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SOLAR IN WEST AFRICAN ENERGY POLICIES – STATE OF THE ART AND ON-GOING DEVELOPMENT

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Abstract

Energy challenges are one of the numerous challenges the Economic Community of West African States (ECOWAS) region faces. The region has vast energy resources, including renewable ones, but its access to modern energy services is very low. This has consequences on the economic development, the daily life of people. ECOWAS Member States recognize that renewable energy sources are one solution, combined with increased efficiency in the use of energy.

This led to the adoption of regional policies for renewable energy and energy efficiency by the ECOWAS Energy Ministers in October 2012. EREP, the ECOWAS Renewable Energy Policy, is proposing a frame and different actions, the ones for solar energy will be presented here, both for solar thermal and the different uses of PV systems, from stand-alone ones to mini-grid systems and grid connected systems. In parallel, the ECOWAS Energy Efficiency Policy (EEEP) was developed. The paper is concluded by the barriers to be removed, and how.

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1. The background of the ECOWAS Renewable Energy Policy

Nota: This paper is based on two references: Reference 1 – Vilar and reference 2 – ECREEE.

1.1. ECREEE and EREP

ECREEE is the Regional Centre for Renewable Energy and Energy Efficiency for the 15 Economic Community of West African States (ECOWAS). It was inaugurated in 2010, with the mandate to promote renewable energy and energy efficiency in the region, by integrating various complementary projects and strategies. West Africa is a group of 15 states, including big countries such as Nigeria but also small ones such as Liberia, Guinea-Bissau, Capo-Verde. It covers a region from the Sahel region in the north to the humid and tropical area in the south. Furthermore, a majority of these states are among the least developed countries in the world, with high levels of poverty both in urban and rural areas. To improve living conditions, energy plays a key role. Today, the region is highly dependent on fossil fuels, even if renewable energy resources are abundant, especially

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solar one. The region overall access rate to modern energy services is low.

This led to the adoption of regional policies for renewable energy and energy efficiency by the ECOWAS Energy Ministers in October 2012. For renewable energy sources, it is called EREP, the ECOWAS Renewable Energy Policy. The EREP, in combination with the EEEP, responds to the severe energy crisis in the ECOWAS region. The countries face the challenges of energy poverty, energy security and climate change mitigation simultaneously.

1.2. The energy challenges

The situation is characterized particularly by:

- A large volume of suppressed demand (7 to 10 TWh from 2006 to 2010)

