes a ban on inefficient cookstoves from 2020. It targets the use of wood and charcoal cookstoves with minimum efficiency at the high rate of 35%. A Non-governmental organisation (NGO) - the Clean Cooking Alliance, gives ICS with an efficiency equal to or greater than 35% a Tier 3 classification (Table 9). This means the fuel or cookstove efficiency level makes a positive environmental impact.[27] However, many ECOWAS countries do not have testing facilities for imported or even locally manufactured cookstoves. As no raw data was available, it was not possible to confirm whether countries reporting improved cookstove penetration rates only include ICS operating above the efficiency threshold. In order to improve the data inadequacies, information from supplementary sources on ICS initiatives is provided. This to some degree permits quantitative analysis of the ICS market (Box 4).

[27] http://cleancookstoves.org/technology-and-fuels/standards/defining-clean-and-efficient.html

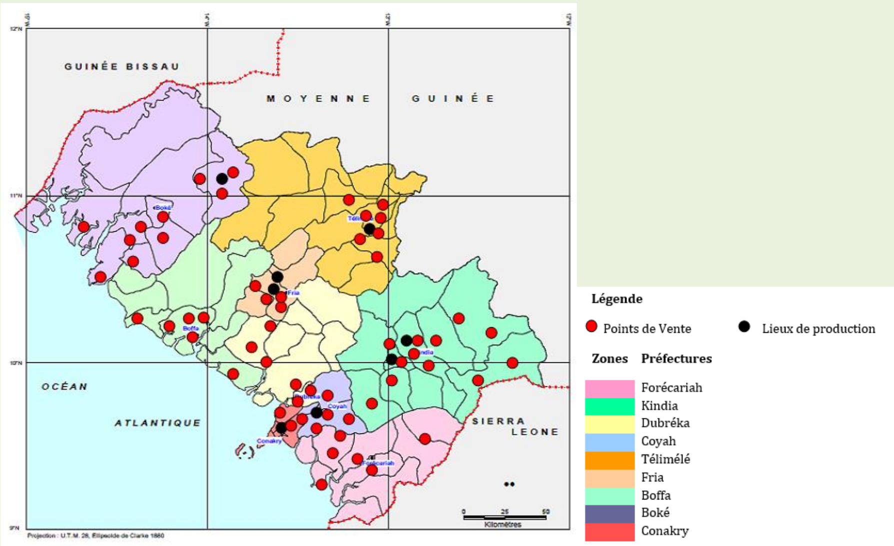
Table 9: Improved cookstove efficiency/fuel use classification tiers

Efficiency/fuel use classification tiers		
	High power thermal efficiency (%)	Low power specific consumption (MJ/min/l)*
Tier 0	<15	>0.050
Tier 1	≥15	≤0.050
Tier 2	≥25	≤0.039
Tier 3	≥35	≤0.028
Tier 4	≥45	≤0.017

Source: Clean Cooking Alliance (CleanCookStoves.org)
**minimum megajoules per litre*

Box 4. Country highlights on improved cookstoves

Guinea
About 245,000 units have been distributed up until 2017, as follows: 72,000 ICS were distributed in 1992-1996 under a national ICS programme. This also distributed 100 large ICS called WAKAN destined for social canteens. In 2001-2004, 165,000 ICS were distributed within a scheme called Programme d'Appui National pour l'Economie du Bois Energie (national support programme for saving fuelwood) (PANEB 1). ICS producer co-operatives continued to manufacture units but no data was collected once this programme had ended. Finally, the NGO Coopération Atlantique Guinée 44 had distributed 8,991 improved wood stoves by May 2017, and more than 6,309 households are equipped with these types of ICS.
A new PANEB programme is planned to produce ICS for both households and the informal sector. These ICS are to be distributed in the country's 33 urban communes.



Outlets and production locations of improved wood stoves (Coopération Atlantique Guinée 44)

Mali
94,014 ICS were distributed in 2017, which compares to a forecast of 100,000 each year.

Liberia, Sierra Leone
A significant number of ICS were distributed under the GIZ Energizing Development (EnDev) programme. Indeed, 2,186 ICS were distributed in Liberia, and 7,600 in Sierra Leone. Most of the ICS distributed in Liberia were delivered in Montserrado county, where most stove producers and retailers are based. In addition, private retailers had distributed 11,600 ICS in Liberia by 2017. For instance, the company Empowerment

Society Intl, Sjedi reports it has distributed 8,000 units. The private sector in Liberia has called for a new subsidy to decrease duty and tax on imports of renewable products such as cookstoves[28] will enable the distribution of another 18,000 ICS between 2018 and 2019.

Nigeria
In Nigeria 7,000 ICS had been distributed by 2017.[29] The Nigerian Alliance for Clean Cookstoves, an NGO, aims to install 10 million stoves within ten years through a co-ordinated effort between partner organisations. In Nigeria, the arid north is the region most dependent on fuelwood. This area could provide a good pilot for efficient woodstoves while the southwest could be a good place for interventions aiming to displace kerosene with LPG.
The GIZ NESP programme also helped local stove manufacturers to provide 100 agroprocessor groups with access to ICS.

3.2 Renewable energy

3.2.1 Installed capacity

Table 10 presents the total on-grid installed capacity and the installed on-grid renewable energy capacity in 2017 in the ECOWAS region. The table also shows the planned on-grid renewable energy capacity that could be commissioned before the end of 2020 (projects that are under construction or funding has been approved, or an official tender process has already started). Details on the renewable energy plants connected to the grid in 2017, as well as the renewable energy plants included in capacity planned by 2020, are presented in Annex 1 and 2.

Table 10: On-grid installed electricity capacity (MW) in the ECOWAS region, 2017

Country	Total installed capacity (MW)	Installed renewable energy capacity (including large and medium hydropower) (MW)	Installed renewable energy capacity (excluding large and medium hydropower) (MW)	Planned renewable energy capacity (including large and medium hydropower) (MW) by 2020	Planned renewable energy capacity (excluding large and medium hydropower) (MW) by 2020
Benin	220,5	2	2	n/a	n/a
Burkina Faso	355	68	68.1	60.8	60.8
Cabo Verde	172.5	33.3	33.3	15	15
Côte d'Ivoire	2,199	824	55	138	71
Gambia	139	1.05	1.05	n/a	n/a
Ghana	4,399	1,615	35.1	20	20
Guinea	617.2	368	53.2	450	n/a
Guinea-Bissau	17.1	0	0	20	20
Liberia	126	88	0	n/a	n/a
Mali	672.4	319.2	8.9	363	223
Niger	107.7	0	0	237	106
Nigeria	12,310	1,941	31.4	n/a	n/a

[28] Duty and tax amount to more than 35% of the ICS price in Liberia.
[29] http://cleancookstoves.org/resources_files/nigeria-market-assessment-mapping.pdf

Senegal	928	102	102	346.7	218.7
Sierra Leone	125.9	76	25.6	n/a	n/a
Togo	229.7	66.6	1.6	24.2	24.2
Regional	**22,619**	**5,504**	**417.3**	**1,675**	**759**
Renewable energy share in 2017 (%)		**24.3%**	**1.8%**		
Renewable energy share – target 2020 (%)		**35%**	**10%**		

Source: national monitoring reports 2017 (based on the 2017 utility and electricity regulator reports and data provided by national directorates of energy), ECOWREX and EREP.

The total installed capacity in the region was 22,619 MW. Renewable energy capacity accounts for 24.3% (5,504 MW) of total capacity. Of the 5,504 MW renewable energy capacity, 5,084 MW (92.4%) is provided by medium and large hydropower plants.[30] The remaining 417 MW is split between small and mini- hydropower (194 MW, of which 2.21 MW is mini-hydropower); PV (180 MW); wind energy (27 MW); and bioenergy (16 MW). The aim is to increase the renewable energy share of the regional electricity mix to 35% by 2020 including medium and large hydropower, and 10% excluding medium and large hydropower.

