

ECOWAS Renewable Energy Policy (EREP)

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ECOWAS Renewable Energy Policy (EREP)

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List of Abbreviations

ADC	Austrian Development Cooperation
ADA	Austrian Development Agency
AECID	Agencia Española de Cooperación Internacional para el Desarrollo (Spanish International Cooperation Agency for Development)
AfDB	African Development bank
AFD	French Development Agency
CEB	Benin Electric Community
CILSS	Comité permanent Inter-Etats de Lutte contre la Sécheresse dans le Sahel
CLSG	Cote d'Ivoire, Liberia, Sierra Leone, Guinea
CLUB-ER	Network of African Agencies and Structures in charge of Rural - Electrification
CSP	Concentrated Solar Power
DDO	Distillate Diesel Oil
DSO	Distribution system operator
ECOWAS	Economic Community of West African States
EDG	Electricity of Guinea
ECREEE	ECOWAS Regional Centre for Renewable Energy and Energy Efficiency
EEEP	ECOWAS Energy Efficiency Policy
EREP	ECOWAS Renewable Energy Policy
ERERA	ECOWAS Regional Electricity Regulatory Authority
FIT	Feed in Tariff
GEF	Global Environmental Facility
GW	Giga Watt
GWh	Giga Watt hour
IPP	Independent Power Producer
IRED	Regional Initiative for Sustainable Energy
MS	Member States (ECOWAS)
MW	Mega Watt
NFI	National Focal Institutions
MWh	Mega Watt hour
NREP	National Renewable Energy Policy
ODA	Official Development Assistance
OMVG	Organisation de mise en valeur du fleuve Gambie
OMVS	Organisation de mise en valeur du fleuve Senegal
RE	Renewable Energy
RET	Renewable Energy Technologies
PPA	Power Purchase Agreement
PPP	Public-Private Partnership
PRBE	Regional Programme for Biomass Energy
PREDAS	Regional Programme for the Promotion of Domestic and alternative energies in the Sahelian region
PV	Photovoltaic
RREP	Regional Renewable Energy Policy
REEP	Regional Energy Efficiency Policy
RMO	Regional Market Operator
RTSO	Regional Transmission System Operator
SSHP	Small Scale Hydropower
TSO	Transmission System Operator
UNIDO	United Nations Industrial Development Organization
UNDP	United Nations Development Programme
WA	West Africa
UEMOA	West African Economic and Monetary Union
WAPP	West African Power Pool
WB	World Bank



Definitions

Coverage rate:	% of the population living in areas where the service is available
Access rate:	% of the considered population which is effectively connected to the considered service
Dispersion rate:	N° of electrified localities / total localities
Woodfuel:	firewood and charcoal
RETScreen:	Excel-based clean energy project analysis software tool that helps decision makers to determine the technical and financial viability of potential renewable energy, energy efficiency and cogeneration projects
HOMER:	Computer model that simplifies the task of evaluating design options for both off-grid and grid-connected power systems for remote, stand-alone and distributed generation (DG) applications



Executive summary

The purpose of the ECOWAS Regional Renewable Energy Policy (EREP) is to ensure increased use of renewable energy sources such as solar, wind, small-scale hydro and bioenergy for grid electricity supply and for the provision of access to energy services in rural areas. The EREP scenario will complement other important conventional sources for power production (e.g. large hydro and natural gas). The policy primarily focuses on the electricity sector, but also considers some additional issues regarding the use of heat in the domestic energy sector and the potential production of biofuels. The gender-balanced policy aims also at promoting job creation and business development throughout the value chain of renewable energy technologies (e.g. manufacturing, installation and construction, operation and maintenance).

Rationale for EREP

The EREP, in combination with the ECOWAS Energy Efficiency Policy (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. The situation is characterised 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.

As the region is endowed with large potentials of renewable energy resources, and as renewable energy technologies are approaching grid parity in certain circumstances, the ECOWAS region stands today at the threshold of a new regional power supply concept based on large bulk power generation provided and distributed by the West African Power Pool (WAPP) and on a substantial contribution provided by renewable energy options financed by the private sector and private banking institutions. Furthermore, under the coordination of the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE) some ECOWAS Member States have already developed renewable energy policies and strategies and the EREP wishes to take advantages of these front-liners.

The EREP takes into account the efforts already deployed by the WAPP through the emergence of a regional power market and by the PREDAS project in the CILSS countries, in particular:

- For electric power: the goal is to cater for short-term current national power supply deficits with renewable energy options becoming part of a long-term perspective and to promote access in rural areas.
- For wood energy: the focus will be on the technological aspects having significant positive impacts on the woodlands (improved stoves and carbonisation) and on awareness creation.
- For biofuels: the policy wishes to capitalise on the achievements of some countries (Mali, Ghana, Burkina Faso, and Senegal).



Added value of a regional policy for Renewable Energy

A regional renewable energy policy creates added value and can complement or facilitate the adoption of national policies. It has the potential to:

- Encourage the adoption of national targets and action plans which contribute to the achievement of the regional targets;
- Bring guidance for a harmonised framework at national level for the preparation of standard PPA, FIT, concession schemes etc. through a close collaboration between ECREEE and the ECOWAS Regional Electricity Regulatory Authority (ERERA) ;
- Enable the harmonisation of tax and duty policies and common standards and regional quality labelling for equipment and systems as well as the certification of skills;
- Create a credible pool of knowledge on renewable energy technologies and resources through ad-hoc institutions and capacity building networks by mutualising the training know-how of the few specialised technical institutions in the region;
- Promote a regional market for renewable energy investments, generation and equipment manufacturing and job creation.

Vision of the EREP

The vision of the EREP is to secure an increasing and comprehensive share of the Member States' energy supplies and services from timely, reliable, sufficient, least cost and affordable 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.

The EREP renewable energy scenario is fully complementary to the WAPP power supply strategy, and conventional national supplies, both as a significant contribution to bulk power generation and as a prevailing contribution to universal energy access for rural areas. Renewable energy can potentially become an engine for industrial development and employment creation and lead the ECOWAS Member States on the more gender-balanced path to "the green economy". The EREP will create strong links and synergies with the envisaged activities under the ECOWAS Energy Efficiency Policy (EEEP).

Objectives

- Improve safety and sustainability of energy supply in the ECOWAS region;
- Support the region's socio-economic development without imposing major economic costs;
- Promote access to energy services in rural and urban areas by 2030 in order to stimulate economic development and social and productive uses;
- Create a favourable environment to attract private sector investment and use renewable energy as an engine for industrial, social and economic development;
- Reduce dependence on imported fossil fuels and exposure to volatile hydrocarbons international markets and thus have a positive impact on regional trade balance;
- Reduce the negative environmental externalities of the current energy system, such as forest resources overexploitation, local pollution or emissions of greenhouse gases, by positioning the



ECOWAS Member States on the path towards sustainable development and a low carbon economy, as well as 'developing greater resistance to climate change;

- Mainstream gender in renewable energy related issues in particular associated with women productive roles.

Targets

Three groups of targets are set by the EREP: for grid-connected renewable energy applications; for off-grid and stand-alone applications; and for 'domestic renewable energy applications':

Table 1: Targets for grid connected renewable energy

in MW installed capacity	2010	2020	2030
EREP renewable energy options in MW	0	2,425	7,606
EREP renewable energy options in % of peak load	0%	10%	19%
Total renewable energy penetration (incl. medium and large hydro)	32%	35%	48%
in GWh	2010	2020	2030
EREP renewable energy options – production in GWh	0	8,350	29,229
EREP renewable energy options - % of energy demand	0%	5%	12%
Total renewable energy production (incl. medium and large hydro)	26%	23%	31%

Table 2: Targets for off-Grid applications

Least-cost option	2010	2020	2030
Off-grid (mini-grids and stand-alone) share of rural population served from renewable energy in %		22%	25%

Table 3 : Target for Domestic applications and biofuels

Least-cost option	2010	2020	2030
Biofuels (1st generation)			
Ethanol as share of Gasoline consumption		5%	15%
Biodiesel as share of Diesel and Fuel-Oil consumption		5%	10%
Improved cook-stoves - % of population	11%	100%	100%
Efficient charcoal production share-%		60%	100%
Use of modern fuel alternatives for cooking (e.g. LPG) - % of population	17%	36%	41%
Solar water heater technologies for sanitary hot water and preheating of industrial process hot water: - Residential sector (new detached house price higher than €75,000) - District health centres, maternities, school		At least 1 system installed	At least 1 system installed



kitchen and boarding schools		25%	50%
▪ Agro-food industries (preheating of process water)		10%	25%
▪ Hotels for hot sanitary water		10%	25%

- 7% of the Renewable Energy equipment, by value, installed in 2020 is regionally manufactured. This proportion should reach 20% by 2030.

Implementation Strategy

The implementation strategy is summarised in the following chart diagram.

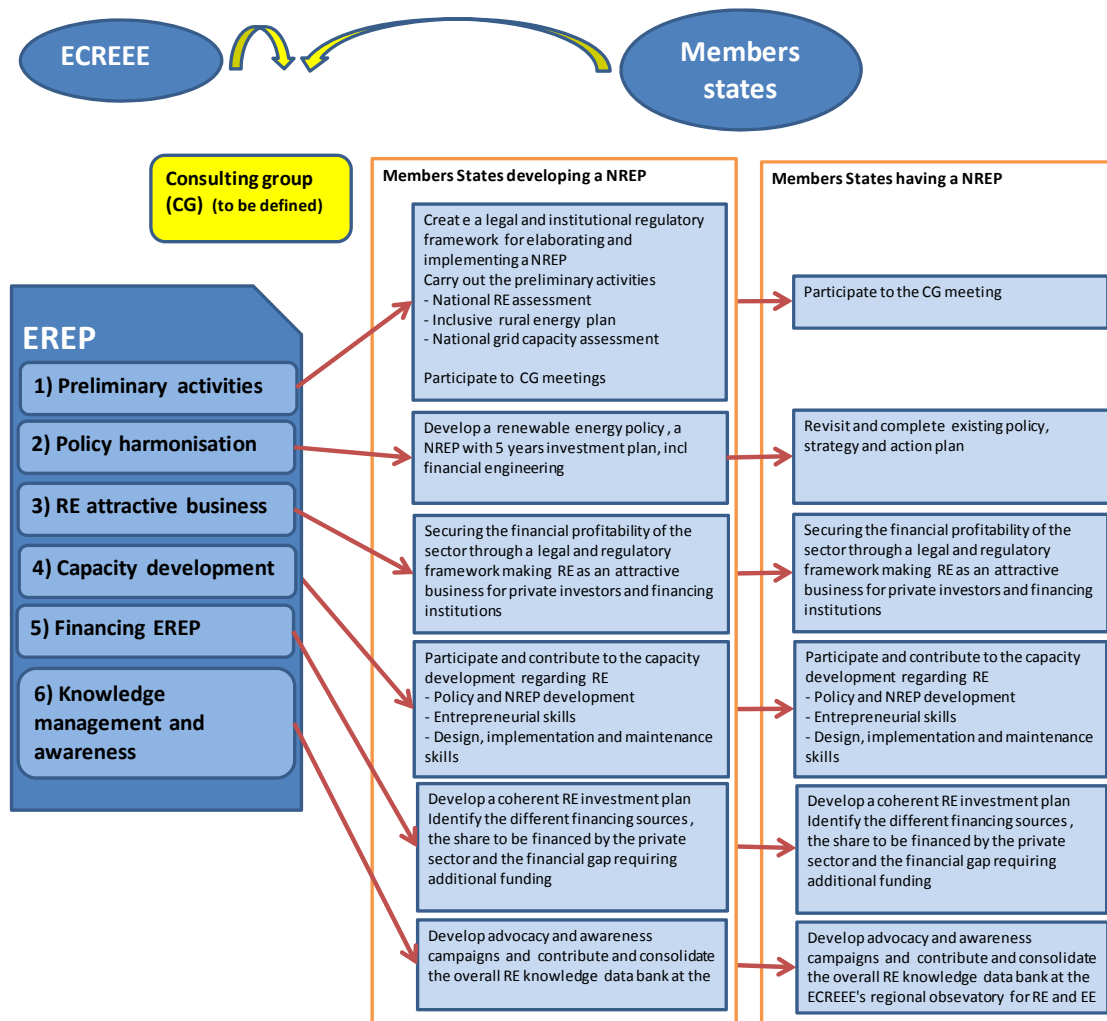


Figure 1 : Implementing the EREP and the NREPs

The policy will be implemented following the principle of subsidiarity; ECREEE will develop activities having an added value for the regional level while at the same time the Member States will develop their National Renewable Energy Policy and Action Plan (NREP) if needed.



The EREP will be articulated around the following six actions:

- Secure a coherent, efficient and flexible legal, institutional and regulatory framework in order to develop consistency between the regional and the national renewable energy policies;
- Each Member State has a National Renewable Energy Policy (NREP) with an associated implementation strategy and a five year rolling action plan;
- Make renewable energy power and hardware production an attractive business for private investors/entrepreneurs;
- Capacity Development for national officials, and required technicians to design, implement and operate renewable energy applications;
- Financial Intermediation seeking a larger involvement of the private industrial and banking sector
- Advocacy, Awareness and Knowledge Management through the ECREEE Regional Observatory for Renewable Energy and Energy Efficiency (ECOWREX).

Monitoring of Policy implementation

A monitoring structure will be established and monitored by the ECREEE. The National Focal Institutions representing ECREEE at the Member States level will ensure the day to day communication between the regional and the national levels.

Time schedule

The present policy is expected to be approved by the ECOWAS energy ministries at the Accra Conference in late October 2012.

Year 1: ECREEE will develop all necessary regional inputs to the NREPs development or update to ensure a launching of the NREPs' development in March 2013.

Meanwhile, ECREEE will develop activities for donors' pledges for EREP and NREPs and for entrepreneurial business to business cooperation.

It is expected that the official launch for NREPs could take place in March 2013. Each Member State should have an updated NREP with a 5 years investment programme latest by March 2014.