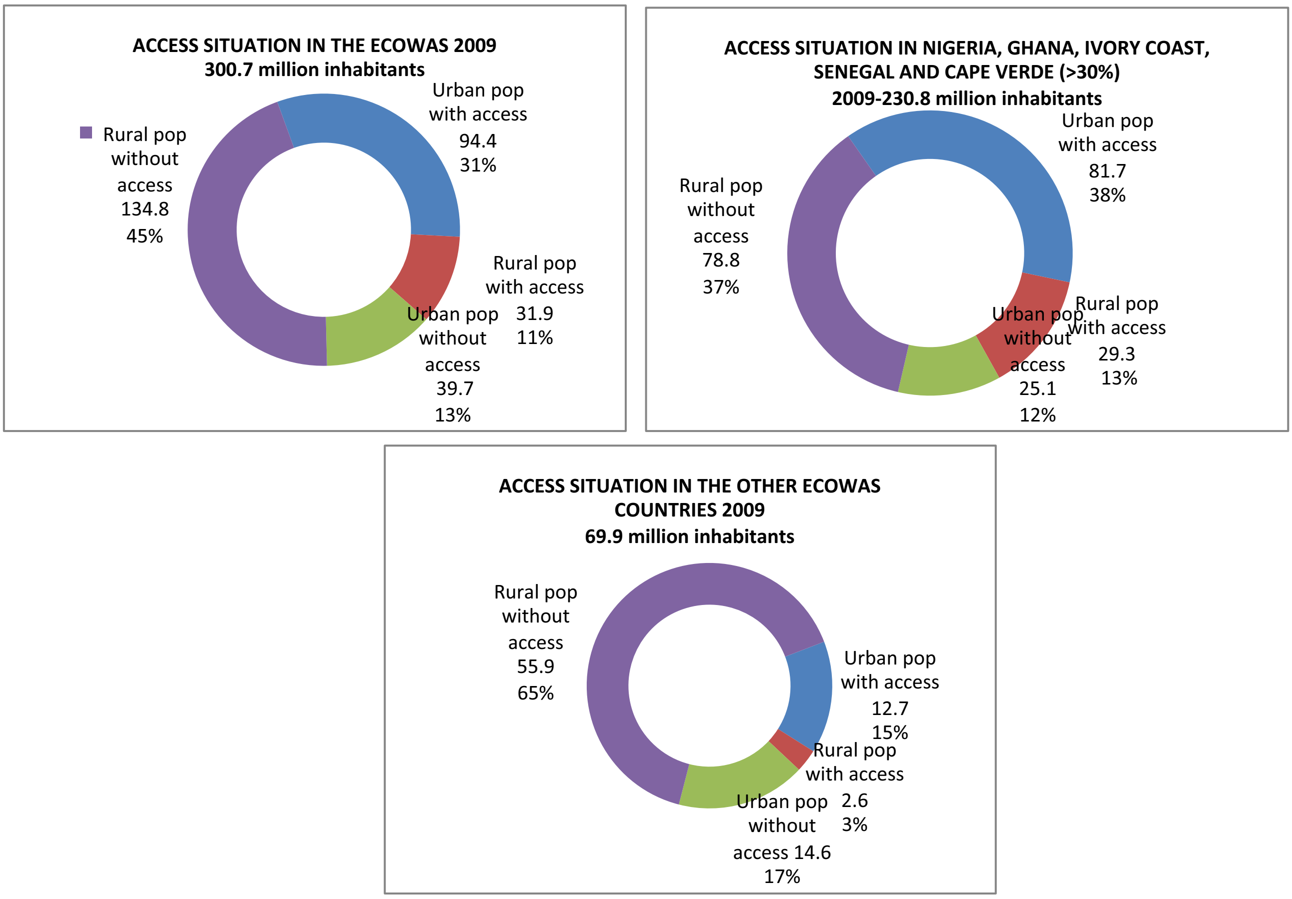
- A general poor access to electricity (40% in average, but for many countries less than 20%), a deficit that is even more pronounced for rural areas

- An unsustainable woodfuel supply that no longer meets the growing demand leading to an overexploitation of the wood resources and for some countries, to deforestation.

1.3. Energy access

In 2009-2010, in the ECOWAS region, with around 300 millions inhabitants, nearly 175 millions people had no access to electricity, 25% are living in urban areas and 75% in rural areas. In some countries, the rate of access for rural population can decrease until 10%. Only six countries have a better electricity access rate in 2009, greater than 30%. Forecast, in the most optimistic scenarios, estimates that 75% of the population will have access to grid energy by 2030. This would still leave almost 150 million inhabitants and 58% of the municipalities in the ECOWAS region without access (reference 3 - UNDP).

Fig1: Access to energy in the ECOWAS region



But it's not only an electricity question. A majority of the population of West Africa today lacks access to other essential modern energy services. Achieving universal access to electricity, to mechanical power as well as to safe and affordable cooking is thus a major challenge in achieving economic development and social progress for women and men in the region.

1.4. Energy security

West African power systems suffer from frequent blackouts and brownouts. At times of stress in world petroleum markets, some countries have suffered from shortages of fuel for transport and power generation.

Unreliable power hinders the region's enterprises and impacts negatively on productive activities of women and men. The cost of providing backup power (typically €0.30 per kWh or more) holds back productive industries: the World Bank estimates that blackouts reduce annual economic growth in Africa by 2%. Firms in Africa lose 6% in sales due to frequent power outages. Some informal sector firms, unable to afford backup generation facilities, cite losses of up to 16 %. On average, shortages affect electricity users in the region 56 days per year. Indeed chronic unreliability in power has become a burning political issue in some of the countries in the region. Increased energy efficiency - along with regional integration of energy systems and increased use of local energy resources - is key to assuring more reliable power supply.