ECOWAS countries will need to make more effort in the next three years to commission new renewable energy plants of small hydropower, PV, wind and bioenergy to achieve the 10% target. Some medium and large hydropower projects under construction in Côte d'Ivoire and Guinea will increase the share in the coming years and will help to achieve the 2020 target if commissioned before 2020. However, in some cases like EREP's objectives in small hydropower (787 MW of installed capacity by 2020) seems to be unachievable considering that installed capacity was 194 MW in 2017 and no more than 30 MW is the cumulative planned installed capacity by 2020.

Figure 5 shows the on-grid installed renewable energy capacity by source excluding medium and large hydropower in 2016 and 2017.

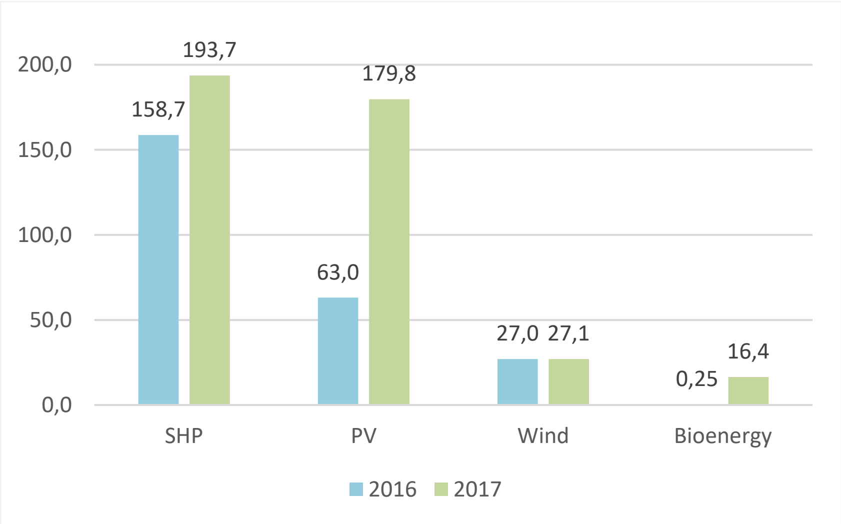


Figure 5: Installed renewable energy capacity in MW (excluding medium and large hydropower)
Source: national monitoring reports 2017 (based on the 2017 utility and electricity regulator reports), EREP and ECOWREX
SHP = small hydropower

[30] Definitions in the ECOWAS Small Scale Hydro Power Program show medium-sized hydropower at 30-100 MW. Large hydropower starts at 100 MW while small hydropower plants have an installed capacity of 1-30 MW.

The increase in installed small hydropower capacity is explained by the inclusion of the Ayame2 plant (30 MW) in Côte d'Ivoire[31] the commissioned Bhanka Soka project (2 MW) in Sierra Leone and 4 MW of small hydropower installed at Bui large hydropower plant in Ghana, used mainly by the Bui facility.

There was a significant increase in on-grid installed PV capacity. Capacity has almost tripled from 63 MW in 2016 to 179.8 MW in 2017. This increase is explained by the PV plants commissioned in Senegal (60 MW) and Burkina Faso (34.2 MW). Moreover, 9MW of solar capacity at the Bokhol plant in Senegal became operational in 2017. Reported distributed solar PV capacity in Ghana (8.5 MW) and Mali (3.2 MW) account for the rest of the on-grid installed solar capacity. This trend will continue in the next few years as some projects are under development or construction in Mali or Burkina Faso, for example (see Box 5).

Bioenergy projects connected to the grid really took off in 2017. Indeed, the region passed from almost zero installed capacity in 2016 to 16.4 MW in 2017. This is explained by resumed operations at SunBird Bioenergy plant in Sierra Leone (15 MW) and an increase in installed capacity at FasoBiogaz plant in Burkina Faso (1.4 MW).

Installed wind capacity remained almost the same at 27 MW from 2016 to 2017. Cabo Verde had the highest installed capacity (26 MW). A minor increase is due to the inclusion of a 150 KW project at Batokunku in Gambia.

The difference between installed and available capacity was significant in some countries. For instance, in Nigeria the operational capacity amounted to 7,390 MW out of 12,310 MW installed. The Nigerian Electricity Regulatory Commission announced a combination of factors as possible causes. They include inadequate gas supply, transmission bottlenecks and limited distribution networks. In addition, approximately 51% of the available capacity in Nigeria ceased to be operational in the third quarter of 2017, due to inadequate gas supply and limitations in transmission and distribution networks.

Box 5. Country highlights on installed renewable energy capacity

Burkina Faso

2017 was a remarkable year because solar energy contributed for the first time to the installed on-grid capacity and production when Zagtouli (33.7 MW) and Ziga (1.1 MW) were both commissioned.

Moreover, the country received funding from the World Bank for the construction of two 20 MW solar plants in the village of Koudougou and a 10 MW solar plant in Kaya. The tender documents prepared by the national utility SONABEL and the Ministry of Energy were finalised in November 2017.

Research for funding continued for the hydropower dam of Bagré-Aval. The EU has shown interest in the project and has evaluated the economic profitability of the project.

Cabo Verde

A Power Purchase Agreement was under negotiation for a 10 MW independent power producer (IPP) PV plant in Santiago that may be commissioned by the end of 2019.

The Master Plan of the Energy Sector included an intention to launch in 2018 two more IPP competitive tenders for a 10 MW wind park in Santiago and a 5 MW solar plant in Boa Vista.

In 2017 legislation on microgeneration was also modified but this needed to be approved. The modifications made would enable the creation of a dynamic and better regulated market.

Côte d'Ivoire

The following on-grid renewable energy plants were under construction: Korhogo PV (25 MW) in Binguebougou to be commissioned by 2019; the Aboisso biomass (46 MW) project.

[31] Ayame 2 was not included in the regional progress report 2016.

Moreover, two feasibility studies were in progress for two solar plants with a combined capacity of 30 MW. Negotiations were also taking place for a 66 MW PV in Korhogo and 25 MW PV in Tchologo. A competition bidding process was also running for the construction of a 25 MW biomass cotton project in Boundiali. A similar process to select the company to construct a 20 MW biomass cocoa project in Gagnoa was completed.

In the context of the ENERGOS 2 project, the EU financed feasibility studies and tender documents for eight small hydropower projects with a combined capacity of 43.5 MW. The same project will finance feasibility studies and tender documents for different solar projects in the north and west of the country.

Ghana

Numerous Provisional Wholesale Electricity Supply Licences were issued to potential IPPs proposing to develop around 6,698 MW of electricity in total from various renewable energy sources. Of these licences, 75 have been issued for PV generation with a total capacity of about 4,243 MW. About 35 licensees have moved to the Siting Permit stage of the licensing process for which 29 are solar PV. However, only eight companies have received construction permits to develop a solar PV project.
A construction permit was also issued for a 225 MW wind project.

Guinea Bissau

The first on-grid renewable energy plant to be commissioned is the 20 MW PV plant at Bor. The project is promoted by the African Biofuel & Renewable Energy Company (SABER-ABREC) and will be the biggest grid-connected PV plant in the country. The plant will be financed by the West African Development Bank (BOAD) and, according to the schedule, construction was due to start at the end of 2018. The plant is due to be commissioned by 2020.

Mali

The following PV plants were under development or construction: Kati (65 MW), Kita (50 MW), Sikasso (50 MW), Segou (33 MW) and Koutiala (25 MW).

Niger

A national programme plans to install 100 MW of solar energy by 2021. In this context and with support from the Indian government the country moved on to construct the first PV plant in Malbaza with a capacity of 7 MW to be commissioned in 2018. Under this national programme three plants are also considered in Dosso (10 MW), Maradi (20 MW) and Niamey-Gorou Banda (30 MW), as well as the Agadez hybrid diesel-solar project (19 MW). The 20 MW Gorou-Banda solar project funded by the EU and the Agence Française de Développement (French Development Agency) will complete the 100 MW solar target in Niger.
The 19 MW Agadez hybrid diesel-solar plant was budgeted at 32 million Euros and will be financed by the EU (50% grant) and French Development Agency (50% loan). The 20 MW solar plant at Gorou-Banda in Niamey is estimated at 26.3 million Euros (EUR), and the finance was approved by AfDB in 2017. Consultants NODALIS Conseils-CAPSIM-IDESUN elaborated feasibility studies and tender documents for an Engineering Procurement Construction (EPC) competition process. In 2017 two processes were launched: the Environmental Impact Assessment and the process for recruiting the EPC company.