Following the adoption of this policy document:

Year 1:

- Member States establish according to their needs their national legal and institutional framework, identifying the national officials in charge of renewable energy planning.
- All necessary guides, curricula, training sessions are prepared and all available information distributed to the Member States through the NFIs.
- A Regional Conference launching the process is held in the region. This event will offer opportunities for back-to-back activities for training and/or business development.

Year 2:

- National Renewable Energy Policies are adopted by Member States with an associated implementation strategy and a-five years rolling action plan and necessary budgetary allocation.
- According to the NREP and action plan, all countries will have mainstreamed renewable energies into their national institutional and regulatory frameworks.



Background Information

At the background of the severe energy crisis in the Economic Community of West African States (ECOWAS), the fifteen Member States¹ have expressed the need to mainstream renewable energy and energy efficiency into their national policies. In this context, the countries have agreed on a stronger regional cooperation and integration to accelerate this process. The renewable energy and energy efficiency directives of the European Union have shown that regional integration can be an effective tool to catalyse necessary actions at national level. As a consequence, the ECOWAS Member States created the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE) in 2010. As part of its mandate, the Centre has been leading the process of developing and implementing the ECOWAS Renewable Energy Policy (EREP) and the ECOWAS Energy Efficiency Policy (EEEP). Both policy documents will be adopted by the ECOWAS Energy Ministers during the ECOWAS High Level Energy Forum, to be held from 29 to 31 October 2012. The policy was prepared on the basis of a comprehensive baseline report on renewable energy in the ECOWAS region.

Scope of the Document

Renewable resources include solar energy, wind, hydro, the heat of the earth (geothermal), plant materials and biomass and organic wastes (bioenergy), waves, ocean currents, temperature differences in the oceans and the energy of the tides. Renewable energy technologies produce power, heat or mechanical energy by converting those resources either to electricity or to motive power. The focus of the EREP lies on commercially viable and mature renewable energy technologies which can rely on a significant feasible potential in the ECOWAS region. The scope of the policy document is limited to the renewable energy technologies described below. They will be referred throughout this document as “EREP Renewable Energy Options”:

- Small-scale hydropower (Small-hydro or SSHP) up to a maximum installed capacity of 30 MW (partially includes also medium-scale hydro power projects (MSHP) from 30-100 MW). Large-scale hydro power (LSHP is starting from 100 MW) is covered by the WAPP Master Plan and widely used in the region. In this sense, the policy shall be seen as complementary to the WAPP Master Plan.
- Bio-energy covering three different fields:
 - Woodfuels (firewood and charcoal) used for domestic cooking purposes and commercial applications (restaurants, breweries, potteries, blacksmith). Excess woodfuels resources could be used for power generation with other biomass
 - By-products from crops production for power generation (stalks, straw, husks, shells, kernels etc.). These can serve as fuel for power generation when gathered together on an agro-industry site. Power can also be generated through biogas production using industrial or urban waste, manure and dung (resource concentration at dairies or slaughter houses or cattle and vegetable markets)

¹ Benin, Burkina Faso, Cape Verde, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo



- Finally energy crops for power generation or sustainable biofuels (e.g. jatropha) offer some interesting perspectives. This policy considers 2nd generation biofuels which do not compete with food crops for available land, and comply with the following minimum criteria: lifecycle GHG reductions, including land use change, and social standards. It is envisaged that ECOWAS will develop a separate policy on sustainable biofuels.
- Wind energy (on-grid and off-grid applications)
- Solar: PV and CSP and solar thermal water heating.

The policy aims at creating synergies with other policies of ECOWAS, WAPP and UEMOA and particularly the ECOWAS Energy Efficiency Policy (EEEP). The policy document is the result of a consultative process with stakeholders in the ECOWAS region. Further technical details and analyses can be found in the annex and the baseline report.



1 Context

The effort to develop and implement a **regional renewable energy policy responds to the severe energy crisis in the fifteen ECOWAS Member States**. The current status of the energy system hampers the social, economic and industrial development of the whole region. The countries face the interrelated challenges of energy access, energy security and climate change mitigation simultaneously. Electricity shortages in urban areas and lack of access to modern, affordable and reliable energy services in rural areas are interrelated with a variety of economic, social, environmental and political problems.

1.1 Energy poverty

In “business as usual” scenarios – without considerable additional investments – **energy poverty and its consequences for the economy and society will continue to be a predominant challenge** in the ECOWAS region in 2030. West Africa, with around 300 million inhabitants, equivalent to roughly one third of Africa’s total population, has one of the lowest modern energy consumption rates in the world. There are **significant energy pricing and income inequalities between urban and rural areas** and among different social groups, a phenomenon common to many developing countries. The urban and rural poor in West Africa spend proportionately more of their income for poor quality energy services than the better-off for better quality services. Whereas urban areas tend to use energy higher up the energy ladder (e.g. electricity, charcoal, kerosene etc.), rural areas continue to rely on traditional biomass for meeting their energy requirements for cooking and lighting.

In 2009-10, it was estimated that nearly 175 million people had no access to electricity. Amongst them, 25% are living in urban and 75% in rural areas. In some countries, less than 10% of the rural population has access. In the most optimistic scenarios it is estimated that 75% of the population will have access to grid electricity by 2030. This would still leave almost 150 million inhabitants and 58% of the localities in the ECOWAS region without access. If this trend continues, the region would be far from achieving universal energy access.

The **private sector has not been attracted to invest in electricity in rural areas** due to the low consumption of electricity, limited ability and willingness to pay, and the high costs of diesel generation. Therefore, most governments have set up Rural Electrification Agencies (REAs) and/or Rural Electrification Funds (REFs) to promote decentralised rural electrification. However, for various reasons, these have not been able to make much impact so far. A first summary of the achievements² of the REAs/REFs since their creation in the late 90’s and early 2000, shows that in many cases the REFs were not adequately designed as sustainable financing mechanisms, and the REAs did not have sufficient financial and technical expertise to mobilize funding and mainstream innovative renewable energy technologies.

² CLUB-ER Publications: Financing Rural Electrification Programmes in Africa, 2010 www.club-er.org



Meanwhile, if the total energy situation is considered, **traditional biomass** (firewood and charcoal) represents the bulk of the final energy consumption, reaching up to 70-85% in some of the countries. Although there are efforts to promote the use of LPG in urban areas, charcoal has remained the basic fuel used in these areas; charcoal is preferred to firewood because of its better combustion and its lower transportation costs compared to firewood, but its conversion from firewood is inefficient. The rural population use firewood in traditional stoves. Increasing population and urbanisation are, therefore, severely impacting the forest and savannah woodland environment, calling for stringent ameliorative measures. The use of woodfuels is also severely impacting the health and quality of life of rural and urban people, particularly women and infants.

1.2 Energy security

The electricity systems in West Africa are facing challenges due to the **growing gap between predicted demand, existing supply capacities and limited capital to invest**. Additionally, the energy intensity and the electricity losses during generation, transmission and distribution are very high, thus compounding the problem. Power shortages lead to regular blackouts and load shedding causing huge social and economic costs. Increasing fossil fuel import dependency, shortages and fluctuating fossil fuel prices are major concerns of West African countries and require a diversification of sources. In some countries even more than 90% of the electricity generation is satisfied by expensive diesel or heavy fuel. As a result, the steadily increasing and fluctuating oil prices have had a devastating effect on the economies in the region.

The **consumer tariff structure is not very rational**. The average consumer tariff lies at 13.6 c€/kWh, but in some countries it is even much higher. This is largely because of rising dependence on oil-based generation. The operating average cost of diesel is 20.4 c€/kWh. Nevertheless, in almost all countries of the region, rates charged to enable residential/commercial/industrial consumers do not enable full cost recovery. This has led to offering of large blocks of highly subsidised electricity to different customers regardless of their incomes. The issue of high connection fees has also not been addressed, which leaves out many poorer households from the grid.

Existing **power generation costs are high**, partly because of the dependence on diesel and heavy fuel whose prices have been rising and much of it has to be imported, for most of the smaller oil importing countries in the region. As a consequence, tariffs are either high or highly subsidised, considerably straining national budgets. The state utilities are often plagued by weak management capacity resulting in less efficient operations and uncertain financial viability. As these utilities continue to be under-capitalized, their capacity to access financial markets for upkeep and expansion projects remains severely constrained. Yet, in most cases, these will be the central actors in the reversal of these challenges.

1.3 Climate Change

With the consideration of climate change, another concern was added to the heavy energy agenda of the ECOWAS region. West Africa is only responsible for a fraction of global energy related GHG emissions. However, the **energy sector will be highly impacted by mitigation and adaptation costs of climate change** in the forthcoming decades. Climate change risks and the need for reliable and affordable energy supply to ensure energy security and energy access create a dilemma. On the one hand, urgent investments are required. On the other hand, the expansion of energy supply based on



inefficient low-cost fossil fuel combustion technologies will increase GHG emissions and interrelated negative climate change impacts which harm Sub Sahara Africa at most. New energy infrastructure investments have a long life-time and determine the GHG emissions for the next 20 to 30 years. Climate change impacts (temperature rise, extreme weather events, and droughts) will challenge the energy security of ECOWAS countries and have to be mainstreamed into energy policy planning. This is particularly important with regard to hydro power due to the possible changes in the rain patterns and river flows.

1.4 Weak policy frameworks

The **institutional, regulatory, legal, and tariff structure and framework are largely non-existent or weakly implemented**. So far there are only a few incentives for private capital to invest in the renewable energy (RE) sector in West Africa. Investments in RE power projects have had a predominant share of Official Development Assistance (ODA) funding. The success stories regarding Independent Power Producers (IPP's) are mostly related to power production through natural gas. If one looks at the big picture, of the total investment of €1.92 billion for the ECOWAS energy sector, total renewable energy investment accounts for only 5 % and IPP investment 3.5%. New projects of wind and solar energy through IPP in Cape Verde could be the harbinger of change. Investors want transparency (easily understood/open to all), longevity, certainty, and consistency. Such frameworks would have to be developed.

The general focus of utilities and Governments has been on conventional power systems, although this is beginning to change. Rural electrification has been largely conceived as a natural grid extension of the national electrification plan. Thus, little attention has been given to mini grids or stand-alone systems and there are only a few scattered examples. Although rural areas have low consumption density, and poor power purchasing potential and cost of transmission lines to reach them is very high, grid based solutions have been thought of being more economical and easier to manage in terms of cross subsidy through tariff. Also, as a consequence, although the ECOWAS region is well endowed with renewable energy resources, their share in the countries' energy mix is almost zero when large hydro power generation is excluded. The policy environment has not helped improve the situation significantly, but there has been a growing realisation over the last few years that drastic action is required to ensure adequate generating capacity in the region, and to develop both conventional and renewable energy sources. The need to address the energy access issues and improve the cooking energy situation has now been recognised as a priority.



1.5 Regional energy policies and initiatives

The Regional Renewable Energy Policy has been developed within the context of several recent regional and global energy policy initiatives and strategy frameworks:

- The ECOWAS White Paper on a Regional Policy for Increasing Access to Energy Services in Peri-Urban and Rural Areas by 2015
- The UN Sustainable Energy for All (SE4ALL) Initiative
- The WAPP Revised Master Plan for an integrated regional power market
- UEMOA-IRED initiative for sustainable energies
- CILSS initiatives on PV and traditional biomass

1.5.1 ECOWAS White Paper

In 2006, the **ECOWAS White Paper on a Regional Policy for Increasing Access to Energy Services in Peri-Urban and Rural Areas** set the following three targets to be achieved by 2015:

- 100% of the total population should have access to improved cooking fuels and stoves, whereas 9.2% currently have access to LPG cooking devices.
- 66% of the population in rural and urban areas should have access to individual electricity supply; 100% for the urban areas and 36% for the rural areas. Furthermore, 60% of the rural population should live in a locality with modern access to water supply, education and health services as well as telecom services.
- 60% of the population living in rural areas should have access to motive power for productive uses.

Furthermore, among the 10 indicators listed to measure the impacts of the policy, indicator 10 states that at least 20% of the new investment in electricity generation in rural areas should be driven by local and renewable resources. Recently undertaken progress reviews of the implementation process of the White Paper indicate that most of the targets will not be achieved by 2015. A renewed political commitment and a stronger focus on sustainable energy solutions are required.

1.5.2 The UN Sustainable Energy for All (SE4ALL) Initiative

The UN Secretary-General has launched the Sustainable Energy for All (SE4ALL) Initiative. The Secretary-General is urging all stakeholders, including at the highest level and in private and public sectors, academia and civil society to take concrete action and commitments towards three critical objectives – all to be achieved by 2030: (1) ensuring universal access to modern energy services; (2) doubling the share of renewable energy in the global energy mix, and (3) doubling the global rate of improvement in energy efficiency. Tangible commitments have been mobilized through the Secretary-General's High-level Group on Sustainable Energy for All (SE4All). The United Nations Conference on Sustainable Development held in Rio de Janeiro, Brazil in June, 2012 (Rio+20) concluded with more than US\$500 billion mobilized with over 700 commitments made, most of them in sustainable energy. The commitments are to be transformed into a framework of concrete actions



globally, including the ECOWAS region. Within this framework, ECREEE has the mandate to represent the ECOWAS region on all matters relating to renewable energy and energy efficiency.

1.5.3 WAPP Revised Master Plan

The framework for an integrated regional power market is set up by the **West Africa Power Pool (WAPP)** with the main objective of finding a technical and economic optimum between:

- Development of large regional power generation projects
- Development of regional power interconnections among the ECOWAS countries, so that power from the projects could flow to the deficit countries.

The WAPP Master Plan approved in September 2011, foresees 30 power generation projects selected as WAPP regional projects with a total capacity of 10.3 GW and a cost of US\$18 billion (€15 Billion). The major share of this new capacity is projected to be available from 2017 to 2019. The selected projects are based primarily on large hydro power (21) with 7,093 MW, on natural gas (3) with 1,300 MW, on coal (2) with 1,075 MW and on renewable energy (4) with 800 MW. It must be noted that some projects are already getting delayed, and, therefore, the proposed scenario will most likely not happen as scheduled. This would have serious consequences for the importing countries and countries relying on new large hydro. In this context, RE technologies might be becoming more competitive.