Thus, all ECOWAS countries face the challenge of guaranteeing reliable supply of electricity and fossil fuels to their growing economies. Accelerating economic growth has stimulated demand for energy, increasing the strain on energy systems.

More efficient use of energy is a powerful tool to increase the reliability of energy systems. In the power sector, higher efficiency would free up capacity, and reduce the need for imports, both for the power sector and for transport fuels. More efficient cooking will reduce demand for cooking fuels, both fossil and renewable. It will thus facilitate efforts to protect forest resources, and guarantee the future supply of cooking fuels.

1.5. Protecting the environment and dealing with climate change

While energy services are essential for modern societies, for life itself, the use of energy can cause multiple forms of harm to our environment. Using less energy to provide the same or better services is the shortest path to reducing negative environmental impact from energy use. Energy efficiency is a sound option for mitigation of the emissions of greenhouse gases and helps to confront the adaptation challenges that climate change poses to infrastructure and living conditions of the population in West Africa.

Unplanned or poorly managed harvesting of wood can contribute to deforestation and desertification. On the other hand, energy efficiency at each link of the fuel wood supply chain - sustainable forest management, improved charcoal conversion, rationalised transport through rural wood markets, improved cook stoves - can contribute to making forests a sustainable and renewable source of energy, as well as a source of valuable non wood forest products. Regional efforts, through the "Comité permanent Inter-Etats de Lutte contre la Sécheresse (CILSS)" have shown that concerted efforts can ensure reliable energy supplies, while at the same time protecting the long-term viability of the region's forests, with positive effects for the global carbon balance. Improved energy efficiency at the end of the wood fuel value chain, notably through improved cook stoves, can reduce the emissions of harmful smoke particles, that are both a danger for health - particularly for women and children - and a factor contributing to local air pollution and global climate change.

The extraction, transport and combustion of fossil fuels - coal, oil, natural gas - involves multiple environmental risks: oil spills that pollute land and water; run off and erosion from coal mines; acid rain from coal fired power plants; urban air pollution (sulphur dioxide, nitrous oxide, carbon monoxide, ozone) from vehicle emissions; etc. Extracting and burning smaller quantities of fossil fuels, through efficient use, immediately reduces all these associated risks. Furthermore, it reduces the emissions of Green House Gases, such as carbon dioxide, methane, and of black soot, that contribute to climate change.

Through access to modern forms of renewable energy as well as efficient use of the energy resources at their disposal, people in the ECOWAS region can become more resilient to climate alterations that impose stringent conditions on their lives and infrastructure, affecting the availability of biomass, water and food.

1.6. The energy challenge in one table

We propose the following table to summarize the energy situation in ECOWAS countries.

Tab. 1: Energy situation in ECOWAS

Country	Population (Year 2009)	Elec. per cap. (kWh)	Elec. per cap. for those with access (kWh)	Rate of access to electricity (%)
Benin	8'520'876	94	354	26.5
Burkina Faso	15'224'780	46	170	27.0
Cape-Verde	506'000	583	670	87.0
Côte d'Ivoire	21'080'000	174	239	72.9
Gambia	1'766'100	116	772	15.0
Ghana	23'840'000	254	381	66.7
Guinea	10'498'597	81	403	20.2
Guinea Bissau	1'449'000	45	300	15.0
Liberia	4'128'600	75	503	15.0
Mali	14'528'662	67	249	27.1
Niger	14'693'112	40	412	9.6
Nigeria	154'880'872	117	231	50.6
Senegal	12'767'600	182	338	54.0
Sierra Leone	5'997'500	9	60	15.0
Togo	6'191'000	109	482	22.5
ECOWAS	**296'072'699**	**121**	**266**	**45.3**

2. The EREP targets

2.1. The EREP vision

The EREP vision is to secure an increasing and comprehensive share of the Member

States' energy supplies and services from timely, reliable, sufficient, cost-effective uses of renewable energy sources enabling:

- Universal access to electricity by 2030

- A more sustainable and safe provision of domestic energy services for cooking thus achieving the objectives of the White Paper for access to modern energy services by 2020.

Three groups of targets are set by the EREP:

- grid-connected renewable energy applications;

- off-grid and stand-alone applications; and

- domestic renewable energy applications, ranging from cooking related applications (cook stoves, household biogas, briquettes and LPG strategy) to energy efficient measures such as solar water heaters and distributed power generation (PV roof top and small wind turbines).