Senegal

60 MW of on-grid solar capacity was commissioned (30 MW at the Ten Merina plant and 30 MW at Santhiou Mékhé).

Sierra Leone

In 2017, Bankasoka Hydropower Dam was commissioned in Port Loko town. The Bankasoka (2 MW), Charlotte (2 MW) and Makali (120 KW) plants were jointly constructed by the Government of Sierra Leone and the Government of China in partnership with United Nations Industrial Development Organization

(UNIDO). In addition, the parliament of Sierra Leone approved "Bumunba II", an extension of Bumbuna (50 MW), to add a further 143 MW of power capacity.

3.2.2 Renewable energy generation

Table 11 displays total on-grid electricity generation and renewable energy generation by country.

Table 11: Total on-grid energy generation and renewable generation (MWh) in the ECOWAS region in 2017

Country	Total generation MWh	Renewable energy generation (including large and medium hydropower) MWh	Renewable energy generation (excluding large and medium hydropower) MWh
Benin	227,528	1,215	1,215
Burkina Faso	1,096,038	138,136	138,136
Cabo Verde	490,945	82,951	82,951
Côte d'Ivoire	9,941,000	3,480,000	222,000
Gambia	313,709	33	33
Ghana	14,069,000	5,644,000	28,000
Guinea	2,587,730	1,212,055	187,874
Guinea-Bissau	90,507	0	0
Liberia	133,442	109,900	0
Mali	2,081,400	809,044	38,886
Niger	299,973	0	0
Nigeria	31,294,886	7,612,736	n/a
Senegal	3,566,621	82,744	82,744
Sierra Leone	300,000	n/a	n/a
Togo	893,680	208,845	4,295
Regional	**67,386,459**	**19,381,659**	**786,134**
Share of renewable energy generation		**28.8%**	**2.2 %**

Source: national monitoring reports 2017 (based on the 2017 utility and electricity regulator reports)

Notes:

The share of renewable energy generation (excluding large and medium hydropower) is based on the weighted average of the countries for which information was available.

At regional level, renewable energy generation including large and medium hydropower comprised approximately 28.8% or 19.4 million MWh of total generation. Renewable energy excluding large and medium hydropower accounted for approximately 2.2% or 786,134 MWh of total generation.

3.2.3 Solar water heaters

Solar water heating to meet domestic, commercial and industrial requirements is one of the most important tools for mitigating electricity demand in West Africa. Despite high demand for heat and the presence of abundant solar resources, SWH use for this purpose is still extremely low in ECOWAS countries. This is abundantly clear from the limited information on SWH penetration in the national monitoring reports (Table 12).

Table 12. Number of existing and/or installed SWH in 2017

Country	Number of SWH in households	Number of SWH in public Institutions	Number of SWH in SMEs*, hotels and industries
Burkina Faso	n/a	181	n/a
Cabo Verde		981	
Liberia	n/a	n/a	45
Mali	n/a	17	n/a
Nigeria	n/a	68 (installed)	n/a
Senegal	n/a	200	n/a

Source: national monitoring reports 2017
SME = small and medium-sized enterprises*
Notes:
In Mali, the Achievements, Challenges and Opportunities report published in 2012[32]compiled by AfDB with support from the National Directorate of Energy under the Scaling-Up Renewable Energy Program in Low Income Counties framework (SREP) stated that more than 1,500 SWH systems had been installed in different facilities including hotels, hospitals and homes.

ECREEE created market studies for five ECOWAS countries in 2015 to evaluate the market for heating and drying agricultural products using solar thermal water technology.[33] Table 13 presents the main results on installed capacity in 2015.

Table 13. SWH catchment area and installed capacity, 2015

Country	Catchment area (m^2)				Capacity (KWthm*)			
	Total	Residential sector	Public institutions	Hotels, SMEs and industry	Total	Residential sector	Public institutions	Hotels, SMEs and industry
Cabo Verde	1,183	n/a	n/a	n/a	828	n/a	n/a	n/a
Burkina Faso	1,070	557.8	200	342.1	n/a	n/a	n/a	n/a
Ghana	1037	86.4	4.1	946.6	725.9	60.4	2.8	662.6
Nigeria	200	n/a	n/a	n/a	140	n/a	n/a	n/a
Senegal	1,611	n/a	n/a	n/a	1,127.7	n/a	n/a	n/a

Source: ECREEE 2016
**kilowatt-therm*

In some countries, limited but significant action and projects have taken place to set the pace for future developments in the SWH sector. Both types of information are presented in Box 6.

Box 6. Country highlights on solar water heaters

Cabo Verde
The National Direction of Industry, Commerce and Energy is to develop a strategic document setting a favourable framework for expanding SWH. The study will produce a new analysis of the market and its potential.

[32] Direction Nationale de l'Energie du Mali (2011).
[33] www.ecreee.org/page/soltrain-west-africa-ecowas-solar-thermal-capacity-building-and-demonstration-program

Gambia

The Renewable Energy Action Plan states that 15% of SMEs, hotels and industry, as well as 8% of public institutions, installed SWH systems in 2013. However, official sources from the Ministry of Energy in 2017 reported a lack of national inventory allowing them to update the market analysis.

Nigeria

The GIZ Nigeria Energy Support Program through the Solar Water Heater Pilot Project installed 68 units with a total collector area of 212 m^2 and annual solar production of 171,373 kilowatt-hours. A grant to a secondary boarding school in Plateau State funded these systems. The SWH provides more than 1,000 students and staff with access to hot water. The project will help to show the technical viability of SWH in schools and improve living conditions for students and staff. Training in SWH installation as well as maintenance was also provided.

SWH installation at the Government Science Secondary School (GSSS) in Kuru, Nigeria

3.2.4 Bioethanol production

Table 14 presents bioethanol and biodiesel production in 2017. Countries not appearing in the table reported no available data, except Benin, Cabo Verde, Côte d'Ivoire and Guinea who reported zero production.

Table 14: Bioethanol and biodiesel production

Country	Bioethanol production (litres)	Biodiesel production (litres)
Liberia	n/a	8,701
Mali	15,000,000	816,630
Niger	n/a	27,360
Senegal	500,000	n/a
Sierra Leone	4,000,000	n/a

Source: national monitoring reports 2017 (based on information provided by the national directorates in charge of energy, Mali's national agency for biofuels development, and private operators)

In Mali, production of bioethanol decreased by ten million litres due to the slowdown in production at the Nsukala plant, which is a sugar plantation and refinery in Segou. In Sierra Leone, the Makeni bioethanol refinery[34] has an annual production capacity of 85 million litres. It uses sugarcane as primary source and cassava as a secondary source, and exports all the bioethanol it produces. Production ceased in 2016 due to the continuing effects of the ebola crisis. However, operations resumed in March 2017. In Senegal, the sugar company Compagnie Sucrière Sénégalaise provided the data on ethanol production. Production capacity is half a million litres per year, of which 200,000 litres are for internal use. The oilseed sector is not yet at the biodiesel production stage apart from one small-scale unit and another demonstration project. The sector is

[34] www.sunbirdbioenergy.com/projects/sierra-leone-makeni/

limited to vegetable oil derived from plant species other than jatropha. Private developers produce castor and sunflower biofuels. However, production remains low and is not intended for the energy sector because the market is underdeveloped.

3.3 Energy efficiency

Energy efficiency is an integral part of regional and national energy policies. Energy efficiency measures aim to free up 2,000 MW of power generation capacity, hence reducing the need for further power generation investments and avoiding the negative environmental impact of current energy practices. In each country's NEEAP, clear energy efficiency goals have been set in accordance with regional targets to promote a viable environment and hold member states accountable. The following section thus provides information available on the status of energy efficiency indicators, measures and actions in the region. These concern the following issues: electricity distribution losses, energy-efficient lighting, energy-efficient refrigerators, energy-efficient air conditioning, energy-efficient buildings and energy efficiency in the industrial sector.