1.5.4 Regional Initiative for Sustainable Energy - IRED

The development objective for the IRED is formulated as follows: *'In 2030, all UEMOA³ citizens will have access to a cheap energy supply, from a West African comprehensive, integrated and harmonised power market delivering clean energy based on a dynamic public private partnership'.*

This initiative is based on 3 main pillars:

- Rehabilitation and development of large hydro-production;
- Conversion from oil to gas of existing thermal production and rehabilitation and development of large gas fired combined cycle plants (450 MW);
- Sharing the regional capacity through the regional integration (interconnections).

It is expected that an increasing share of additional power capacity can be covered by renewable energy.

1.5.5 Permanent Inter-State Committee for Drought Control in the Sahel (CILSS)

The CILSS initiative (PREDDAS) covers 7 of the ECOWAS countries (Niger, Burkina Faso, Mali, Senegal, Cape Verde, Guinea Bissau and The Gambia) and focuses on woody biomass, sustainable management of forest and wooded lands and sustainable use of wood-fuel, including substitution strategies (LPG and kerosene). Efforts are being made in the CILSS countries to build commitment around a national domestic fuel policy having sustainable forest management, efficient uses of the resources (cook stoves and charcoal production) and fuel substitution as main pillars.

³UEMOA Member States are: Benin, Burkina Faso, Ivory Coast, Guinea-Bissau, Mali, Niger, Senegal, and Togo.



1.5.6 The ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE)

ECREEE is a specialized agency of ECOWAS with a public mandate to promote regional renewable energy (RE) and energy efficiency (EE) markets. It acts as an independent body but within the legal, administrative and financial framework of ECOWAS. The Centre was established in 2010 with support of the Governments of Austria and Spain and with key technical assistance of the United Nations Industrial Development Organization (UNIDO). In 2011, the ECOWAS Commission launched two complimentary projects to develop the Regional Renewable Energy Policy and the Regional Policy on Energy Efficiency. ECREEE aims at creating an enabling environment for regional RE&EE markets by mitigating various barriers for the dissemination of green energy technologies and services. The Centre implements activities, programs and projects in the scope of four priority areas: 1) tailored policy, legal and regulatory frameworks; 2) capacity development and training; 3) knowledge management, awareness raising, advocacy and networks; and 4) business and investment promotion.

1.6 Opportunities and promising trends

1.6.1 National RE Policy Development

Several countries have adopted or are in the process of developing a renewable energy policy and favourable institutional structure. However, only some countries have taken concrete steps to implement the policies. There is a lack of clear responsibility for renewable energy policy implementation in most countries, and only a few have dedicated agencies in this area. There is also a lack of clear mandate to promote renewable energy. In general, the responsibility for renewable energy is located within the Ministry of Energy (Senegal created a Ministry of Renewable Energy but the policy action was reversed). There are only few cases where there are separate Directorates, but most are poorly staffed, funded and organised. Except for Cape Verde, Ghana and Nigeria, there are no regulatory authorities dealing with renewable energy.

Cape Verde has been, in general, the pioneering country making renewable energy a priority for the development of the country. It aims at 50% penetration of renewable energy in the electricity mix by 2020 and has taken a number of steps towards implementation (e.g. RE law and other incentives). Recently, Cape Verde installed 25.5 MW of grid-connected wind farms and 7.5 MW of grid-connected solar PV plants. Senegal, Ghana, Mali, Liberia, Guinea, and Nigeria have developed a detailed renewable energy policy. Ghana and Senegal have passed a renewable energy law and feed-in-tariff systems are under preparation. Liberia, Mali, and Senegal have adopted ambitious RE targets of 30%, 25% and 15% (of installed capacity) respectively by 2021, and Ghana and Nigeria 10% by 2020.

1.6.2 Renewable energy potential

There is a huge technically and economic feasible potential for renewable energy development in West Africa. The resources are generous and well distributed among the countries.

- Wind potential is concentrated in the costal zones (Cape Verde, Senegal, Gambia, and possibly Ghana, Mali and Nigeria) ;
- Small-scale hydro potential is located particularly but not exclusively in the southern part of the region (Cote d'Ivoire, Ghana, Guinea, Guinea Bissau, Liberia, Togo and Sierra Leone) ;

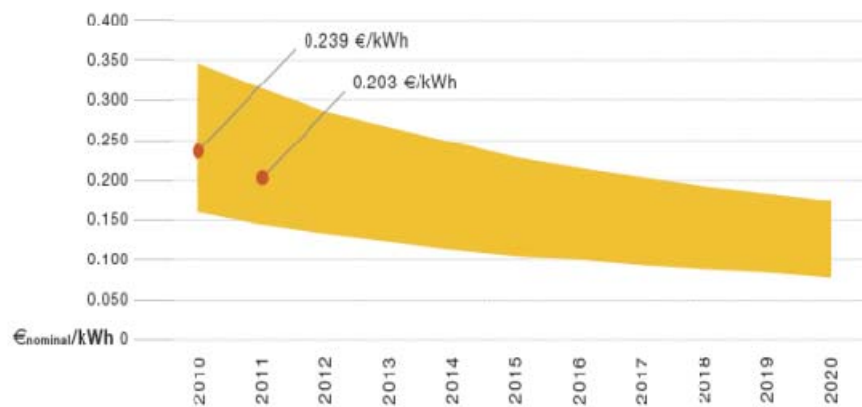


- Solar resource is abundant in the northern regions (Niger, Burkina Faso, Niger and the northern part of Ghana and Nigeria) ;
- Except for Cape Verde, biomass resources are well distributed among the region.

Therefore, there is considerable potential to address both grid and off-grid related energy service needs of the region.

1.6.3 Renewable energy becoming more competitive

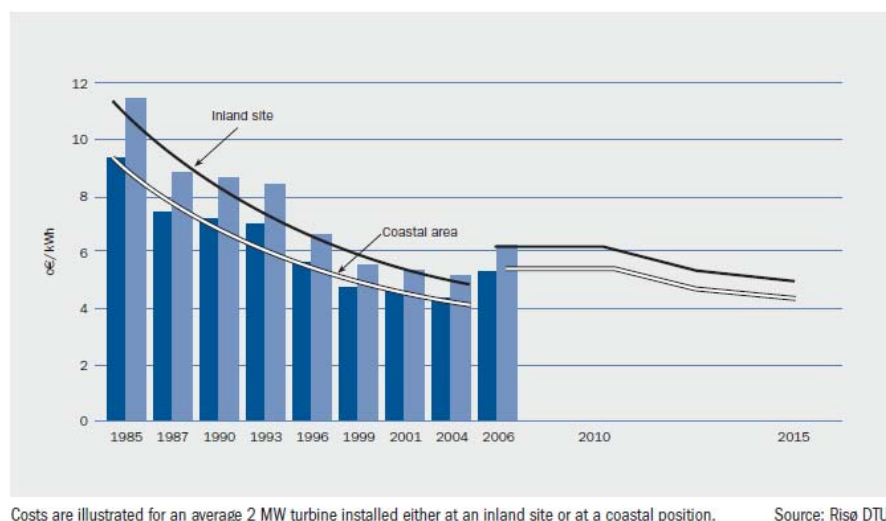
The market trend indicates a **price decrease for renewable energy technologies** on the one hand and a price increase for fossil fuel costs on the other hand. The reductions for solar PV are shown in the graph below, and price reduction for all renewable energy technologies is foreseen within the next 20 years.



(Source: European Photovoltaic Industry Association EPIA)

Figure 2 : European PV LCOE range projection 2010-2020

As far as wind energy is concerned, the experience curves illustrated in the graph below also show the promising future development of wind turbine economics by 2015:



Costs are illustrated for an average 2 MW turbine installed either at an inland site or at a coastal position.

Source: Risø DTU

Figure 3 : Using experience curves to illustrate the future development of wind turbine economics until 2015



1.6.4 Private sector investment

Globally and also in developing countries, investment in renewable energies is increasing. Although, there are few players and investors in West Africa, there is a **nascent interest from the private sector which needs to be capitalised by putting in place appropriate and stable policy and enabling regulatory frameworks.**

1.6.5 Advantages of renewable energy

In comparison to larger energy projects, EREP renewable energy options present a series of comparative advantages as they tend to be:

- Faster to implement
- Closer to the demand (reducing system losses and transmission costs)
- Less demanding in terms of investment packages, making it more suitable to the financial capability of regional/local entrepreneurs and financial institutions
- Cleaner in terms of pollutions and thus leading the ECOWAS Member States on the path to low carbon development patterns
- Economically more reliable in terms of reducing reliance on fossil fuel imports and exposure to volatile international markets
- Create more local economic and social added value.



2 Vision of the policy

The vision of the EREP is to secure an increasing and comprehensive share of the Member States' energy supplies and services from timely, reliable, sufficient, least cost and affordable uses of renewable energy sources. This should enable the entire region to reach **universal access to sustainable energy services by 2030**.

In line with the ECOWAS/UEMOA White Paper for Energy Access, the EREP vision also includes a **more sustainable and safe provision of domestic energy services for cooking**.

The EREP scenario is fully complementary to the regional WAPP power supply strategy and national supply strategies. The scenario aims at reaching a **significant contribution of RE to bulk power generation** and **an almost exclusive contribution to universal energy access for rural areas** without the perspective to be connected to the grid in the near future.

Renewable energy technologies might become an **engine for industrial development and employment creation - "the green economy"** - related to manufacturing of items, the design of equipment, building, operating, and maintaining of equipment and plants. It would also become part of a comprehensive rural development strategy, spawning rural entrepreneurship and increase in rural incomes.

It is also expected that the woody resources, which are severely threatened by the demographic growth and its inefficient uses, will recover due to the efforts to introduce efficient cooking stoves, improved charcoal burning methods and new paradigms for forestry management.

EREP Best-Case Scenario by 2030

As a result of the development of regional and national conducive institutional and regulatory frameworks during 2013-2014, a flourishing market for renewable energy technologies will grow. This enables a comprehensive integration of new renewable energy sources into national energy systems and the regional electricity balance as well as considerable job and business creation. The success is a result of a solid commitment to EREP approach at the highest level by all ECOWAS Member States, under the competent monitoring of ECREEE and its partners. Universal access for all ECOWAS citizens becomes a reality in 2030, and 75% of the population at that time is grid connected. Renewable energy reaches a share of about 48% of the overall installed electricity capacity in the ECOWAS region (incl. medium and large hydro) in 2030. The remaining 25% of the ECOWAS population living in smaller localities in remote rural areas will enjoy electricity services from mini-grids or will be supplied by highly reliable stand-alone systems. Mini-grids will provide high quality services at competitive prices.



2.1 Objectives for the EREP

The EREP aims at reaching the following overall policy objectives:

1. To improve energy security and energy sustainability

With the implementation of the WAPP Master Plan, the ECOWAS energy crisis is projected to be largely resolved from 2018 onwards. Although delays are quite likely, renewable energy power generation should become a full-fledged component of power production in the region to the maximum extent possible, for all countries, whether importers of energy or future exporters. But it would be especially important for the former, as they are the countries with the highest costs and least access. The power production from small hydro, biomass, and even wind and PV for the best locations, would be competitive with conventional power generation based on expensive diesel oil, DDO or fuel oil. (Refer to Annex 1 or cost estimates) The future oil prices may make this even more important.

It is expected that WAPP projects will take time. Renewable Energy projects, on the contrary, can be implemented much faster, once the proper policy and environment are in place. Therefore their contributions, although smaller, can be realized much more quickly.

There are also substantial possibilities of off grid applications such as solar PV for diesel mitigation and solar water heating which would reduce electricity demand.

2. To promote universal access to energy services

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Electricity access for rural areas faces two constraints: insufficient power capacity to cope with the actual connected demand and the need to develop national and rural transmission and distribution grids to reach remote areas with dispersed population. According to the present electrification patterns, it is estimated that grid extension electrification would reach 74.8% of the 600 million ECOWAS inhabitants in 2030, but only 42% of the localities will be served. The actual cost of local small scale diesel generation is about 33.0 c€/kWh and the minimum distribution cost for rural areas is 6.2 c€/kWh for less populated areas (50 inhabitants/km², 10% real discount rate and universal access from the beginning). As universal access is not necessarily sought from the beginning, this rural distribution cost is higher, close to the bulk power cost of the HV grid. The great advantage of renewable energy technologies is that they are deployable in a decentralized and modular manner. This makes them a particularly suitable energy source for small grids or off-grid solutions, which constitute a great potential in many rural areas where connection to the grid is too expensive. Off-grid renewable solutions are in that case the least cost and most sustainable options for rural areas.

3. To provide solutions for domestic cooking energy

Essentially, this would imply deployment of improved cook stoves to a majority of the population, improved practices for production of charcoal and supply of LPG, at least to urban areas. Current practices have led to very substantial deforestation. Therefore, to meet the supply



side, sustainable forest management practices would be necessary, which would reverse the current negative deforestation trend as well as provide sustainable supply of woodfuels in the future.

4. Create a favourable environment to attract private sector and using renewable energy as an engine for industrial development, fostering social and economic development

Increased investment in renewable energy will also mean job creation through (i) the renewable energy supply chain: from power plant construction and grid connection to operation and maintenance; (ii) productive uses of energy (irrigation, water pumping, desalination, ice production, telecommunication); (iii) business development (planning, manufacturing, assembling, installation and maintenance services); and (iv) provision of social services (health and education). This would also lead to a blossoming of local entrepreneurship and employment promoting economic development and also rise in rural incomes.

5. Mainstreaming gender in renewable energy related issues in particular associated with women productive roles

EREP renewable energy options will offer abundant job opportunities for men and women, in industry and trade sectors, but also in the management and the maintenance of decentralised and individual energy systems. EREP will secure an equal access for men and women to training, credit, and forums for local decision making on renewable energy.

6. To reduce the negative environmental externalities of the current energy system, such as air, soil and water pollution and GHG emissions, by leading ECOWAS Member States on the path to sustainable low carbon development, as well as developing an increasing resilience to climate change impacts, facilitating the development and implementation of NAMAs in the ECOWAS Countries.