2.2. Cross cutting issues for Energy Efficiency and Renewable Energy

Energy efficiency and renewable energy are two complementary and essential building blocks to achieve sustainable development. Many of the public policy actions to encourage energy efficiency will also encourage increased use of renewables. Furthermore, expansion of the use of renewables is facilitated by efficient use of energy. Thus, in parallel to the current policy on energy efficiency, ECOWAS has also adopted a policy on renewable energy. These two policies, along with the existing policy on access, form a "Sustainable Energy For All" policy framework for the ECOWAS region.

Synergies between energy efficiency and renewable energies can be exploited in several ways. Energy efficiency measures, by reducing total energy consumption, allow renewable energy systems to meet a larger share of demand, thus diminishing the need for fossil fuelled systems, and facilitating achievement of national targets for renewable energy. Energy efficiency contributes to optimizing the use of off-grid systems based on renewable energy. In buildings, renewable energy and energy efficiency technologies are complementary: on-site renewable energy systems for cooling, water heating and electricity production can be optimized through energy efficiency measures. Improving the energy efficiency of cook-stoves using traditional biomass contributes to optimizing the use of biomass and to the conservation of forests. Where applicable, co or tri generation of electricity, heat and cold increase the conversion efficiency of biomass resources.

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3. Trends for solar

The use of solar energy will participate to the objectives of the EREP through different technologies: PV, solar heater, solar cooking, solar air-conditioning…

3.1 Strategy for solar heater

One of the important measures for electricity demand mitigation is the use of solar water heating for domestic, commercial and industrial requirements. This is a mature technology. It is necessary to promote its use as much as possible. Therefore, the following targets are proposed:

- 25 % and 50% of the district health centers and the maternity clinics as well as the school kitchens, boarding schools and barracks by 2020 and 2030.

- For hotels, 10% by 2020 and 25% by 2030.

- For agro-food industries using process hot water applying oil-fired boilers, at least 10% of these industries will apply this technology as pre-heater to their boilers by 2030 and 25% by 2030.

- All new built detached houses costing more than € 75,000 are equipped at least with one solar water heater system.

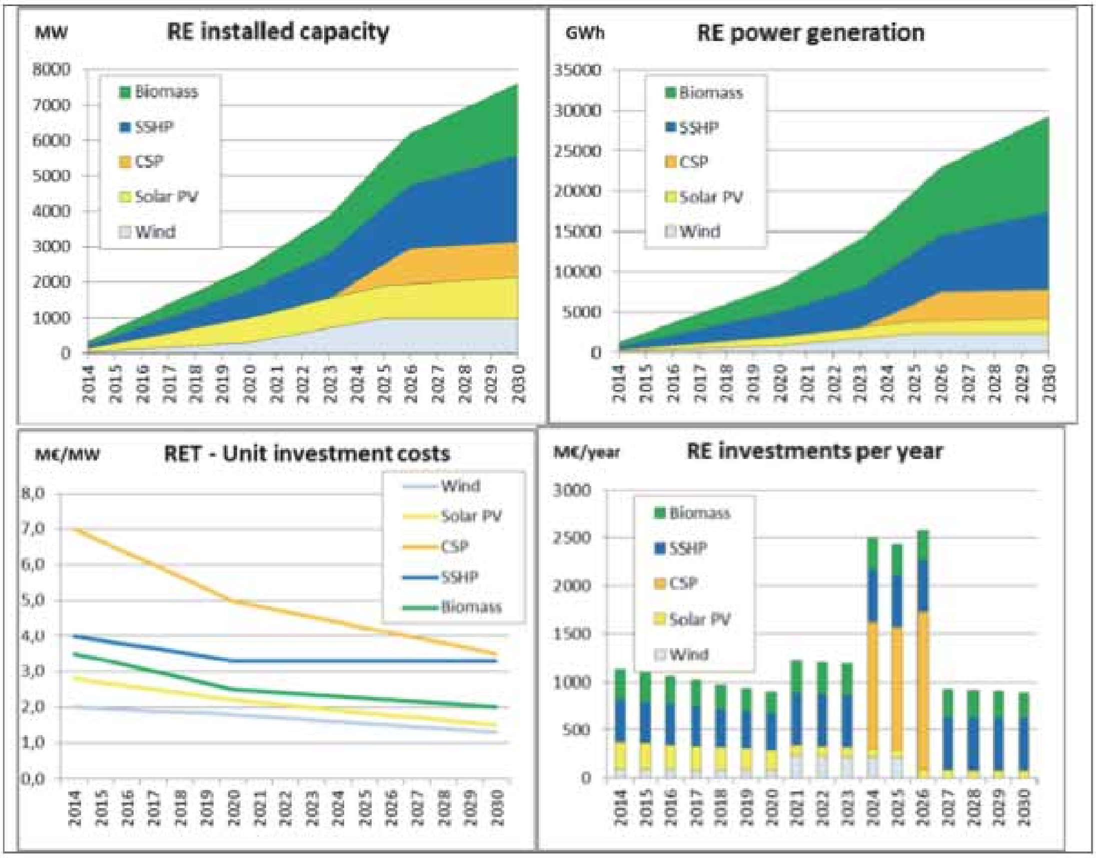
Clearly, this application would be more viable when the tariff is diesel based and if subsidy for power elsewhere is withdrawn from larger users. For much of the public system, funds would have to come from the national budget and a proper system of service and maintenance would be necessary. It will also save considerable amount of electricity. Mandating the use solar water heater technologies by hotels might be required, as also by the new and existing large houses, and this target may need to be increased. It would be also necessary to consider stand-alone solar PV installations for self consumption in urban areas or institutions which are dependent upon diesel generation. Where day time use is required, solar systems with minimum battery support would be especially viable.