3.3.1 Commercial, technical and total distribution losses in the region

Utilities employ different measures to reduce electricity losses at both technical and commercial level. However, in most cases, losses remain high, putting utilities under considerable financial strain. Technical losses stem from inefficiencies in transformers and links in distribution cables. Non-technical losses include illegal connections (bypassing meters and manipulating connection lines), the malfunction or absence of meters,[35] [36] and low collection rates.

Country reports and information provided by the utilities show that 39.5% of the electricity produced (26,611 GWh) was lost in the ECOWAS region in 2017 while 12.9% (2,554 GWh) was the regional weighted percentage of non-technical losses. This is calculated from the seven countries that reported non-technical losses (Figure 6). Hence the actual percentage is likely to be larger. It could be quantified if the countries that reported aggregated losses differentiated between technical and non-technical losses.

[35] GIZ (2017).

[36] According to the Nigerian Electricity Regulatory Commission (NERC), only 3.5 million of the 7.5 million customers in Nigeria are metered.

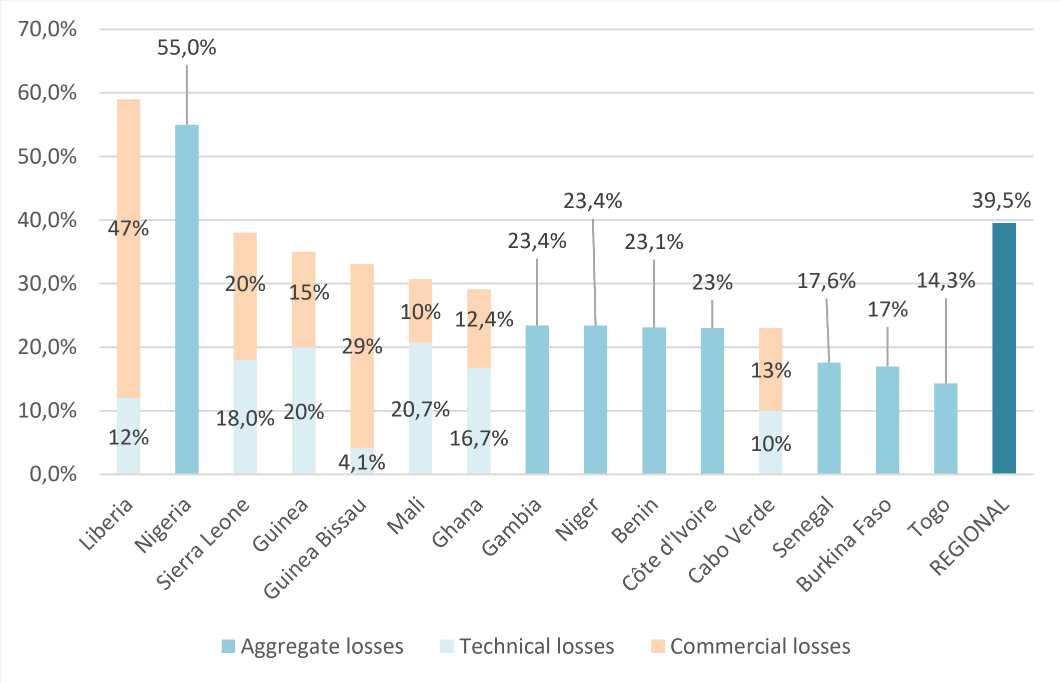


Figure 6. Electricity losses in the ECOWAS region in 2017
Source: national monitoring reports 2017 (based on information provided by the 2017 national utility and electricity regulator reports and the national directorates of energy)

This report aims to monitor the technical and non-technical losses in the electricity distribution system. However, this has not been possible for each country as utilities in eight countries did not disaggregate the losses by type but reported the aggregated percentage instead. In Burkina Faso, Côte d'Ivoire, Niger and Senegal the utilities differentiated the losses occurring at transport and distribution level.[37] However, values are presented in aggregate with no distinction between technical and non-technical losses. In Burkina Faso total losses at distribution level (including non-technical and technical losses) amounted to 14.49% while 2.49% of losses were reported to have occurred between production and transport. Similarly, Côte d'Ivoire, Niger and Senegal reported total losses at distribution level at 15.3%, 12.5% and 16% respectively. None of these countries differentiated between non-technical and technical losses. Losses at transport level amounted to 7.7%, 10.9% and 1.6% respectively.

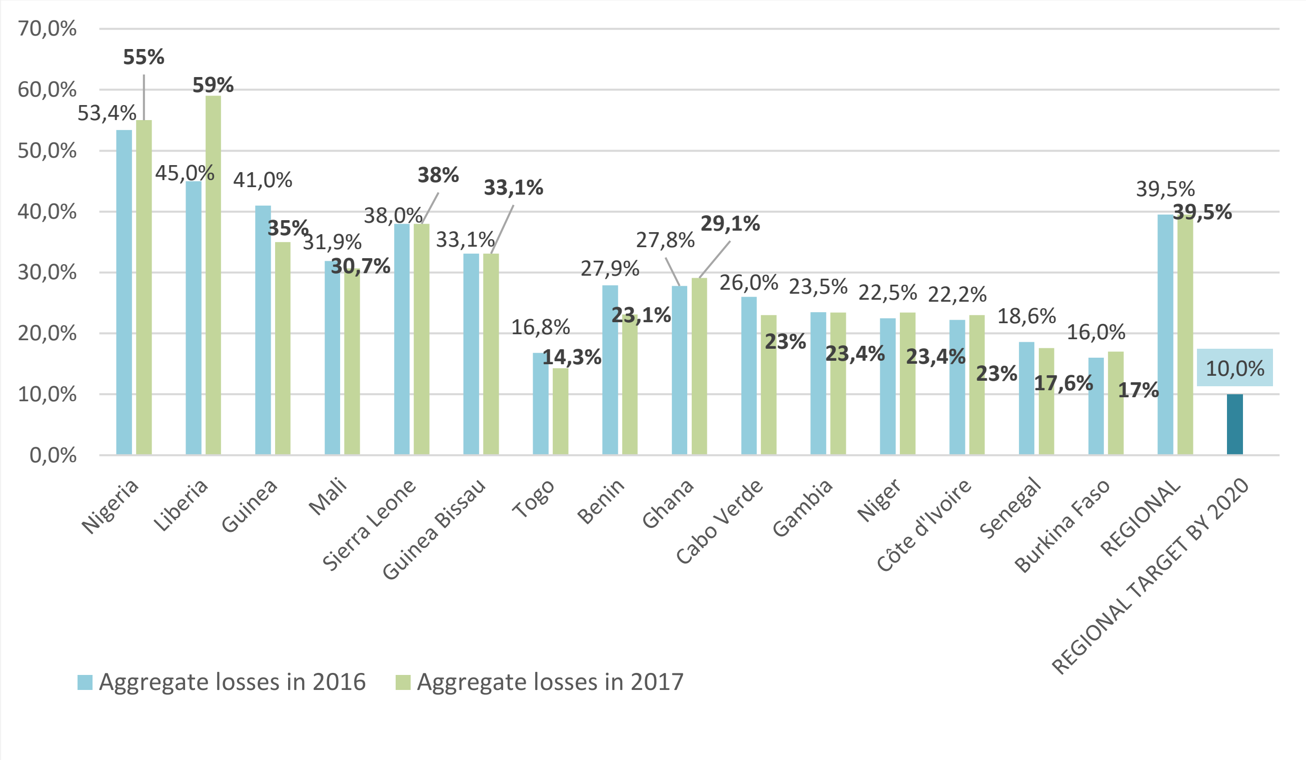
Information provided by seven countries separated technical from non-technical losses. Ghana and Liberia further disaggregated the percentage of technical losses, further providing information on losses occurring during transmission and distribution. In Ghana, technical losses at distribution level amounted to 12.6% while technical losses at transmission level amounted to 4.1%. The comparable figures for Liberia were 8% and 4% respectively.

Liberia and Nigeria stand out as the countries with the highest electricity losses, which amount to more than half the electricity produced. The regional weighted percentage of 12.9% for non-technical losses would increase considerably if Nigeria separated information on technical and non-technical distribution losses.

Figure 7 compares the aggregated losses in 2016 and 2017.