7. To strengthen synergies with ECOWAS Energy Efficiency Policy (EEEP)

Synergies between EREP and EEEP regarding efficient uses of electricity, standardisation and labelling activities, and cook-stoves initiative will be strengthened at regional and national level.

Along with other developments in the energy sector, particularly those embodied in the WAPP Master Plan and the proposed policy on energy efficiency, EREP would help achieve the following results:

- mitigate the severe energy crisis in the ECOWAS region by addressing the challenges of energy security, energy access and climate change mitigation simultaneously;
- improve the financial sustainability of the overall energy generation and supply situation;
- reduce consumer tariffs and fossil fuel dependency and imports in some of the countries;
- meet the rapidly growing electricity demand in urban areas;



- increase supply reliability and energy security by using national available energy sources and contribute to universal access to modern, reliable and affordable energy services in rural areas where RE solutions tend to be at lower costs in comparison to conventional solutions by 2030;
- create a favourable environment to attract the private sector and using renewable energy as an engine for development and employment through jobs creation in the renewable energy supply chain;
- stimulate social and economic development: job creation, productive uses (irrigation, water pumping, desalination, ice production, telecommunication), business development (planning, manufacturing, assembling, installation and maintenance services), and provision of social services (health and education);
- secure sustainable supply of woodfuels for cooking energy needs thus preserving the forests and savannah areas.



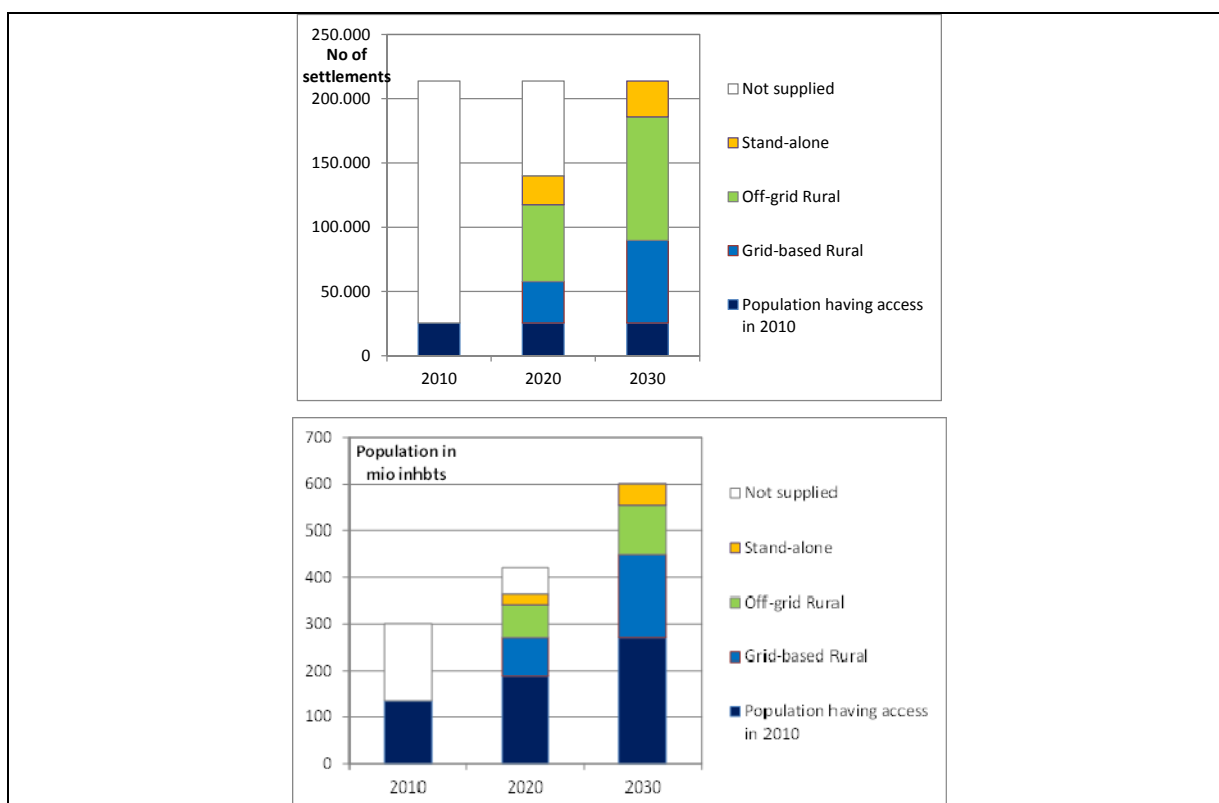
3 ECOWAS Renewable Energy Targets by 2030

Three groups of targets are set for the ECOWAS Renewable Energy Policy: *the first* for “**on-grid connected renewable energy applications**”; *the second* for “**off-grid and stand-alone applications**”; and *the third* for “**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). Each of these is considered separately.

3.1 Justification

In 2010, the overall ECOWAS population was estimated to be 300.7 million inhabitants who are distributed among 213,700 localities with more than 200 inhabitants. There are also several smaller settlements but their total population does not exceed 2% of the overall situation. In 2010, it was estimated that 42% of the overall ECOWAS populations have a potential access to the grid, however only 12% of the localities are covered by electrification. It is estimated that 75 % of the population will be supplied by the grid in 2030, thanks to the implementation of the WAPP generation and transmission plan. In 2030, 104 million inhabitants will be supplied with decentralised mini-grid systems for 96,000 localities having a suitable size (200 to 2,500 inhabitants) while 47 million inhabitants living in small settlements will be supplied by stand-alone systems.

Figure 4: Localities and population supplied by the grid and decentralised RE solutions by 2030





3.2 Grid-connected Renewable Energy targets

The targets for grid-connected renewable energy, as presented in Table 4, 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.

Table 4: Grid-Connected Renewable Energy Targets for the ECOWAS region

in MW installed capacity	2010	2020	2030
EREP renewable energy options in MW	0	2,425	7,606
EREP renewable energy options in % of peak load	0%	10%	19%
Total renewable energy penetration incl. medium and large hydro	32%	35%	48%
in GWh	2010	2020	2030
EREP renewable energy options – production in GWh	0	8,350	29,229
EREP renewable energy options - % of energy demand	0%	5%	12%
Total renewable energy production incl. medium and large hydro	26%	23%	31%

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 as SSHP, wind and biomass are still viable and attractive options. Details are provided in the annex. The possible distribution of EREP investments by RE technology are summarised in Table 5 and 6.

Table 5: Scenarios for grid connected EREP renewable energy options

	Wind	Solar PV	Solar CSP	Small scale hydro	Biomass	Total
Installed capacity in MW						
By 2020	318	686	-	787	634	2,425
By 2030	993	1,156	1,000	2,449	2,008	7,606
Production in GWh						
By 2020	836	1,082	-	3,102	3,330	8,350
By 2030	2,314	1,823	3,679	9,654	11,758	29,229
Investments in millions €						
Up to 2020	541	1,166	-	2,872	1,901	6,479
Total investments,						



2030	1,540	1,773	3,980	8,357	4,959	20,609
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This table is illustrated by the charts in annex 1.

Table 6: Share of renewable energy in the overall ECOWAS electricity mix by 2020/2030

in MW	2020	2030
Load forecast ECOWAS in MW	25,128	39,131
RE capacity in MW	2,425	7,606
EREP-RE penetration in MW	10%	19%
in GWh	2020	2030
Demand Load forecast ECOWAS	155,841	243,901
RE production in GWh	8,350	29,229
EREP-RE penetration in GWh	5%	12%

Investments in renewable energies are at the same level of magnitude as the investments proposed by the WAPP Master Plan. Renewable Energies will need some financial support (e.g. subsidies, soft loans) during the first years to initiate the development of a regional market for renewable energy.

3.3 Mini-grids and stand-alone systems

The baseline report has shown that around 25% of the ECOWAS population in rural areas can be served by decentralised renewable energy solutions more cost-effectively (as shown in Table 7).

Table 7: RE Targets for mini-grids and stand-alone systems by 2020/2030

Least-cost option	2010	2020	2030
Off-grid (mini-grids and stand-alone) share of rural population served from renewable energy - %		22%	25%

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 decentralised 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. Some of the off-grid localities supplied before 2020 might be included in the grid extension as they will have grown up and their EREP renewable energy options connected to the grid. Therefore, the need for new mini-grids between 2021 and 2030 is higher than the increase of mini-grids as shown in the Table 8. The number of new mini-grids required is assessed to be 68,000 (see Table 9).

Table 8: Market assessment for mini-grid and stand-alone equipment

	Population in millions inhabitants			Localities		
	2010	2020	2030	2010	2020	2030
ECOWAS	300.7	421.0	601.4	213,700	213,700	213,700
Off-grid Rural		71.4	104.3		59,836	96,165 ²
Stand-alone Rural		21.0	47.2		(22,438) ¹	(27,781)



Off-grid Rural	0%	17%	17%	0%	28%	45%
Stand-alone Rural	0%	5%	8%	0%	10%	13%

1) No. of settlements (< 200 inhabitants) but not exhaustive – registered differently country by country

2) Some of the growing off-grid localities will be included in the grid extension and their EREP renewable energy options connected to the grid to support the voltage and reduce the community energy bill. The local distribution LV grid will be reused and extended.

Table 9: Estimated investment costs of mini-grid targets for ECOWAS in M€

	No of mini-grid	Invest per mini-grid	Total investment (M€)
2014-2020	60,000	0.283	16,980
2021-2030	68,000	0.215	14,620
2014-2030			31,600

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 (see in the annex 1) shows that such decentralised 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 with SHS or micro renewable energy systems that will be developed in the coming 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.

3.4 Renewable energy applications for domestic uses

3.4.1 Domestic cooking energy targets

Table 10 presents the renewable energy targets for domestic cooking energy.

Table 10 : RE Targets for Domestic Cooking Energy

Least-cost option	2010	2020	2030
Improved cook-stoves - % of population	11%	100%	100%
Efficient charcoal production share -%		60%	100%
Use of modern fuel alternatives for cooking (e.g. LPG) - % of population	17%	36%	41%

- For **improved cook-stoves**, as the pressure on the ECOWAS regional woodlands will grow exponentially, the policy includes the banning of inefficient stoves after 2020, enabling 100% of the urban populations to use high efficient wood and charcoal stoves (efficiency >35%) from 2020, and 100% of the rural populations to use high efficient charcoal stoves from the same date.
- For **charcoal production**, respectively 60%/100% of the production should be by improved carbonisation techniques (yield > 25%) in 2020 and 2030, as charcoal progressively replaces fire wood in the cities.



- For **modern cooking fuels (e.g. LPG)**, **penetration** rate should increase from current penetration rate of 17% to 36% by 2020 and 41% by 2030.

The major challenge to be overcome for domestic energy is not only to reduce consumption of woodfuels but also to secure sufficient and affordable cooking energy to the increasing urban population which will be in 2030 more than the actual total population of the ECOWAS.

According to the undertaken modelling exercise (see in the annex), in 2010, 36% of the population (108 million inhabitants) was living in localities with sizes bigger than 5,000 inhabitants. Their supply in domestic energy can be considered as fully monetised, as the distance to the resource is too high for free collection. The main domestic energy sources are provided by the forest (fire wood and charcoal). In some countries, the use of alternative fuels like LPG and kerosene has increased to an estimated 30% of urban population (LPG - Senegal, Ghana, Burkina Faso, Côte d'Ivoire) and kerosene (Nigeria) corresponding to a total 17% penetration. The remaining 70% in urban areas are covered by woodfuels with an increasing demand for charcoal as it is easier to transport, store and use. This change in consumption pattern from fire wood to charcoal as primary cooking fuel is irreversible. There will also be a huge demographic impact of the likely doubling of population by 2030, and continuing rapid growth in urbanisation.

As a consequence, the forest and other wooded land areas of the ECOWAS region have been reduced by 14.8% during the period 1990-2005 (FAO 2005) and this trend continues even if it has slowed somewhat. In 2005, ECOWAS total forest and wooded land's area was estimated at some 121.4 million ha (FAO, 2005). In 2010, the woodland was estimated to 114.0 million ha. Only four countries have succeeded in maintaining or increasing their forest areas: Cape Verde, Cote d'Ivoire, Burkina Faso and Gambia. However, the most exposed country in terms of deforestation is Nigeria, which has lost 62% of its forest areas since 1990, due to the pressure of the 7th world largest population on its forestry resources.

It is estimated that the current woodland resource cannot and should not provide more than 89 million tonnes woodfuels to avoid overexploitation with increasing risk for deforestation (see Figure 5). Actually, the requirements by 2030 in the normal situation would be 255 million tonnes. Thus the overexploitation index would be 241%, leading to a severe, and possibly irreversible, deforestation of the region.

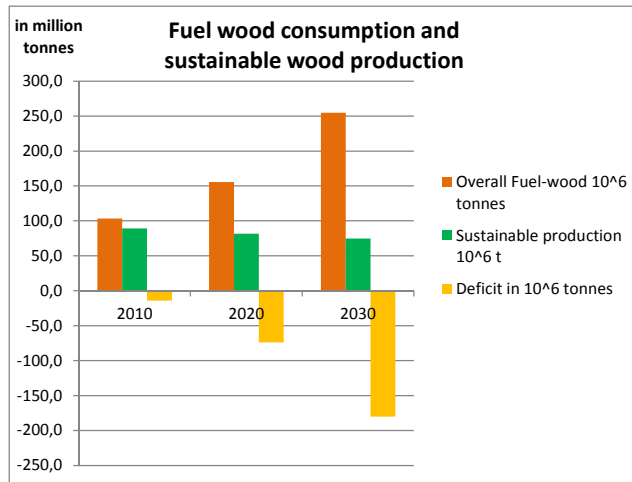


Figure 5: On the way to the ECOWAS region's deforestation

The recent evaluation of the PREDAS programme (CILSS 2010) shows that even if the forest potential in many CILSS countries *appears* sufficient to cater for the domestic demand, efforts still need to be made to strengthen the forestry management in order to extend the sustainable woodfuels production through community participatory management and improved charcoal burning as well as to secure an efficient use of this resource through promotion of efficient cook stoves. Four measures are identified to slow down this negative and alarming evolution:

- To develop and implement forestry management based on larger participation, responsibility and control from the local population seeking to increase the forest area substantially by 2030.
- To universalise dissemination of high efficiency cook-stoves (> 35%) to the urban population by 2020. All other stoves will be removed from the market and their manufacture banned by that date. **The target is thus defined as 100% penetration by 2020.**
- In terms of charcoal production, the approach is to secure higher carbonisation efficiency. The targets are to **increase the present average carbonisation efficiency from 14% by 2010, to 20% by 2020 and 25% by 2030 or in terms of production 75% efficient charcoal burning by 2020 and 100% by 2030.**
- The baseline for use of modern fuels like LPG and Kerosene as domestic energy is a penetration rate of 17% due to the large use of kerosene in Nigeria, accounting for 2/3rds of the 17%. Due to the positive and consistent impact of both previous measures, better carbonisation up to 2030 and ban of inefficient cooking stoves as of 2020, the substitution strategy will become less relevant except for Nigeria, as the gap between the domestic demand and the sustainable woodfuels production will grow steadily. Therefore, the target for the contribution of modern fuels to the regional domestic energy needs to be increased up to 36% by 2020 and 41% by 2030. By that time, this should occur as a result of the social welfare growth for the urban middle class. As shown in the figure below, the increase of LPG consumption will remain moderate for the ECOWAS countries except Nigeria (from 12% of the demand in 2010 to 20% in 2030). The use of kerosene in Nigeria will meanwhile grow from 20% in 2010 to 60% in 2030.