3.2. Strategy for PV in grid-connected system, mini-grid systems or stand-alone systems

The targets for grid-connected renewable energy are based on a realistic evaluation of available RE resources at national level and on a technical and financial assessment of the different renewable energy technology options that are already commercially available (such as wind turbines, PV panels, hydro turbines, conventional thermal steam power generation and cogeneration with biomass, and diesel or dual fuel gas motors coupled to power generators). It is assumed that PV technology will remain cheaper than CSP technology in the mid-term view; CSP may become an attractive option after 2020.

The EREP renewable energy scenario is fully competitive under commercial conditions for countries relying today on diesel generation. Over a 25 years period, the EREP levelised cost of energy (LCOE) will be from 0.7 c€/kWh to 1.7 c€/kWh lower than the reference cost of diesel generation up to 2018-2021. This conclusion concerns the following countries: Burkina, Cape Verde, Guinea Bissau, Mali, Gambia, Niger, Guinea, Sierra Leone, Liberia and Senegal. However, for countries such as Côte d'Ivoire, Ghana, Togo, Benin and Nigeria, which can rely on low generation and supply costs from large hydro and gas, the most competitive RE sources such SSHP, wind and biomass are still viable and attractive options.

Fig. 2: RE installed capacity and production 2014–2030, RE unit cost and investment needs 2014–2030



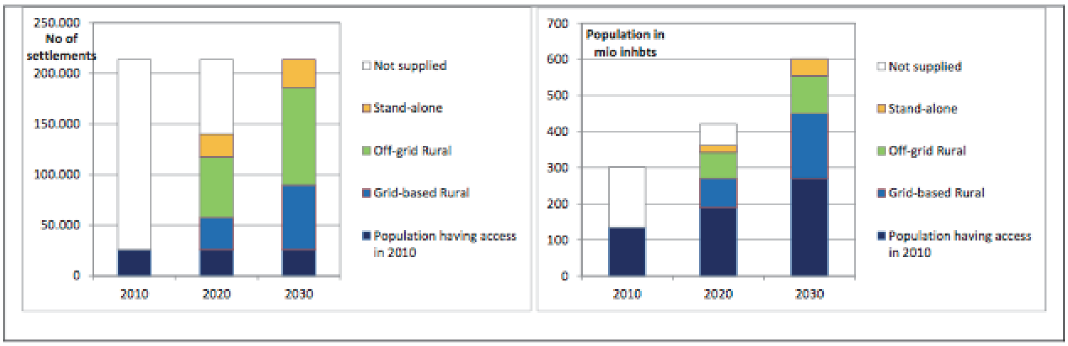
The EREP preparatory work has shown that around 25% of the ECOWAS population in rural areas can be served by decentralized renewable energy solutions more cost-effectively.