[37] Losses at transport level occur between production units and transport to the transmission grid and are all technical losses. Losses at distribution level occur between distribution grid and consumers. These are considered technical or non-technical (commercial) losses.

Figure 7. Aggregated electricity losses, 2016 and 2017



Source: national monitoring reports 2016 and 2017 (based on information provided by the 2017 and 2016 national utility and electricity regulator reports and the national directorates of energy), EEEP.

Some increases are observed in Nigeria, Burkina Faso, Côte d'Ivoire, Niger and Ghana. Liberia, a country with 47% of non-technical losses, shows a remarkable increase. Three countries observed no change, including Sierra Leone, Guinea-Bissau and Gambia. Decreases are observed in Guinea, Mali, Benin, Cabo Verde, Togo and Senegal. If this is a trend it will be confirmed in the next few years.

No clear regional trend is visible on electricity losses. For example, technical losses in Burkina Faso and Ghana have remained the same in 2012-2016 while Gambia and Côte d'Ivoire have seen a reduction in technical losses by 4-5% over the same period. The national variations did not reduce the regional losses, which continued at 39.5% – still far from the regional target of 10% by 2020.

In Mali, the national utility, Energie du Mali SA (EDM-SA), reported that the global performance of the distribution system increased by 1.2%. In Togo, the Autorité de Réglementation du Secteur de l'Electricité (ARSE) similarly reported an improvement of 2.04% in the overall performance of the system.

The degree of network losses may correlate with the initiatives undertaken by the utilities as well as government action to fight energy fraud and limit the percentage of losses allowed to energy producers and distributors. The introduction (or increased use) of prepaid meters and better distribution networks has been the main source of improvement.

3.3.2 Energy-efficient lighting

This report aims to monitor at country level the penetration rate of efficient lighting for both private and public purposes. However, a regional assessment of efficient lighting penetration rates in 2017 was not possible. In general, countries reported on the total existing number of efficient lights (Table 15) but with the exception of Burkina Faso, Mali and Togo were unable to calculate the penetration rates.

Table 15. Existing number of efficient lights in the ECOWAS region, 2017

Country	Number of efficient lights	Number of efficient public lights	Number of solar street lights	Penetration rate efficient lamps (%)	Penetration rate efficient public lighting (%)
Benin	832,440	35,800	16,760	n/a	n/a
Burkina Faso	n/a	34,570	1,920	5	18
Cabo Verde	n/a	n/a	n/a	n/a	n/a
Cote d’Ivoire	4,463,370	n/a	116,940	n/a	n/a
Gambia	n/a	n/a	n/a	n/a	n/a
Ghana	n/a	n/a	n/a	n/a	n/a
Guinea	1,183,900	4,420	31,510	n/a	n/a
Guinea Bissau	n/a	34,630	1,480	n/a	n/a
Liberia	n/a	2,000	n/a	n/a	n/a
Mali	2,065,650	8,000	8,390	18,1	22,2
Niger	37,320	n/a	1,540	n/a	n/a
Nigeria	n/a	n/a	20,000	n/a	n/a
Senegal	n/a	38,620	1,840	n/a	n/a
Sierra Leone	n/a	n/a	8,470	n/a	n/a
Togo	420,320	n/a	13,540	n/a	38,2
Regional	**9,003,500**	**228,270**	**202,400**	**-**	**-**

Source: national monitoring reports 2017 (based on information provided by national directorates in charge of energy, donors and national utilities)

Notes:

Solar street lights could be considered efficient public lights. However, it has been preferred to separate this information in a different column.

In general, the values are reported based on the information provided by specific country programmes led by individual governments, such as in Côte d’Ivoire and Nigeria (Box 7). Alternatively, they are generated by donor programmes such as the PRODERE project funded by Union Économique et Monétaire Ouest-Africaine (West African Economic and Monetary Union) (UEMOA); the African Biofuel & Renewable Energy Company (SABER-ABREC) programmes on energy efficiency and the GIZ EnDev activities. Thus, the existing number of efficient lights may be greater, especially as far as on-grid lighting is concerned.

The existing data gap in the penetration rates is due to different possible factors. Examples include the absence of national studies to assess the number and type of lights used for private and public purposes, or the lack of data collaboration and sharing between national stakeholders. In addition, there is a lack of organised data collection systems and reporting by the custom agencies (import & export) while national household surveys conducted periodically by countries do not usually include questions on efficient lighting.

Additional information per country is presented below in Box 7.

Box 7. Country highlights on energy-efficient lighting

Côte d'Ivoire

The national utility, Compagnie Ivoirienne d'Électricité (CIE), implemented a remote management system for public lighting that will allow the operation of the public lighting network to be optimised. In addition, it will enable the remote execution of the following activities: lighting control and parameterisation, real-time monitoring, and response and anomaly detection. This will contribute to increasing the energy efficiency of the network. By end 2017, about 260,000 public lights were controlled by the system following the installation of 4,172 remote control cabinets. Moreover, a national decree prohibits the use of incandescent lamps from end December 2019. This is the background to the distribution of 4.5 million efficient lamps between 2012 and 2017 by Programme National de Distribution de Lampes Basse Consommation (National Programme for Distributing Low-Energy Lighting) (PNDLBC). About 700,000 is yet to be distributed.

Guinea-Bissau

Two projects are in progress to replace public street lamps with LED bulbs in Bissau and the rest of the country. The project is promoted by UEMOA and SABER–ABREC. Under the framework of the UEMOA Programa Regional para a Eficiência Energética (Regional Program for Energy Efficiency) (PREE), 3,900 street lights and 20 state institution lights were replaced. UEMOA will also finance the replacement of 300 street lights with 75-watt LED bulbs on Bissau's main avenue. This was due to take place in 2018. A new project foresees the installation of 10,000 public solar lamp posts with a unit capacity of 150 watts. The project targets the installation of new lamp posts in different locations in the interior of the country. Total electricity production of these systems is estimated at approximately 54.56 GWh per annum.

Liberia

The national utility, Liberia Electricity Corporation (LEC), installed 2,000 low-consumption street lights.

Nigeria

The Nigerian Federal Government distributed 20,000 solar lighting systems to rural communities.

Sierra Leone

The GIZ EnDev programme installed 8,471 solar street lights (1.27 MW in total).

In addition to the Efficient Lighting Strategy at regional level,[38] a regional Minimum Energy Performance Standard (MEPS) for efficient on-grid and off-grid lights was developed under the ECOWAS Standards Harmonization Model (ECOSHAM). Ministers in charge of quality adopted MEPS at a meeting in Niamey in October 2017. Since then, MEPS have been implemented at national level in the form of national energy efficiency standards for electric lights (Table 16).

[38] www.ecreee.org/news/west-africa-nations-phase-out-incandescent-lamps

Table 16. Countries that have introduced national energy efficiency standards for electric lights

Country	Status
Benin	Adopted
Cabo Verde	Under development[39]
Ghana	Adopted, approved; MEPS and labels implemented
Nigeria	Adopted, approved; not yet implemented
Senegal	Adopted

Source: ECREEE

3.3.3 Energy-efficient electrical appliances

The promotion of energy-efficient electrical appliances such as refrigerators and air conditioners has been addressed at regional level. However, the penetration rates of energy-efficient appliances, such as air conditioners and refrigerators, was not reported by most countries in 2017. This may be due to lack of baseline data or absence of data collection and reporting by the national custom agencies (import & export). In addition, the national household surveys do not generally include questions on the use of energy-efficient appliances.

Burkina Faso reported a penetration rate of 44% for energy-efficient air conditioners and refrigerators.[40] Ghana reported imports of 148,523 efficient air conditioners and 212,338 efficient refrigerators in 2017. Although it had no baseline data, the Ghana Energy Commission announced savings of 400 GW of electricity in 2012-2015 due to its Refrigerator Energy Efficiency Program. During the same period, Ghana avoided the release of 1.1 million tonnes of CO_2, recovered 1,500 kilogrammes of chlorofluorocarbons and destroyed 30,000 illegally imported refrigerating appliances. In addition, the country has since 2015 been equipped with an assembly plant for manufacturing energy-efficient refrigerators, as well as a refrigerating testing laboratory. This is located at the Ghana Standards Authority and is the first of its kind in sub-Saharan Africa.