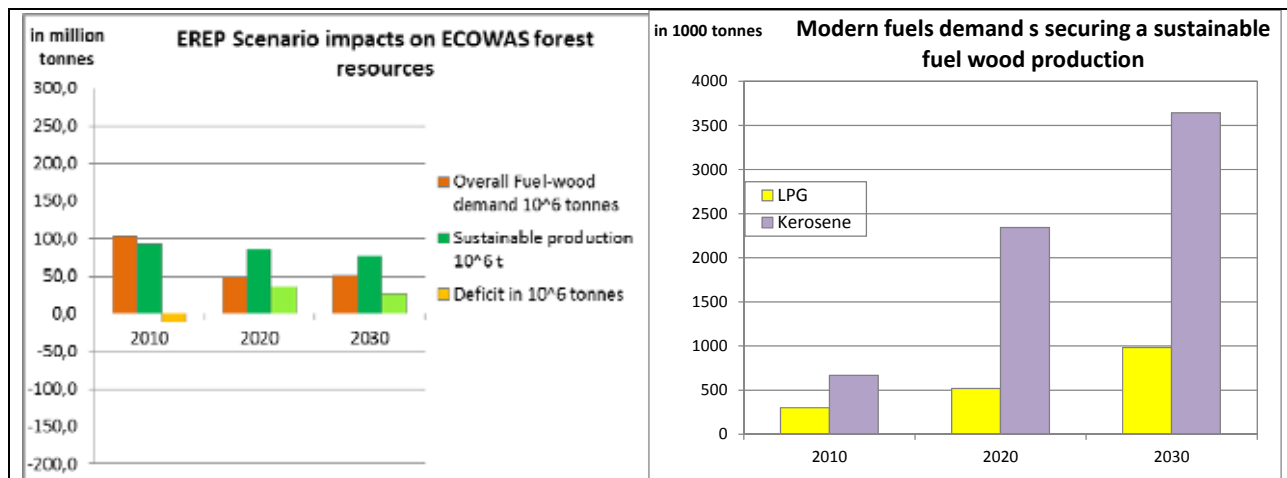


Figure 6: EREP scenario for domestic energy

3.4.2 Targets for solar thermal water heating

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 (see Table 11):

- 25 % and 50% of the district health centres 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.

Table 11 : Target for Solar Water Heating

Least-cost option	2010	2020	2030
Solar water heater technologies for sanitary hot water and preheating of industrial process water:			
• Residential sector (new detached house price higher than €75,000)		At least 1 system installed	At least 1 system installed
• District health centres, maternity clinics, school kitchens and boarding schools		25%	50%
• Agro-food industries (preheating of process water)		10%	25%
• Hotels for hot sanitary water		10%	25%

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. At present no targets for such off grid applications have been set, but these will be considered in due course.

3.5 Biofuels

In West-Africa the general attitude towards biofuel is cautious, as biofuel production is generally considered for the national demand and mainly as rural drive energy for motive power for the rural areas. At present time, two options can be taken into consideration: production of ethanol to be mixed in the gasoline (5 to 15% blending) and production of raw vegetable oil (e.g. jatropha) to be used directly or as biodiesel in diesel motors for local electricity production or pumping. The proposed targets will not anticipate the use of second generation biofuel production as that could be commercially available within 5 to 10 years. Therefore, two targets (see Table 12) are set:

- Ethanol production corresponding to 5% of the ECOWAS gasoline consumption in 2020 and 15% in 2030, to reduce the CO₂ emissions of 5/10% for light traffic in 2020/30
- Raw vegetal oil/biodiesel production corresponding to 5% of the ECOWAS diesel oil/DDO/fuel oil consumption in 2020 and 10% in 2030.

Table 12 : Target for the use Biofuels

Least-cost option	2010	2020	2030
Biofuels (1 st Generation)		5%	15%
Ethanol as share of Gasoline consumption			
Biodiesel as share of Diesel and Fuel-Oil consumption		5%	10%

The purpose of developing biofuels is both economic by cutting the importation of 5/10% gasoline at 2020/2030 horizon and social to bring development, added value and motive power to the rural areas through a local production of raw vegetable oil or biodiesel.

3.6 Development of renewable energy markets and of private investment

The target is to ensure that **7% of the renewable energy equipment installed in 2020 are regionally manufactured corresponding to a regional production of 170 MW**. This proportion should reach 20% in 2030, i.e. 1,520 MW/year.

Mainstreaming renewable energy in the Member States' institutional legal and regulatory frameworks will be instrumental for the local industrial development and employment creation. In particular, setting targets for different market segments will stimulate local entrepreneurial activities



related to manufacturing of items, the design of equipment, and building, operating, and maintaining of equipment and plants.

The targeted installation of 60,000 mini-grids systems by 2020 and 68,000 from 2020 to 2030 respectively and stand-alone systems of around 47 million people will naturally lead to development of related local manufacturing as well as operation and maintenance activities. The same can be stated for the domestic sector, where activities for improved cook-stoves and solar water heater technology will help to kick-start or intensify local related activities in these sectors.

Furthermore, fiscal measures and incentives as well as enforced regulations regarding norms for equipment and systems and certification of skills will be vital to create confidence within the private industrial and banking sector.

3.7 RE Barriers to be addressed

Various types of barriers are to be addressed to make the EREP scenario a reality. The existing barriers delay and hinder the dissemination of renewable energy technologies and services.

3.7.1 Policy and regulatory barriers

- The focus of national policy has consistently been on centralised grid development and conventional sources of electric power generation. There is an absence of clear-cut policies for the dissemination of renewable energy technologies. There has been lack of holistic energy planning and energy policy sometimes does not even include renewable energy. As a result, renewable energy technology development follows an ad-hoc path with no allocation of financial resources.
- Several incentives have been provided to promote investments in conventional power generation. Subsidizing grid development has also encouraged this which does not favour investments in alternative energy solutions.
- Non-discriminatory open access to the national electricity grid for renewable energy is not yet assured. There are other regulatory issues.
- Absence of a full-fledged rural electrification strategy with a clear demarcation between grid and off-grid electrification. In fact, the policy is mainly based on grid extension.

3.7.2 Financing and Investment barriers

- Production costs of renewable energies are often higher than subsidised conventional electricity price and it even tends downwards to economic grid parity cost. This also brings in the question of the high upfront investment cost to obtain renewable energy technologies for countries facing recurrent power shortage, and of absence of adequate financing mechanisms.
- For financial institutions, renewable energy technologies are perceived as too expensive solutions with lack of reliability and long-term viability. There is lack of effective regulation to support a workable financial framework encouraging investments.



3.7.3 Technological Barriers

- Procurement of equipment and local maintenance support for renewable energy-based electricity projects remains a real challenge because of the weakness of the present renewable energy market.
- Lack of actual conceptual capacity.
- Lack of critical mass to create conditions for local business.

3.7.4 Capacity barriers

- Lack of capacity in policy formulation, project development and RET financing – both individual and institutional. Availability of technical personnel at different levels, from engineers to technicians remains inadequate. Lack of promoters and entrepreneurs which would be essential for both centralised and decentralised and standalone systems.
- Lack of capacity to plan, structure and appraise projects in a financial view.

3.7.5 Limited public awareness

- Limited public awareness of advantages of renewable energy and its potential with regard to the energy challenges the respective country is facing.
- Inadequacy of awareness reinforces and underlies all of the other barriers and creates a market distortion which results in higher risk perception for potential renewable energy technologies.

3.7.6 Lack of Standards and quality control

- Poorly established standard and quality control of locally manufactured and imported technologies. Creating quality assurance is a precondition for building consumer confidence and in growing the market for renewable energy.

3.7.7 Inadequate resource assessment

Reliable and up-to-date sources of data would assist investors in making decisions on projects of renewable energy with more certainty. These barriers clearly indicate that developing renewable energy is not, for the most part, a problem of solving technological issues. It is, more fundamentally, one of putting in place an adequate institutional framework for the creation and implementation of policies that promote the use of truly accessible cleaner energy sources.



4 Implementation Strategy for the ECOWAS Renewable Energy Policy

4.1 Guiding principles for the EREP implementation

The strategy of the EREP builds on five key guiding principles:

Subsidiarity: to be applied during the implementation of the policy. The EREP will intervene in regional actions only when they can bring added value to national actions. The roles of national and regional institutions in the EREP process will be defined precisely.

Participatory approach: promotion of the approach based on the involvement of the end users in the definition of technical and organisational options. This will be realised by creating, when needed, a forum of national stakeholders for the private sector and the civil society together with the national officials from the relevant ministries, utilities and regulatory authorities. Its role will be to provide advice during the development of National Renewable Energy Policies and to assure the follow-up of their implementation.

Optimisation of the use of available financial resources and the raising of additional resources will require a mix of Public Development Aid (multi- and bi-lateral), national public financing and private financing. This will be done by seeking complementarities between regional and national funding sources and by prioritising 'high impact/ low cost' solutions.

Promoting public-private partnerships: this partnership will cover technical aspects, management systems, fund-raising and financial risk-taking. It is highly important that public actors (state, public institutions, local authorities, etc.) and private actors (national and local entrepreneurs, financial institutions, associations and co-operatives, NGOs, etc.) are mobilised. This will entail setting up appropriate regulatory frameworks and a transparent, incentive based framework.

Support to gender equality: in the context of implementation of the EREP an effort will be made to mainstream gender issues. Participatory approaches will be applied;

In addition to the above, the strategy will be implemented through a multi-sectoral approach ensuring that all needs are taken into account as well as the financial sustainability of retained solutions which should respect the principle of technological neutrality e.g. ensuring that only least cost solutions will be considered.

4.2 Legal and institutional framework and main stakeholders

The EREP will be the catalyst to turn the vision and the identified and quantified targets into concrete action and reality. However, the ECOWAS member countries will each define their own respective strategies for achieving the regional targets. In this process, they will be assisted by ECREEE. The Centre has a coordinating and monitoring role in the development and the implementation of the policy. ECREEE will be supported by key international partners (e.g. UNIDO, EUEI-PDF, Austria, and Spain).



At the regional level, the leading coordinating organisation for the implementation of the EREP is ECREEE. The Centre deals with the regional renewable energy sector, as the counterpart of WAPP which deals with the regional bulk power market. Both entities are ECOWAS institutions with competences and duties on complementary domains of the regional energy sector. Both cooperate with the ECOWAS Regional Electricity Regulatory Authority (ERERA) which is the third regional institution acting on the regional energy market. ECREEE will coordinate most of its activities in close cooperation with the National Focal Institutions (NFIs) in the Ministries of Energy among all ECOWAS countries and a network of regional and international training and research institutions. A challenge for ECREEE will be to build a relationship of trust with the international renewable energy business community and to be able to attract financing in both the renewable energy and the energy efficiency sector.

At the national level, the main challenge for the implementation of the NREP will be to develop portfolios of bankable projects that can be attractive for private investors and financial institutions in order to fulfil the quantitative and qualitative targets. Finally, the role of the private sector (manufacturers, energy services providers, investors, etc.), of the banking sector and of the civil society, including universities, research centres, NGOs, foundations, consumers associations etc. will be vital for the success of this policy. Their awareness and involvement must be sought throughout the implementation of the EREP and the formulation of NREPs.

The EREP implementing strategy will apply different approaches that will be carried out in parallel:

- **A top down approach** monitored and assisted by ECREEE in close cooperation with the NFIs, through guidance to the process, the preparation of technical guidelines and methodologies aiming at providing the countries with the necessary tools and capacity to prepare and implement the EREP on national levels. In this regard the countries will develop national renewable energy policies (NREPs).
- **A bottom up approach** from the Member States that will have to make the necessary efforts to harmonise their energy policies, electricity laws and regulations with the regional policy and streamline and strengthen their organisation so that a clear mandate for effective implementation of the policy is set up. This process will be carried out under the guidance and assistance of ECREEE.
- And a **‘bringing into coherence’** approach, ensuring consistency between national and regional implementation strategy, contributing to the rationalisation of national targets with regional targets.