In 2010, 42% of the total ECOWAS population, estimated to be 300.7 million inhabitants, had access to electricity. The market for mini-grids and decentralized supply systems will typically address the need of the rural population living in rural centres and villages with a population between 200 and 2,500 inhabitants. Some larger cities can be included in this market segment according to their peripheral geographical situation vis-à-vis the national grid. This market will supply 71.4 million inhabitants by 2020 and 104 million by 2030.

Mini-grid systems will be powered by solar PV, small scale hydro, biomass and small wind turbines or hybrid systems in combination with diesel generators eventually powered by locally produced biofuels. The financial assessment shows that such decentralized mini-grid systems are quite profitable compared with fuel costs for diesel generation and the on-grid costs for rural electrification (direct period of return of capital costs on avoided diesel costs is between 5 to 7 years).

The remaining scattered 10% demand would be progressively supplied with a penetration rate of 300,000 stand-alone systems per year during the next 16 years. The costs for mini-grids are roughly estimated at €17.0 billion up to 2020 and €31.6 billion up to 2030. Stand-alone systems will require an investment in the magnitude of €0.6 billion, sufficient to provide a minimum electricity service for 47 million inhabitants by 2030.

Fig. 3: EREP scenario for electricity supply in the ECOWAS region



4. Conclusion

To reach these potentials, analysis of barriers for renewable energy highlights both the need for, and the importance of, a regional RE policy. The EREP aims at assisting the ECOWAS Member States in addressing the following issues and challenges:

- Creation of an enabling environment by the development of a fully developed institutional, regulatory and financial framework and creating appropriate incentives to attract and give confidence to private investors for grid projects and medium and small sized renewable energy solutions especially in rural and peri-urban areas.

- Better assessment of renewable energy potentials to provide reliable and convincing data backgrounds for projects identification.

- Fostering the adoption of holistic planning that includes renewable energies in a comprehensive strategy and allocation of financial resources to implement renewable energy programs in ECOWAS Member States.

- Building proper technical capacity in terms of concept, design, and maintenance for renewable energy technologies with regards to projects development as well as to policy development, to reduce the perception that these technologies are more risky and less reliable than a conventional diesel motor or a grid extension.

- Raising awareness on the consequence that conventional fuel subsidies have on the development of renewable energy, as constituting hidden costs into the electricity tariffs structure

- Facilitating the dissemination of information for the banking system and investors to reduce the perception of financial risk related to renewable energy sources due to their high upfront costs and the fact that they are viewed as new technologies in West Africa. Implementation of regulation for renewable energy applications and improving knowledge and skills pertaining to renewable energy shall modify this perception as technological barriers and weakness of the present renewable energy market in West Africa also contribute to the high costs for acquisition of equipment / spare part supply / maintenance / services.

- The development of renewable energy is part of a progressive approach. Before reaching a renewable energy environment supported by strong private sector and bank system involvement, it is necessary, as part of an emerging market, to provide financial support to the development of renewable energy by mixing subsidies, tax incentives and by the establishment of a favorable regulatory framework for renewable energy Independent Power Producers, and the feed in tariff approach.

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5. References

Reference 1 – Vilar, Renewable Energy in Western Africa: situation, experiences and tendencies, 2012

Reference 2 – ECREEE, ECOWAS Renewable Energy Policy (EREP) September 2012

Reference 3 – UNDP, report on general energy access in ECOWAS region, UNDP Dakar, Regional energy poverty project, 2011

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6. Figures and tables

Figure 1: Access to energy in the ECOWAS region (reference 1)

Figure 2: RE installed capacity and production 2014□2030, RE unit cost and investment needs 2014-2030 (reference 2)

Figure 3: EREP scenario for electricity supply in the ECOWAS region (reference 2)

Table 1: Energy situation in ECOWAS (reference 2)