In Sierra Leone the GIZ EnDev project installed 1,001 solar fridges, each with a capacity of 370 Watt-peak (Wp) in 2017. Since 2003 the Ministry of Health has installed around 900 solar powered fridges donated by UNICEF, the United Nations Children's Fund. These are employed to cool vaccines across the country in the context of the Expanded Program on Immunization.

MEPS also included standards for energy-efficient refrigerators and air conditioners. Table 17 lists the countries that have introduced national MEPS for electrical appliances.

Table 17. Countries that have introduced national MEPS for electrical appliances

Country	Appliance	Status
Benin	Air conditioners	Not adopted
Cabo Verde	Air conditioners, refrigerators, TVs, water heaters, washing machines	Under development[41]

[39] Cabo Verde has not developed MEPS but has developed regulations that specify the minimum energy efficiency required for importation and sale of each product.

[40] Projet Régional d'Etiquetage des Equipements Electriques Domestiques dans les Etats Membres de l'UEMOA.

[41] Cabo Verde has not developed MEPS but has elaborated regulations that specify the minimum energy efficiency required for the importation and sale of each product. It has also developed measurement and testing mechanisms to establish the necessary and obligatory conditions applicable for the technical documentation process, equipment data sheets, as well as inspection and verification of equipment energy efficiency.

Ghana	Air conditioners, refrigerators	Adopted
Nigeria	Air conditioners, refrigerators	Adopted[42]
Senegal	Air conditioners, refrigerators	Adopted[43]

Source: ECREEE

EEEP promotes the introduction of energy efficiency labelling throughout ECOWAS. Ghana introduced mandatory energy efficiency labels for electric appliances as early as 2005. Cabo Verde developed the National Program Document on equipment labelling under the framework of Projeto Eficiência Energética em Edifícios e Equipamentos (Energy Efficiency in Buildings and Equipment Project).[44] This document is in line with the ECOWAS Energy Efficiency Initiative on Standards and Labelling, which will regulate labelling for products that meet minimum energy efficiency standards, as well as creating a comparative label. Côte d'Ivoire has a decree approved in 2016[45] setting the terms, conditions and obligations for implementation of energy control. This introduces mandatory labelling for electrical appliances.

3.3.4 Energy efficiency in buildings

The adoption of regional standards and labels and the development of energy-efficient building codes are two major EEEP targets. The ECOWAS Ministers of Energy approved the regional Energy Efficiency in Buildings (EEB) Directive at their 11th meeting in Guinea in 2016. Some ECOWAS member states are already implementing activities to promote energy efficiency in buildings.

Côte d'Ivoire approved a decree in 2016[46] that lays down the terms, conditions and obligations for implementing energy control in buildings. This introduces mandatory and periodic energy audits for establishments that consume large amounts of electricity, including public buildings and institutions.

Nigeria adopted a Building Energy Efficiency Guideline and Building Energy Efficiency Code in June 2016.[47] This was commissioned by the Federal Ministry of Power, Works and Housing in collaboration with the Nigerian Energy Support Program (NESP). It aims to give practical advice to professionals on how to design, construct and operate energy-efficient buildings. It also aims to educate the public about energy efficiency measures and provide it with information to help identify energy efficiency measures in buildings. In addition, the NESP programme reported on six energy-efficient buildings.

In Senegal, a Franco-Senegalese ministerial agreement on low-carbon buildings was signed in December 2016 between Agence Française de l'Environnement et de la Maîtrise de l'Energie (French national agency for energy efficiency) (ADEME), and the Senegalese Environment Ministry. Consequently, the eco-construction industry has grown, as evidenced by the emergence of local actors and new jobs. In order to further promote sustainable practices, ADEME is taking part in the Typha Combustible Construction Afrique de l'Ouest (TyCCAO) project. This will use *Typha Australis* – an invasive West African plant with thermal insulation and combustion properties – both as a construction material and for biomass energy. The project plans to use Typha at a large scale to fight climate change by providing a renewable fuel and developing energy-efficient

[42] The Nigerian Energy Support Program (NESP) supported the Standards organisation of Nigeria (SON) in developing MEPS for air conditioners and refrigerators.
[43] Programme pour la promotion des énergie renouvelables, de l'électrification rurale et l'approvisionnement durable en combustibles domestiques (PERACOD) helped the Agence pour l'economie et la maitrise de l'energie (AEME) develop standards for three group of products: grid lights, refrigerators and air conditioners. Twelve standards were approved in 2014 in partnership with AEME and the Association Sénégalaise de Normalisation (ASN).
[44] www.peee.cv
[45] Décret n°2016-862 du 03 novembre 2016.
[46] Décret n°2016-862 du 03 novembre 2016.
[47] Federal Ministry of Power, Works and Housing of Nigeria (Housing) (2016).

buildings. As far as existing energy-efficient buildings is concerned, two projects have been reported by a private developer while 115 buildings have been built between 2012 and 2017 using the Nubian Vault technique (Table 18).

In Cabo Verde, implementation of energy efficiency measures in the building sector is supported by the Energy Efficiency in Buildings and Equipment Project. For further decision-making and energy efficiency measures as well as for the Code of Energy Conservation in Buildings, the country has already developed the framework for the energy management system to measure buildings energy savings, water use and emissions reductions. The Code of Energy Conservation in Buildings will set the minimum requirements for energy efficiency in the design and construction of buildings. It will also define the requirements needed to achieve energy efficiency levels above the minimum requirements and will provide intervention guidelines for existing buildings to meet the minimum energy efficiency requirements. With the approval and implementation of the energy management system and the Code of Energy Conservation in Buildings, the country expects to increase the number of energy-efficient buildings. In 2017, the seven energy-efficient buildings reported were the same as in the 2016 regional progress report.[48]

Table 18 presents the contribution made by non-profit organisation (NPO) La Voûte Nubienne to energy efficiency in buildings, although this was not reported by countries in their National Monitoring Reports. The technical concept Nubian Vault is an ancient architectural process made mainly from raw earth. It is an adapted housing solution, responding to private and community uses in rural areas and in cities. The need for fans or air conditioning in Nubian Vault constructions seems to be minimal or absent so these can be considered energy-efficient.[49] According to the 2016-2017 annual report published by Voûte Nubienne,[50] 1,772 constructions were built in five ECOWAS countries in 2012-2017 (Table 18).

Table 18. Total number of energy-efficient constructions built by NPO La Voûte Nubienne, 2012-2017

Country	Total number of energy-efficient constructions built in 2012-2017	Total number of m^2 built in 2017	Number of energy-efficient households built in 2017	Number of energy-efficient public buildings built in 2017	Number of energy-efficient buildings for productive-industrial activities built in 2017
Benin	36	583	19	2	1
Burkina Faso	886	5,454	179	9	18
Ghana	27	589	9	1	3
Mali	660	4,394	201	4	0
Senegal	113	393	14	0	0

Source: Association la Voûte Nubienne (2018)

3.3.5 Energy efficiency in industry

The NEEAPs highlighted energy efficiency improvement in the industrial sector as a way to liberate energy generation capacity and create a more competitive industrial sector by reducing operational costs. The action plans also reported and quantified energy efficiency efforts and targets in this sector.

This progress report aims to monitor the number of industries, companies etc. that have implemented energy efficiency measures. Several activities would indicate the consideration and implementation of energy efficiency measures. These include, for example, energy audits, replacement of incandescent lamps by

[48] ECREEE (2018).
[49] Madiana Hazoume (2013).
[50] Association la Voûte Nubienne (2018).

efficient lights, replacement of inefficient refrigerators and cooling systems, and implementation of international standards like ISO 14001. However, the ECOWAS countries have not generally reported on these measures.

Burkina Faso, Côte d'Ivoire, Guinea and Nigeria reported that 21 companies in total had implemented energy efficiency measures by 2017. In Burkina Faso the Ministry of Energy's General Directorate for Energy Efficiency reported that nine companies had implemented energy efficiency measures. The national utility in Côte d'Ivoire, CIE, has achieved the following certifications: ISO 9001, OSHAS 18001 and ISO 14001. The last of these concerns the interconnected electricity production perimeter. The utility is also preparing for its ISO 50001 certification. In addition, a decree published by the government in 2016[51] lays down the terms, conditions and obligations for mandatory and periodic energy audits of the major energy consumers. Another 2016 decree[52] establishes the creation, organisation, characteristics and management of the national fund for energy management (FONAME). This will provide financial support for energy management and audits as well as for the necessary energy efficiency measures that will result. Guinea has reported that one industry[53] has implemented energy efficiency measures.