4.3 Strengthening coordination among ECOWAS Member States

ECOWAS Member States have different RE starting points for the NREP formulation and adoption of implementation strategies:

- A first group of Member States are already advanced in the development of a renewable energy strategy and associated implementation strategy;
- A second group of Member States where the effort to mainstream renewable energy is in progress;



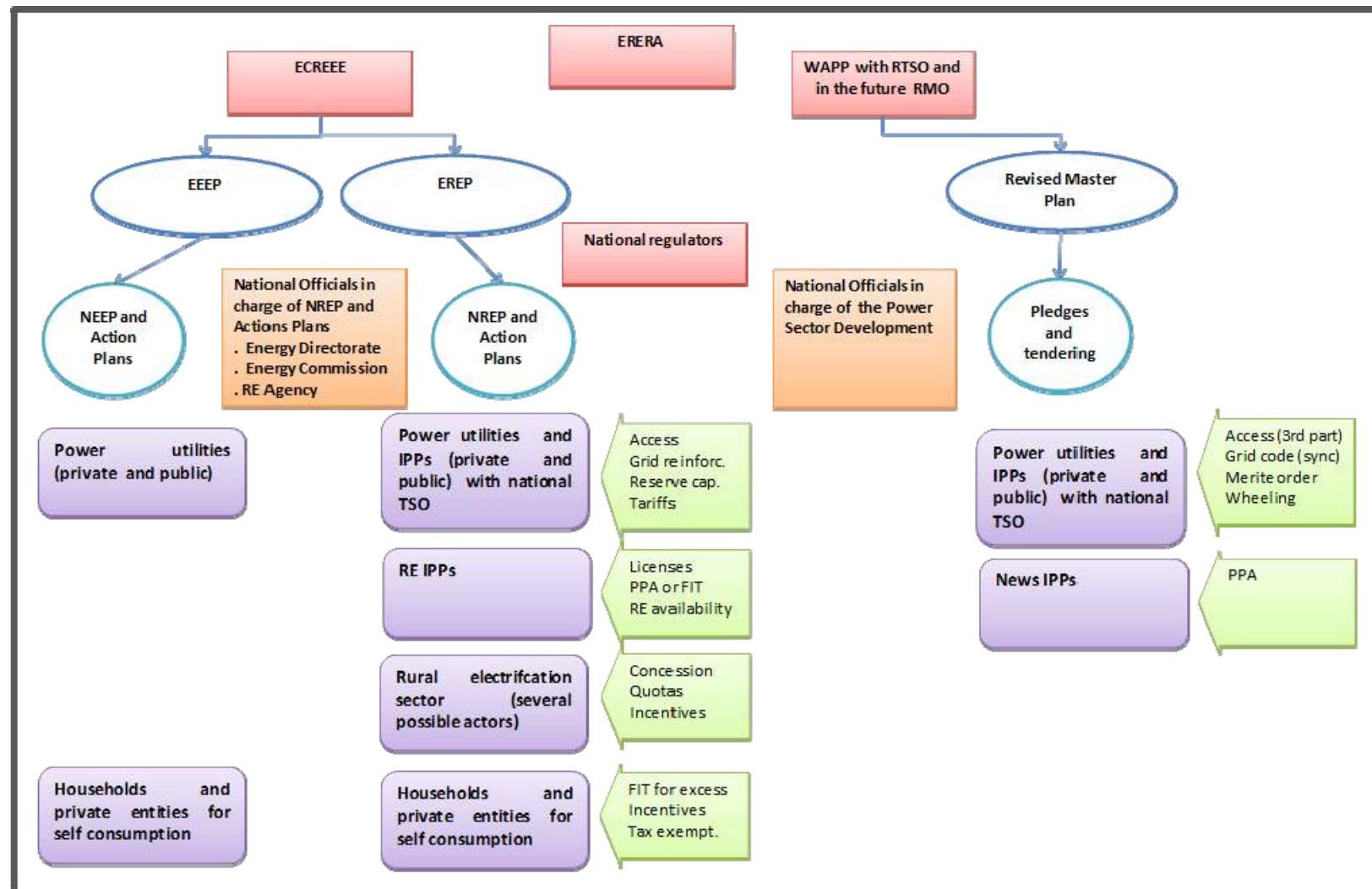
- A third group of Member States where renewable energy remains low on the national agenda and the main reforms are still to be initiated.

The main challenge for the EREP will be to provide support to the less advanced Member States to enable them to develop, adopt and implement a NREP and to benefit from the expertise, experience and dynamics of the region and the most advanced Member States. The success of the policy would be dependent on the degree of involvement of the national governments and the leadership provided both at the political level, but also of the selected heads of the institutions to be set up. It would also be partly dependent on the degree of harmonisation achieved between different countries. Strong coordination between all concerned stakeholders is necessary:

- Regional and national regulators and harmonisation efforts for pricing policies, tariffs, PPA, regional rules for third party access including for renewable energy sources, etc.
- The WAPP, especially for all that relates to the planning and erection of the regional interconnected grid, grid access, commercial regulations etc.
- The UEMOA, to avoid duplication of policies and exploiting the synergies.



Figure 7 : Organizational chart for the implementation of the EREP





4.4 Key Issues and challenges to be addressed

The 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 programmes 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 favourable regulatory framework for renewable energy Independent Power Producers, and the feed in tariff approach.

4.5 Action 1: To secure a coherent, efficient and flexible legal, institutional and regulatory framework in order to develop consistency between the regional and the national renewable energy policies.

4.5.1 Strengthening the national and regional institutional framework

- **Regional institutional framework:** ECREEE is the lead coordinating institution. ECREEE has already established a network of National Focal Institutions (NFIs) nominated by the Ministers in charge of



Energy. The institutions are either the Ministries themselves or their implementing agencies. These relations would be further developed and intensified during the preparation, implementation, and monitoring of the EREP. ERERA is presently geared to intervene on the up-coming bulk power markets, but is presently acting as adviser in the preparation of bilateral agreements for power exchanges. ERERA needs to develop competences on economic, financial and tariffs aspects for renewable energy, for example feed-in-tariffs, Power Purchase Agreement and regulation for cost sharing regarding grid reinforcement required by renewable energy connection to the grid. ERERA also has to develop a close cooperation with the national regulatory bodies on tools and mechanisms for renewable energy policy implementation (quotas, incentives, legal agreement such as licences, concessions and authorisations), seeking in that way a regional harmonisation. There is also space for cooperation between ECREEE and the WAPP with regard to renewable energy grid stability issues and/or general capacity strengthening and knowledge sharing on renewables. ECREEE also takes leadership in the implementation of the ECOWAS Energy Efficiency Policy and will create synergies to the EREP process as much as possible.

- **National institutional framework:** All Member States shall mandate national official bodies or institutes with the duties and the competence to develop and implement a National Renewable Energy Policy (NREP). On the regulatory side, it is also necessary to revisit the mandate and duties for the national regulatory authorities to extend their fields of competence to renewable energy with the obligation to be associated to all renewable energy contractual matters and with the duties to give mandatory advice. The national and the regional regulatory authorities need to network on a series of topics regarding the technological advances (smart grid, micro solar modular system, CSP and evolution of investment and O&M costs). The selected National Agencies, the Regulatory Authorities and the Rural Electrification/Energy Agencies should be strengthened with proper offices, staff and resources. Their status within the governmental system should be sufficiently raised.

4.5.2 Support the national level with the development process through regional cooperation

ECREEE in cooperation with its international partners will assist the Member States' specific requests with ad hoc guidance or support:

- **ECREEE will publish a comprehensive RE baseline report on the ECOWAS region** by March 2013
- **Guide on how to adequately assess their national renewable energy resources** and some guidance on existing models or available expertise that could contribute to the assessment. ECREEE will implement at least four regional RE potential assessments on PV, CSP, wind and bio-energy by March 2013. SSHP and further bioenergy assessments will be made available by end of 2013. Highly qualified expertise will be required to ensure that each national renewable energy resource assessment is validated and credible for project developers through an operational and realistic evaluation calibrated to selected criteria such as distance to the main grid for grid connected applications, potential local demand for isolated applications such as SSHP or reliability of the resource for biomass.
- **Guide on how to assess the national grid conditions** to connect renewable energy capacity. ECREEE will develop, in cooperation with the WAPP, standard methods to assess the required grid improvements and costs in order to secure physical transport capacity, frequency stability, adequate dispatching facilities and sufficient regulating capacity to connect a series of typical new renewable energy capacities. This assessment will also be valuable for identifying energy efficiency measures to reduce losses in the grid. A grid strengthening plan would need to be prepared for each country. This



exercise would need to be done in tandem with the resource assessments so that sites for individual projects/parks can be synergised and feed into each other.

- **Guide for integrated rural electrification planning** taking into account the least-cost options between grid extension plans and off-grid renewable energy solutions. This guide will enable a clear demarcation between on-grid and off-grid rural electrification, showing the impact of hidden costs in the less economic share of on-grid rural electrification that constitutes often a 100% subsidy to supplied isolated localities.
- Start to **mainstream the EREP into a revised ECOWAS/UEMOA White Paper on energy access** with a time horizon by 2030, to be implemented by the end of 2013;

4.6 Action 2: Each Member State will develop or revisit their National Renewable Energy Policy (NREP) with an associated implementation strategy and a five year rolling action plan

4.6.1 Regional targets

At the regional level, targets for renewable energy penetration have been identified and are set for different segments of the energy market (grid-connected, mini-grids, stand-alone and micro systems, biofuels, charcoal production, domestic energy, LPG) to ensure the achievements of the ECOWAS White Paper on access by 2020 (target 2015) and the universal access by 2030 as defined in the Chapter 3 on "Targets":

4.6.2 Setting National targets

The regional targets have been developed on global assumptions that will be refined through the preliminary studies developed under the EREP Action 1. Each Member State will develop or confirm a set of national targets for renewable energy applications, according to their detailed resources assessment and their grid capacity to connect renewable energy over the time. A preliminary guidance to weight renewable energies in each country is given in the previous chapter on "targets".

National targets will be based on the most appropriate least-cost technology options for the different energy market segments: grid-connected, off-grid, stand-alone and micro systems, domestic energy, LPG, charcoal production. These targets will be developed in accordance to the regional targets set. Some countries already have specific policy covering some aspects of the regional renewable energies, for example the CILSS countries with their domestic energy strategy (Burkina, Mali, Senegal, and Ghana) with a biofuel strategy, and many countries with a more or less recent renewable energy policy and strategy (Cape Verde, Ghana, Liberia, Senegal, Nigeria).

4.6.3 Developing a National Renewable Energy Policy (NREP)

Based on the targets and the selected technology options, Member States will **develop a policy and an implementation strategy covering the period up to 2030. The policy will contain a five-year action plan with a rolling budgeting plan** following the time schedule of the national budget.

The Member States will also **select a modus operandi for implementing their NREP**: a modus operandi that can be different from a supply segment to another. **The measures chosen will generate a need to adapt**



the national legal and regulatory framework for grid-connected and off-grid renewable energy production (renewable energy plants and individual renewable energy equipment for self-consumption and as energy efficiency measures).

■ **Grid-connected operations**

Member States will have to consider the following principles:

- Guarantee through their Transmission System Operator (TSO) and Distribution system operator (DSO), the purchase and transmission of all available electricity from renewable energy-based electricity producers. While renewable energy-based electricity plant owners bear the cost of connection, grid operators must cover part (at least 50%) or all the cost for system upgrade, if required. All upgrade costs must be declared to ensure the necessary transparency.
- Establish stable and long-term favourable pricing mechanisms and ensure unhindered access to the grid for renewable energy IPPs and PPPs. Derogation can be applied for Member States that wish to develop net-metering and distributed renewable energy production⁴ schemes in a pilot development phase.
- Make commercial regulations which embrace authorized renewable energy sources application and connection procedures, costs incurred by each party, tariff, and billing arrangements.
- Make technical regulations that specify the requirements for a renewable energy generator to connect to the grid. These include responsibilities of each party, criteria for synchronization (acceptable voltage levels, frequency, power factor, etc.) required protection relays, and provisions for emergency disconnection.
- The present grid code already developed by the WAPP should be revised to incorporate renewable energy-based power generation. These regional rules, which shall authorise access of IPPs and PPPs (including renewable energy IPP) to the regional grid, shall provide suitable sets of commercial and technical measures and standards for connection to the grid and sale of electricity to any consumer. This will require a reform of the legal and regulatory national framework for Member State power sectors as free access to the grid is only granted in Ghana and Nigeria (Sources: WAPP).

■ **Modus operandi**

The Member States will have to select a Modus Operandi suitable to their situation. The two approaches can be:

- **Quantity-based approach** where the public authorities set a goal to be reached by setting mandatory quotas to the electricity distribution utilities (Renewable Portfolio Standard: RPS) or through competitive biddings (tendering the required capacity as IPP after an agreement between the Member States' government and its utility or TSO).

⁴ Net-metering and distributed production corresponds to a domestic RE production for self-consumption with excess power production sold to the grid. The grid is used to balance the net demand of the producer.



- **Price-based approach** with the purchase obligation system imposed on electricity companies at guaranteed prices (feed-in tariff) and provision of the legal and regulatory framework for renewable energy production business.

■ Off-grid operations

ECOWAS Member States should prepare separate rural electrification policies which would promote the construction of mini-grids and stand-alone power systems including a large share of renewable energy in areas not covered by the electricity grid (off-grid) to provide least-cost power services for local economic activities and sustainable living. Policy support for renewable energy should further be demonstrated by increased budgetary allocations in most countries. As previously emphasized, the prerequisite of real least cost off-grid operation is the strict application of the **all-inclusive/integrated rural electrification planning**.

Member States should apply the following guiding principles:

- No new grid extension proposal should be considered for a particular area unless there is a cost benefit analysis vis-a-vis the decentralised renewable energy option.
- Where grid supply is given, all households should be connected, and connection costs should be rationalised.
- Some guidance regarding sizes of villages (e.g. <200 households), distance from the grid (>20 Km) should be considered so that grid extensions would not reach those communities, at least for the present.
- Some simple regulatory measures could be designed for renewable energy based mini-grids.
- Regulations and subsidy schemes during the ‘technology learning period’ shall be considered to ensure an acceptable end consumer tariff which could be differentiated for different kinds of consumers and a reasonable return to the investor.
- A minimum renewable energy threshold shall be set up for such systems.
- Similar subsidy support should be available for stand-alone systems. In case the system is financed by a bank, the subsidy should be released to the bank.

Given the number of official stakeholders engaged in Rural Electrification activities and the specificities of each country (national utilities, rural electrification agencies and funds, electricity cooperatives, private investors, renewable energy services companies, local banking systems with loan schemes to finance SHS,...), the **modus operandi** will be selected for each market segment (mini-grid concessions, quotas for larger concessions, etc...) and adapted to each Member States situation.

■ Wood-fuel and domestic energy

The NREP for these issues will be developed in close cooperation with the forestry department managing the woody resources, the associations of wood-loggers, charcoal burners and woodfuel transporters, the association of improved cook-stoves manufacturers and associated NGOs (cook-stoves dissemination, biogas plant dissemination, briquettes production). A participative approach should be adopted to set revised targets for domestic energy in order to achieve within 5 to 10 years’ time frame the objectives defined by the ECOWAS/UEMOA White Paper for energy access.



■ **Biofuels strategy**

Based on the experience gained by four ECOWAS Members States (Mali, Senegal, Burkina Faso and Ghana) in formulating biofuels policy, implementation strategy, and with already existing commercial small scale biofuel production (Mali and Burkina Faso), a specific regional policy will be developed by ECOWAS. The policy will build on the precautionary principle to ensure that biofuel production does not conflict with food production. The Member States, which decide to include biofuels in the NREP will take advantage of the experiences developed in the mentioned countries.

■ **Gender Mainstreaming**

Gender Action Plan as part of the NREP with objectives, outcomes, activities etc. will be developed by the Member States.

4.6.4 **The contribution of the ECOWAS Renewable Energy Policy (EREP) to the development of National Renewable Energy Policies (NREP)**

- **Harmonisation of the approaches - Guidelines to ensure coherent approaches:** ECREEE will develop planning guidelines to ensure a coherent and comprehensive approach for renewable energy planning in the different ECOWAS Member States. The guideline will provide advice and recommendations ensuring a broad and active contribution of the national stakeholders associated with these activities. Special attention will be given to the civil society, the consumers associations and the NGOs, the private sector (manufacturers and energy services providers) and the banking sectors.
- **Technology guidelines.** Based on the EREP baseline report and several reports dealing with renewable energy technologies and costing approach, a practical guideline covering the major renewable energy least cost options will be prepared and distributed through the National Focal Institutions to the national renewable energy officials and regulators to provide pertinent costs information enabling the decision making on the technology basket. An assistance to adapt the panel of identified least cost options to the different ECOWAS regions or Member States will be provided.
- **Developing models for PPA, FIT, Quotas, rural electrification concession, mini-grid concession, credits schemes and RESCOs.** All these legal, technical, and financial documents will be developed as regional paradigms at the regional level through the collaboration between ECREEE and ERERA, to provide models to the national renewable energy officials and regulators, when implementing the NREP.
- **Standards for renewable energy equipment and systems.** In close cooperation with the Bureau of Standards of UEMOA, the regional research institutes working on renewable energies and the regional/national branch organisations representing the renewable energy sector, assisted by an international expert organisation on renewable energy standards, ECREEE will launch **a regional conference** to compile the existing standards regarding renewable energy and energy efficiency and biofuels in the ECOWAS region, to assess the needs for new standards. Based on the results of this conference, the ECREEE will finance in close cooperation with the relevant regional R&D institutes, the development of new standards to be validated by the ECOWAS and UEMOA specialised bodies.



- **Gender Mainstreaming:** Advocacy to include gender policy and vision in the institutional framework as well as a guideline to mainstream gender in the NREP is prepared by the ECREEE in close collaboration with ENERGIA and ABANTU for Development.
- In addition to the above, ECREEE will contribute (“learning by doing”) to the formulation and the development of NREPs through the implementation of several programs in the different technology areas to create an enabling environment: (i) the ECOWAS Renewable Energy Facility (EREF) for peri-urban and rural areas; (ii) a regional small scale hydro power program and bioenergy program will be launched in 2013; (iii) the US\$50 million energy component of the GEF Strategic West Africa Program (SPWA), which is co-financing renewable energy and energy efficiency projects in all fifteen ECOWAS countries, is coordinated in cooperation with UNIDO; (iv) ECREEE operates the ECOWAS Observatory for Renewable Energy and Energy Efficiency (ECOWREX).
- Preparation of a **regional implementation strategy for the attainment of the rural RE targets** of the EREP (White Paper) by end of 2013.
- Launch **call for proposals of the ECOWAS Renewable Energy Facility on mini-grids** to be launched by mid of 2013

4.7 Action 3: To make renewable energy power production an attractive business for private investors/entrepreneurs

Enhancing the financial viability of national utilities is a cross-cutting issue for ECOWAS Member States and a prerequisite to make renewable energy power production an attractive business for private investors/entrepreneurs. The financial health and reliability of a national energy sector is a major condition to create confidence for potential private investors. That means a sector that has a reasonable debt with regard to its turnover and with tariffs ensuring a proper level of auto-financing after reimbursement of the debt. In addition, specific measure will contribute to boost the penetration of renewable energies in the energy mix:

- License/concession agreements as well as the general regulatory framework shall be simplified (“fast track procedure”) and its cost lowered for the investors to provide additional incentives for eligible renewable energy investments.
- Incentives to local renewable energy manufacturers and assemblers (code of investments, taxes holidays) shall be proposed and coordinated among ECOWAS countries.
- Subsidies to alleviate up-front costs for technology moving towards a fully competitive production. Subsidies shall meet incremental costs for producing agreed quantity of renewable electricity through approved sources. To ensure an efficient allocation of resources, subsidies shall be allocated through competitive bidding or other control mechanisms to avoid the free riders profits.
- Taxes and duties exemptions on specific components to avoid unfair competition for imported ready-made equipment need to be considered by the Member States.
- Technical standards and skill certification will be developed in cooperation with UEMOA.
- Public awareness on regional produced devices will be promoted to ensure the emergence of a regional market for renewable energy applications and devices.



- Efforts to involve women in business activities (producers, operators, managers, entrepreneurs, etc.) will be put in place.

4.8 Action 4: Capacity development

4.8.1 At regional level

A Capacity Development Needs Assessment for skills and competences within renewable energy will be carried out and implemented by ECREEE in collaboration with regional training institutes. Based on the assessment, ECREEE will develop a regional capacity building programme by March of 2013. Complementarities between regional and national capacity development activities will be enhanced. At the regional level:

- Train-the trainers Networks for different RE issues and aspects will be established by ECREEE in cooperation with local vocational institutes. A pool of trainers will be created. Two or three major institutes will share the leadership of this network, which purpose is to propose professional vocational and graduate training in renewable energies. Curricula and renewable energy training courses will be developed and made available through the network.
- Specific training packages for renewable energy business development will be carried out targeting all relevant stakeholders and based on best tools available on the market (e.g. RETScreen, HOMER):
 - Entrepreneurs and project developers;
 - Renewable energy national officials and regulators to help and assist them in the development of their NREP;
 - Local Banks and financing institutions on renewable energy financing.
- Network of regional and international experts will be made available by ECREEE through several cooperation programmes established with international public and private organisations and Networks (UNIDO, IRENA, GIZ, AIEA, ARE, CLUB-ER, etc.). South-south cooperation will be strengthened.
- Capacities in the areas of RE potential assessments and measurements will be strengthened.

4.8.2 At national level

Capacity development at the national level shall also cover development issues such as project implementation, management, operation, and long term sustainability; hence, it shall be conducted for national decision makers and field operators:

- Training of renewable energy national officials and regulatory authorities will be organised. Sessions gathering a few countries will be organised to reduce the transaction costs.
- Renewable energy curricula will be introduced at the national universities and technical institutes assisted by the regional network.
- Practical renewable energy courses will be introduced at the utilities national training centres and opened to trainees from the private sector.
- Training of national craftsmen and electrician will be carried out.

Attention to gender issues will be raised throughout the action implementation.



4.9 Action 5: Financial intermediation

4.9.1 At regional level

ECREEE will be instrumental to mobilise additional financial resources for the development of renewable energy in the ECOWAS region:

- ECOWAS and ECREEE will organise donors, financiers and project developers round-tables to make the EREP visible and credible in order to mobilise the required ODA and private finances to its implementation;
- ECREEE will develop fund raising activities to secure further calls of the ECOWAS Renewable Energy Facility (EREF) for small scale projects in peri-urban and rural areas to support the EREP and NREPs;
- ECREEE will play a lead role in pooling projects for 'green financing' and develop in-house the required expertise to reduce the transaction costs usually associated to this type of project through the ECOWAS Renewable Energy Business and Investment Initiative;
- Guaranty funds for regional/national banking sectors will be negotiated with the international development and funding organisation.

4.9.2 At national level

In each Member State a rolling investment plan for the sector will be prepared including the investments for the EREP. This plan will be financed from different financial sources: (i) from the resources of the sector (tariffs and taxes), (ii) from the national allocations to rural electrification and renewable energy; (iii) from international financial institutions and ODA funds; and finally, (iv) a growing share will be financed by the private sector, through private investors and promoters or private financial institutions. For this share and eventual financial gaps to be filled, the national level can request support from the regional level fund raising and B2B activities.

Specific actions will consist in:

- Nationals officials will develop efforts to mainstream renewable energies in the EU/WB/AfDB/AfD/others' energy programmes.
- Budget lines for renewable energy will be integrated in the national rolling budget systems including a minimum budget set for renewable energy initiatives for gender/women.
- Renewable energy and Rural Electrification Funds will be established and/or adapted to become real financial specialised institutions with an established capacity to raise funds and lend to national private developers.
- Information towards the national banking institutions is carried out through meetings and national conferences.
- Fiscal measures regarding renewable energy businesses and biofuels are developed.
- Tax exemptions are proposed to reduce end-users tariffs.



4.10 Action 6: Advocacy, Awareness and Knowledge Management

4.10.1 At regional level

ECREEE shall be instrumental in Knowledge Management, sharing best practices, lessons learned from successes and failures, and establishing a regional network of renewable energy professionals:

- ECREEE will establish the GIS based ECOWAS Observatory for Renewable Energy and Energy Efficiency (EOWREX) which will provide regularly updated market information on renewable energy policies, business opportunities, potentials and contacts in the ECOWAS region. The Observatory will be established under the umbrella of the UNIDO-GEF project "Promoting Coordination, Coherence and Knowledge Management under Energy Component of the Strategic Program for West Africa (SPWA)".
- ECREEE will organise annual Forums with renewable energy professionals (National - Regional - foreign entrepreneurs), on a Business to Business (B2B) approaching order to stimulate the technology and business transfer to the region. These events will be organised in partnership with private sector networks and association (e.g. Alliance for Rural Electrification).
- ECREEE will produce an annual RE investment and business report in cooperation with other partners (UNIDO, IRENA, REN-21).
- ECREEE assists UNIDO in the implementation of the GEF Strategic West Africa Program.

4.10.2 At national level

- **Awareness campaigns and materials will be broadcasted on national TV and radio** (e.g. competition of best Renewable Energy business idea), in national language and local dialect to address remote rural areas, promoting the image of renewable energy as a full-fledge power supply, fully commercial product and cost competitive. Energy efficiency aspects will be integrated into the campaigns.
- **National forum for renewable energies backing up the national policy development**
The national officials and the regulator will create in collaboration and with support of the NFIs, a national renewable energy forum gathering together individuals representing a broad spectrum of the society having interest in renewable energy development, like such as those in agriculture and industries, NGOs, and some national officials from other departments. This forum will comment and enrich, as a backing group, the development of the NREP.
- **Renewable energy days with information and training sessions**
Back to back to major commercial or cultural events, renewable energy days will be organised to bring together the national renewable energy associations, branch organisations and NGO's in order to promote awareness on renewable energy sources.
- **Sensitisation on renewable energies in schools**
In order to sensitise the up-coming generations, pedagogic materials containing information on renewable energy and the necessity to protect the woody resources will be developed based on the experience of some ECOWAS countries (e.g. Renewable Energy introduced in schools in Ghana) and distributed in the 15 Member States. Furthermore, information sessions on renewable energies will be organised in schools.



4.11 Synopsis of the Regional Renewable Energy Policy

	PILLAR	Specific Actions	Strategic objective	Actors/leader
Regional Level	Preliminary activities	Strengthening regional institutional Framework	• Relations with WAPP and ERERA, developed and intensified • NFIs geared to ensure a proper interface between regional and national level • Provide RE planning support for Member States to prepare NREP	ECREEE + cooperation with WAPP/ERERA
		Regional RE Potential Assessments	• Publication of a comprehensive RE baseline report end of 2012 • By March 2013, at least four regional assessments for PV, CSP, wind, bio-crops are made available. SSHP and further bioenergy assessments will be made available by end of 2013.	ECREEE + Possible cooperation with UNIDO, IRENA, ESMAP, USAID
		Development of RE potential assessment Guide for the Member States (MS)	• By March 2013, a methodology and guidelines are prepared to help the MS in carrying out an operational and valuable assessment of their RE resources (see further activities under capacity building).	ECREEE
		Development of an all-inclusive rural electrification policy	• A guide for all-inclusive rural electrification enabling to delineate the off-grid market and showing impacts of hidden costs is available • Start to mainstream the EREP and EEEP into a revised ECOWAS/UEMOA White Paper on energy access by end of 2013	ECREEE
		National Grid assessment	• Standard methods to assess the grid's and the system's capacity to connect RE productions (dimension, stability, dispatching functionalities, regulating power capacity) and evaluate the cost of grid extension for RE connection to the grid and EE measures to reduce losses are developed	ECREEE + WAPP
		Synergies to the ECOWAS Energy Efficiency Policy	• Synergies with the EEEP are sought (renewable energy applications to suppress electricity uses and cook-stoves initiative)	ECREEE
Regional Level	Policy and Action Plan	Regional Targets	• Regional targets for renewable energy penetration are stated by EREP and adopted by the ECOWAS Ministers • Launch preparation of a regional biofuel policy by March 2013	
		Harmonization of the approaches :	• By March 2013: Guidelines to ensure coherent approaches for the development of NREPs are available	ECREEE





	PILLAR	Specific Actions	Strategic objective	Actors/leader
Regional Level		Technology assessment	Technology guidelines & Panel of least cost options are developed for different regions or for different MS	ECREEE
		- Models for FIT, PPA - Standards for RE equipment and systems	- Models for PPA, FIT, Quotas, rural concessions are developed - A regional conference to compile existing standards regarding RE and EE and biofuels in the ECOWAS region is launched to assess the needs for new standards	ECREEE + ERERA
		Regional RE technology promotion programs	- Several technology promotion programs are launched by ECREEE (e.g. small scale hydro, EREF, bioenergy program) - Preparation of a regional implementation strategy for the attainment of the rural RE targets of the EREP (White Paper) - Call for proposals of the ECOWAS Renewable Energy Facility on mini-grids to be launched by mid of 2013	ECREEE
		Gender Mainstreaming	- Advocacy to mainstream gender into the institutional framework - A guideline to mainstream gender into the NREP is prepared	ECREEE + partners (e.g. ENERGIA, ABANTU for Development)
		Forum on NREPs development	A forum on the preparation of the NREPs is organized	ECREEE
		Monitoring system to assess RREP	Monitoring system to assess progress of the EREP implementation	ECREEE
	Capacity Building	Regional capacity building program formulated	By March 2013 a capacity needs assessment is undertaken and a capacity development program for the next five years formulated	1 ECREEE + UNIDO, IRENA, AIEA, ARE, EUEI-PDF, GIZ etc.