In Nigeria, the government was preparing energy efficiency standards conforming to ISO 50001. These standards will set energy audit regulations for industry. In 2017, eight companies had already implemented energy efficiency measures as pilot projects with the support of the GIZ NESP programme. Two of these – one in the steel industry and other in the food production industry – implemented an Energy Management System based on ISO 50001. In addition, seven companies[54] also supported by GIZ NESP implemented energy audits and retrofitted some of their equipment based on identified energy saving opportunities. Six of these companies also participate in the energy efficiency network developed for Nigerian Industries – a learning platform for companies to exchange ideas on energy efficiency issues. The Government of Nigeria estimates that the industrial sector could save 30-50% of energy by implementing energy efficiency measures. Ensuring that the energy efficiency standards conform to the ISO 50001 prepared by the government, will set the path for the future because the government will regulate the energy audit process for the industries.

Under the framework of a project funded by the Agence Française de Développement (French Co-operation Agency),[55] three companies in Togo implemented energy efficiency measures. This consisted of replacing engines and furnaces with high energy-efficient technologies, as well as installing solar panels for energy production. These companies are involved in sheet metal and metallurgical products, construction materials, gas and plastics production. To illustrate the gains, one of the companies reported annual savings of EUR 92,216 and 543 MWh respectively.

[51] Décret n°2016-862 du 3 novembre 2016.
[52] Décret n°2016-1131 du 21 décembre 2016.
[53] The Topaz Group : www.topazgroup.com
[54] These companies operate in the following industrial activities: chemicals and pharmaceuticals, domestic and industrial plastic, rubber and foam, food, beverages and tobacco, pulp and paper products, printing and publishing.
[55] Sustainable Use of Natural Resources and Energy Finance (SUNREF) project: www.sunref.org/projet/moderniser-les-equipements-dune-usine-de-produits-metallo-siderurgiques/

4 HIGHLIGHT OF 2017: BURKINA FASO STARTS UP PRODUCTION OF LARGE-SCALE SOLAR POWER

Burkina Faso experienced a remarkable year for renewable electricity in 2017 as it commissioned its first two on-grid solar PV plants: 33.7 MWp Zagtouli in a southwestern district of the capital Ouagadougou; and 1.1 MWp Ziga in the Centre-Nord region 70 kilometres northeast of Ouagadougou. The inauguration of Zagtouli and Ziga represented the first stepping stone towards the national goal of 220 MWp on-grid solar PV by 2020. These two plants accounted for 10% of total electricity generation capacity in Burkina Faso. This places Burkina Faso comfortably in line to meet 2020 regional commitments set by EREP for renewable energy penetration excluding medium and large hydropower. Renewable energy sources contributed 12.6% of the total electricity produced in 2017. This percentage will increase in 2018 because Zagtouli and Ziga only started generation in November and May 2017 respectively.

With 129,600 solar panels covering 60 hectares, Zagtouli is the largest solar plant in the ECOWAS region and provides electricity to about 660,000 people. CEGELEC, a French electrical engineering company that is part of VINCI Energies, was the engineering procurement construction contractor. They finalised the construction in less than twelve months and relied on the participation of local companies. The national utility, SONABEL, buys electricity at the price of USD 0.06 kW per hour – significantly cheaper than the electricity produced by conventional energy plants in the country. The project cost amounted to around EUR 1.06 million per MWp and was financed by the Government of Burkina Faso along with two other organisations: the EU (European Development Fund) provided a EUR 25 million grant and the French Co-operation Agency provided a EUR 22.5 million loan. SONABEL is also the offtaker for the Ziga solar plant, which is funded by the Government of Taiwan.

The country expects to commission more solar projects in the coming years with increasing private sector participation. Two competitive bids were launched in 2013 and 2016 for the development of two on-grid solar plants with a total 150 MWp capacity. Thus far only one of the plants, the 28 MWp Zina IPP, has made significant progress; it is expected to be commissioned in 2019. The World Bank supported this project with the International Finance Corporation mandated as lead implementer. Through International Development Association funding the World Bank also supports the 20 MWp Koudougou and 10 MWp Kaya planned solar plants. The tender documents for these two projects were finalised in 2017 and developed by SONABEL and the Ministry of Energy.

Burkina Faso also has significant off-grid solar capacity. For example, the Essakane gold mine in the northeast of the country commissioned 15 MWp of solar PV capacity in 2017 to add to an existing isolated diesel power plant. The resulting 70 MWp hybrid solar-diesel power plant is the largest of its kind in the world.

In summary, PV plants commissioned and under construction could together provide the country with about 90 MWp installed solar capacity by 2019.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The ECOWAS region aims to provide 65% of its population with access to electricity by 2020. The region is moving towards this target; 52.3% of the population had access to grid electricity in 2017. However, the percentage of access in terms of population was probably higher. This is because it was not possible to quantify the share of households with access to electricity through stand-alone renewable energy systems. At the same time, the Regional Monitoring Framework does not monitor access provided by conventional mini-grids and stand-alone systems such as diesel generators.

Member states could make greater efforts now if the region is aiming for 22% of the rural population in 2020 to obtain energy access from decentralised renewable energy services. It was not possible to quantify the share of households with access through stand-alone renewable energy systems but it is clear that the number of installed CEMGs in 2017 was too far from the target of 60,000 by 2020, which seems to be unattainable. In 2017, only 443 CEMGs was installed which amounts to an estimated electricity access of less than 2% for the rural population.

Nevertheless, some countries, such as Senegal, Burkina Faso and Sierra Leone, made considerable steps to increase installed renewable energy capacity. ECOWAS countries will need to continue with their efforts to reach the regional target of 10% of on-grid electricity from renewable sources by 2020 (excluding medium and large hydropower). Indeed, the share in 2017 only amounted to 1.8%. The region aims to have about 2,425 MW of on-grid installed renewable energy capacity by 2020 (excluding medium and large hydropower). However, capacity amounted to 417 MW in 2017. The situation is different if medium and large hydropower power are included. The share of on-grid renewable energy capacity in 2017 including medium and large hydropower power plants installed in the region amounted to 24.3% with an installed capacity of 5,501 MW. However, the 2020 target is 35%. New medium and large hydropower power projects in Guinea and Côte d'Ivoire will contribute to achieving this target.

About 40% of the electricity produced at regional level in 2017 was lost due to a combination of technical factors and non-technical losses. No clear trend from the past few years visibly indicates that the region is advancing towards its target of 10% of electricity losses by 2020. The identified reduction of losses in some ECOWAS countries will need to be confirmed in the next few years to verify whether national efforts are moving the region towards its target.

In terms of energy efficiency, member states should also increase efforts to promote Solar Water Heaters considering the competitiveness of these systems and the amount of reduction in electricity consumption. The assessment of these systems faces a challenge due to lack of data.

5.2 Recommendations

Each individual ECOWAS country should have updated knowledge of where it stands in terms of renewable energy, energy efficiency and energy access. This will benefit both the country and the region, helping each make effective plans and decisions. The Regional Monitoring Framework could become an important tool for policy makers and other stakeholders by providing annual snapshots and trends along the three axes covered.

It was not possible to monitor the regional share of access to ICS and modern cooking solutions because of a lack of updates in periodic national surveys on household living conditions by the national statistical services. Even though these censuses evaluated access to modern cooking solutions such as LPG, it was not possible to calculate regional access because the reference year differs considerably between countries. Moreover, it was not possible to monitor ICS access because these systems were not generally included as an indicator in national censuses. It is therefore highly recommended that the national statistical services update their national censuses on household living conditions to incorporate the use of ICS.

The ECOWAS countries should generally put more effort into collecting distributed electricity generation data such as the installed capacity and production of solar systems. Some countries such as Ghana, Mali and Cabo Verde have started quantifying the installed capacity. The Regional Progress Report could also include a section on distributed installed capacity and generation in future editions to complete the monitoring exercise on total installed renewable energy capacity.

Monitoring energy efficiency targets was also a considerable challenge in most countries due to the lack of properly functioning data collection systems. Some initiatives in the region have made progress on systematic data collection and processing. For instance, the EU has supported Benin in putting in place a data collection system entitled SINEB. It is supporting UEMOA in re-establishing the UEMOA member state energy information system (Système d'Information Énergétique) (SIE). ECOWAS member states require technical and financial support to improve collection of renewable energy and energy efficiency data. This will allow them to monitor their progress at the national level and supply the information to regional and international institutions such as UEMOA, ECREEE, IEA, International Renewable Energy Agency (IRENA) and African Energy Commission (AFREC).

Energy efficiency in industry should be measured against international benchmarks such as how much energy is required to produce one tonne (or relevant unit) of product by different economic sectors. In the future, it could be worth carrying out an energy efficiency benchmarking exercise for industries in the ECOWAS region.

Finally, the monitoring framework exercise should be aligned with the member state energy information system data collection process. To achieve this, the energy information systems should incorporate into their data collection the indicators lacking from the monitoring framework. Aligning and enhancing national data collection systems would facilitate collaboration and information sharing between countries, further benefitting the region as a whole.

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ANNEX 1: ON-GRID RENEWABLE ENERGY POWER PLANTS IN THE ECOWAS REGION IN 2017

Table below present grid connected renewable energy power plants for 2017 in ECOWAS region. They are classified by country and technology with their installed capacity. Medium and large hydropower plants are excluded.

Country / renewable energy on-grid power plant	Technology	Installed capacity (MW*)
BENIN		
Yéripao	Small hydropower	0.5
Djougou	PV	1.5[1]
	Total	**2**
BURKINA FASO[2]		
Kompienga	Small hydropower	14
Bagre	Small hydropower	16
Tourni	Small hydropower	0.5
Niofila	Small hydropower	1.5
FasoBiogaz	Bioenergy	1.3
Zagtouli	PV	33.7
Ziga	PV	1.1
	Total	**70.1**
CABO VERDE		
Cabeolica Santiago - Monte São Filipe	Wind	9.35
Cabeolica São Vicente - Selada do Flamengo	Wind	5.95
Cabeolica Sal - Lajedo da Ribeira de Tarrafe	Wind	7.65
Cabeolica Boa Vista - Morro da Vigia - Ponta do Sol	Wind	2.55
Parque Eolico de Santo Antão	Wind	0.5
Murdeira (Sal)	PV	2.5
APP-PV_ETAR	PV	0.021
APP-PV_SALMOURA	PV	0.017
Praia (Santiago)	PV	4.75
	Total	**33.3**
CÔTE D'IVOIRE		
Ayamé 1	Small hydropower	20
Ayamé 2	Small hydropower	30
Faye	Small hydropower	5
	Total	**55**
GAMBIA		
Gamwind	Wind	0.9
Batokunku	Wind	0.15
	Total	**1.05**
GHANA		
Navrongo	PV	2.5
Oyandze	PV	20
Safisana Biogas	Bioenergy	0.1
	Total	**22.6[3]**
GUINEA		
Grandes Chutes	Small hydropower	27.6
Donkea	Small hydropower	15
Baneah	Small hydropower	5

Kinkon	Small hydropower	3.4
	Total	**51**[4]
MALI		
Sotuba	Small hydropower	5.7
	Total	**5.7**[5]
NIGERIA		
Ankwil 1 (Bagel 1)	Small hydropower	1
Ankwil 2 (Bagel 2)	Small hydropower	2
Bakolori	Small hydropower	3
Challawa Gorge	Small hydropower	3
Ouree	Small hydropower	2
Tunga	Small hydropower	0.4
Kwall (Kwali Falls)	Small hydropower	2
Ngell	Small hydropower	2
Jabi	Small hydropower	n/a
Jekko 1	Small hydropower	4
Jekko 2	Small hydropower	4
Kurra (Kurra Falls)	Small hydropower	8
	Total	**31.4**
SENEGAL		
Bokhol (Senergy 2)	PV	20
Malicounda (N.B.: 11 MW were operational in 2016)	PV	20
Diamniadio (CICAD)	PV	2
Senergy PV, Santhiou Mékhé	PV	30
Ten Mérina, Mérina Dakhar	PV	30
	Total	**102**
SIERRA LEONE		
Goma 1	Small hydropower	6
Charlotte	Small hydropower	2
Makali	Small hydropower	0.64
Port Loko (Bhanka Soka)	Small hydropower	2
Addax Bioenergy	Bioenergy	15
	Total	**25.6**[6]
TOGO		
Kpime	Small hydropower	1.6
	Total	**1.6**
	Total ECOWAS region	**400**

Source: ECOWREX

[1] The total planned capacity of the Djougou solar PV plant in Benin is 5 MW, but only 1.5 MW were installed in 2017.
[2] There were also 15 MWp (Essakane plant) of solar installed capacity not connected to the national grid that contributed to provide electricity access to the inhabitants of the area of the Essakane gold mine.
[3] Four megawatts of small hydropower installed at Bui for own production and 8.5 MW installed through distributed solar PV are not included.
[4] The following three hydropower power plants operated by the national utility EDG were not included as they are connected to isolated grids: Tinkisso (1.65MW), Loffa (0.16MW) and Samankou (0.41MW)
[5] The following solar plants operated by the national utility EDM SA are not included as they are connected to isolated grids: Ouelessebougou (334 kWp), Tominian (266 kWp), Nara (649 kWp), Diema (649 kWp), Bankass (384 kWp), Koro (384 kWp), Ansongo (382 kWp), Soufouroulaye (40 kWp), Haoussa Foulane (40 kWp) and N'Tjiba (50 kWp). Also, the 3.2 MW of distributed solar energy reported by the country was not included.
[6] Yele hydropower plant (0.25 MW) was not considered as it serves to an isolated grid.

ANNEX 2: PLANNED ON-GRID RENEWABLE ENERGY POWER PLANTS

Table below includes grid connected renewable energy power plants that could be commissioned before the end of 2020. A power plant is classified as planned when it is under construction or funding has been approved, or an official tender process has already started.

Country	Project	Technology and capacity planned	Planned renewable energy capacity (including large and medium hydropower) (MW*) by 2020	Planned renewable energy capacity (excluding large and medium hydropower) (MW) by 2020
BURKINA FASO	Samendeni Zina Kaya Koudougou (PV)	Small hydropower (2.8 MW) PV (28 MW) PV (10 MW) PV (20 MW)	60.8	60.8
CABO VERDE	Boavista - SPV-5MW-BV1 Santiago	PV (5 MW) PV (10 MW)	15	15
CÔTE D'IVOIRE	Singrobo Korhogo Aboisso	Medium hydropower (67 MW) PV (25 MW) Biomass (46 MW)	138	71
GHANA	Gomoa Onyaadze	PV (20 MW)	20	20
GUINEA	Souapiti	Large hydropower (450 MW)	450	0
GUINEA-BISSAU	Bor	PV (20 MW)	20	20
MALI	Gouina Kati Kita Sikasso Segou Koutiala	Large hydropower (140 MW) PV (65 MW) PV (50 MW) PV (50 MW PV (33 MW) PV (25 MW)	363	223
NIGER	Kandadji Malbaza Dosso Maradi Niamey-Gorou Banda Agadez Gorou-Banda	Large hydropower (130 MW) PV (7 MW) PV (10 MW) PV (20 MW PV (30 MW) PV-Diesel (19 MW) PV (20 MW)	237	106
SENEGAL	Sambangalou Taiba Ndiaye Kahone[1] Touba-Kaël[2]	Large hydropower (128 MW) Wind (158.7 MW) PV (30 MW) PV (30 MW)	346.7	218.7
TOGO	Sarakawa	Small hydropower (24.2 MW)	24.2	24.2

Source: national monitoring reports 2017 (based on the data provided by national directorates of energy), ECOWREX.

[1] Engie-Meridiam project; [2] Engie-Meridiam 2 project

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