	PILLAR	Specific Actions	Strategic objective	Actors/leader
		Establishment of local train-the-trainer networks in cooperation with institutions, universities and individual experts	- A network of local training institutes and pool of trainers for different RE training is created - Train-the-trainer training packages on different issues are available and workshops organised - Funding to support national follow-up trainings secured	2 ECREEE + UNIDO, IRENA, AIEA, ARE etc.
		Capacity building on RE business development	Training network on business development for entrepreneurs and projects developers operational	3 ECREEE + UNIDO, IRENA, AIEA, ARE etc
		Capacity building on RE financing	Training network on financial structuring, planning and appraisal of projects for local banks, financing institutions and project developers established (e.g. RETScreen, Homer)	4 ECREEE + UNIDO, IRENA, AIEA, ARE etc
		Capacity building on RE resources assessments and measurements	Training network on RE potential assessments and measurements established (e.g. SSHP hydrology assessments, wind)	ECREEE + UNIDO, IRENA, ESMAP, AIEA, ARE etc
	Financial Intermediation	EREP donors round-table	Donors round-table organised to make the EREP bankable	ECOWAS + ECREEE
		Fund raising for rural renewable energy projects	- Fund raising for reformulated ECOWAS/UEMOA White Paper on energy access and mainstreaming of RE&EE - Fund raising for further call for proposals of the ECOWAS Renewable Energy Facility in peri-urban and rural areas	ECREEE
		Fund raising for a pipeline of medium to large scale RE projects	ECOWAS RE Business and Investment Initiative launched to pool medium sized and larger projects for green financing; project pipeline prepared;	ECREEE + development banks, private investors
		Guaranty Fund	Guaranty funds negotiated for regional /national banking sector	ECREEE
	Knowledge Management, advocacy and awareness	Knowledge Management	- ECOWAS Observatory for Renewable Energy and Energy Efficiency is established. The official launch will take place in October 2012. Further RE resource assessments undertaken; - Coordination of the energy projects of the Strategic Programme for West Africa (GEF-SPWA) in cooperation with UNIDO	ECREEE with support of UNIDO-GEF
		Communication and Awareness raising	- RE&EE Awareness campaigns materials to be broadcasted on national TV and radio are developed - Annual RE investment and business industry report published	ECREEE + REN21, IRENA, UNIDO



	PILLAR	Specific Actions	Strategic objective	Actors/leader
		Advocacy and awareness with renewable energy Professionals	• Forum with renewable energy professionals (Regional – foreigners; business to business approach)	ECREEE

	PILLAR	Specific Actions	Strategic objective	Actors/leader
National Level	Preliminary activities	Strengthening national institutional Framework	• National official bodies or institutes with the duties and the competence to develop and implement a NREP are mandated by ECOWAS Member States, where needed. • Mandate and duties for the national regulatory authorities to extend their fields of competence to renewable energy are revisited	ECOWAS MS
		Renewable Energy Potential Assessment	• By mid-2013 ECOWAS MS have assessed or updated renewable energy potential and the resource assessment is validated	Possible support by UNIDO, IRENA, ESMAP, USAID
		Development of an all-inclusive rural electrification policy	• By end of 2013 ECOWAS MS have carried out an all-inclusive rural electrification policy	ECOWAS MS
		National Grid assessment	• ECOWAS Member States have assessed their grid capacity for RE plant connections and their needs for grid and dispatching upgrade and for regulating power capacity.	ECOWAS MS
	Policy and Action Plan	National Targets	• National Targets are set based on the assumptions of preliminary studies	ECOWAS MS
		National Renewable Energy Policy (NREP)	• By March 2014 all ECOWAS Member States have harmonized or prepared the NREP including an implementation strategy up to 2030 with 5 years action plan and budget	ECOWAS MS
		Grid-connected operation	• Purchase and transmission of RE electricity is granted • Commercial regulations for RE are set • A modus operandi (a Renewable Energy Portfolio Standard or the required RE capacity is tendered as IPP) • Other tools may be applied: Feed-in Tariffs, PPA, Tariff regulation, tax exemption, tax holidays, License, Net-metering	ECOWAS MS



	PILLAR	Specific Actions	Strategic objective	Actors/leader
National Level		Off-grid operations	Based on all-inclusive Rural electrification planning, independent RE systems are planned for off-grid areas choosing a modus operandi for different market segment (mini-grid concessions, larger rural electrification concessions, stand-alone systems standards)	ECOWAS MS
		Wood-fuel and domestic energy	The ministry in charge of energy in close cooperation with its homologs from environment and commerce develops a national approach seeking the banning of inefficient stoves by 2020 and inefficient charcoal burning by 2030	ECOWAS MS, CILSS, ECREE
		Gender Mainstreaming	Gender Action Plan as part of the NREP with objective, outcomes, activities etc. is developed.	ECOWAS MS
	Make Renewable Energy as an attractive business for private investors/entrepreneurs	RE Incentive schemes	General regulatory framework is developed as simple and low-cost for investors to provide additional incentives for RE investments. tools include: incentives for manufacturing, subsidies for up-front costs, tax & duties exemption, technical standards and skill certification	ECOWAS MS
		Gender Mainstreaming	Involve women in business initiatives (producers, operators, managers, entrepreneurs, etc.)	ECOWAS MS
National Level	Capacity Building	Establishment of local train-the-trainer networks in cooperation with institutions, universities and individual experts	- pool of trainers created - training for Renewable Energy officials/regulatory authorities upon request from NFIs, regional sessions can be organized to reduce costs - RE curricula are introduced at universities and technical institutes - Practical RE courses implemented at utilities training centers - Craftsmen and electricians trained - National RETScreen and HOMER training carried out - Attention to gender issues will be raised	ECOWAS MS
	Financial Intermediation	Energy Sector Investment Programmes	Overall energy sector investment programmes are developed including RE investments. The financial gap is identified after all existing financing sources have been exhausted (sector resources through tariffs, government contribution through finance law,	ECOWAS MS



	PILLAR	Specific Actions	Strategic objective	Actors/leader
			traditional funding institution and private sector)	
		Energy Sector Investment Programmes	• Efforts are made by national officials to mainstream Renewable Energy in donors' programmes	ECOWAS MS
		National Budget	• Specific budget lines for RE planned in the national budgets	ECOWAS MS
		Renewable Energy Funds	• Renewable Energy or Rural Electrification Funds established / adapted to become real financial institutions with an established capacity to raise funds and lend.	ECOWAS MS
		Banking institution awareness	• Meetings and conferences for banking institutions organised	ECOWAS MS
		Fiscal Measures	• Fiscal measures and tax exemption are developed and proposed	ECOWAS MS
		Gender Mainstreaming	• Minimum budgetary target set for RE initiatives for gender/women	ECOWAS MS
	Knowledge Management, advocacy and awareness	National Forum	• National Forum gathering all actors interested in Renewable Energy to back up the NREP development and implementation	ECOWAS MS
		Communication and Awareness raising	• Every year a Renewable Energy Day organised for associations, NGOs etc.	ECOWAS MS
		Awareness raising in schools	• RE introduced in schools using material prepared at regional level	ECOWAS MS



4.12 Time frame of implementing the policy and monitoring

During the first two years following the approval of the EREP by the Energy Ministers of the Region, each Member State shall strengthen the national and institutional framework with the guidance and support from the ECREEE for the harmonisation of the approaches and guidelines to ensure that approaches are coherent with the regional framework set. This process shall bring Member States to develop a NREP with setting or confirming national renewable energy targets, selection of the modus operandi for grid and off-grid operation, wood-fuel and biofuel energy:

Year 1:

- Member States establish as needed their national legal and institutional framework, identifying the national officials in charge of renewable energy planning;
- All necessary guides, curricula, training sessions are prepared by ECREEE and all available information is distributed to the MS through the NFIs;
- The ECOWAS Observatory for Renewable Energy and Energy Efficiency (ECOWREX) and other knowledge products (e.g. RE potential assessments, RE baseline report) are published to inform investors and developers on existing opportunities.
- RE capacity needs assessment undertaken, regional capacity building program formulated and train-the-trainer networks on different RE issues are operational;
- Member States will initiate in close cooperation with the regional level all capacity development activities necessary for developing a NREP (energy planning support - e.g. MESSAGE model);
- Member States will assess their needs for updating their renewable energy resources data and start consequently the required updates;
- ECOWAS/White Paper on Energy Access revised, regional rural RE implementation strategy formulated and EREF call on mini-grids launched;
- A Regional Conference launching the process is held in the region. This event will offer opportunities to back-to-back training activities.

Year 2:

- National Renewable Energy Policies are adopted by Member States with an associated implementation strategy and a five-years rolling action plan and necessary budgetary allocation.
- According to the NREP and action plan, all countries will have mainstreamed renewable energies in their national institutional and regulatory frameworks. According to the country, actual situation and the choices taken in terms of modus operandi, the following elements of the legal and institutional framework will be updated:
 - National Energy Policy
 - Electricity Law
 - Renewable energy and rural electrification framework
 - Tariffs for electricity supply and services
 - Role and competence of the national regulator.
- Throughout the entire process, specific financial means will have to be raised both at regional and national level to:



- Promote regional standards, as for example capitalising on the Bureau of Standardisation already existent in UEMOA.
- Promote investment and financing initiative for IPP medium-large scale projects
- Support renewable energy business and enterprises creation through the EREF and other instruments
- Develop technical capacity (regional curricula, specialisation of existing centres, make network of international experts available, train national officials' regulatory bodies, technicians, etc.)
- Develop awareness through:
 - Campaigns
 - Pilot applications
 - ECOWAS Observatory for Renewable Energy and Energy Efficiency
- Completion of RE resources/potential assessments
- The ECOWREX continues to provide reliable and updated data
- Regional technology promotion programs are under implementation (e.g. small scale hydro power, bioenergy, mini-grids)
- Train-the Trainers networks are consolidated and delivered
- Financing for projects of the ECOWAS Renewable Energy Facility and the ECOWAS Renewable Energy Investment and Business Initiative mobilised

4.13 Monitoring progress under the EREP

ECREEE will develop a monitoring and reporting system in close collaboration with NFIs and national officials. Under the umbrella of ECREEE, a steering organisation will be put in place to follow and guide the implementation of the EREP. The steering committee will hold bi-annual meetings, back to back to the ECREEE board meetings or to regional events during the first two years, and on an annual basis afterwards. Monitoring and revising the policy according to developments is absolutely critical for its longer-term relevance.



Annex I: Detailed targets for grid-connected and off-grid EREP scenario and financial assessments

The table summarises both the existing medium and large hydro capacity for the WAPP, the planned capacity as stated in the WAPP revised master plan and the EREP scenario.

Table 13: Grid-connected renewable energy targets

in MW of installed capacity	2010	2020	2030
Load forecast ECOWAS, in MW peak load	10,659	25,128	39,131
WAPP existing RE in MW (medium and large hydro)	3,447	3,447	3,447
WAPP RE projects in MW (medium and large hydro)		2,825	7,893
WAPP total RE capacity (medium and large hydro)	3,447	6,272	11,340
WAPP RE Penetration in % of peak load	32%	25%	29%
EREP renewable energy options in MW	0	2,425	7,606
EREP renewable energy options in % of peak load (excl. medium and large hydro)	0%	10%	19%
Total RE penetration (incl. medium and large hydro hydro)	32%	35%	48%

in GWh of produced electricity	2010	2020	2030
Load forecast ECOWAS - Energy demand in GWh	65,696	155,841	243,901
WAPP existing RE production (large hydro) in GWh	16,965	16,965	16,965
WAPP RE projects - production (large hydro) in GWh		10,529	29,879
WAPP RE total production (large hydro) in GWh	16,965	27,494	46,844
WAPP RE production Share (large hydro)	26%	18%	19%
EREP renewable energy options – production in GWh	0	8,350	29,229
EREP renewable energy options - % of electricity demand (excl. medium and large hydro)	0%	5%	12%
RE production Share	26%	23%	31%

The EREP renewable energy options (scenario) complement the WAPP Master Plan which is mainly based on gas and large hydro. The EREP will add a considerable share of new renewables to the electricity mix. Due to the lower capacity factors of most of the new renewable energy technologies, the amount of electricity produced in comparison with the WAPP projects will be relatively low by 2020. The performance improves between 2020 and 2030 when CSP including storage will be introduced into the EREP scenario.

Grid connected EREP's options

It is expected that 2,424 MW of new RE will be installed by 2020 and 7,606 MW by 2030. The possible contribution of each renewable energy technology to the targets could be as follows: Wind 13%, Solar 28%, Hydro 33% and Biomass 26% (as presented in Figure 8). Until 2020, solar technology will be restricted to the use of PV which is less expensive and easier to implement than CSP technology. As of 2020, 1,000 MW CSP with energy storage is proposed as the investment cost is decreasing. In terms of energy produced, the different technologies have different capacity factors,



which mean that the production per installed MW can vary from 5,250 MWh/yr for biomass plants, to 3,900 MWh/yr for small scale hydro, to 2,600 MWh/yr for Wind and 1,600 MWh/yr for PV.

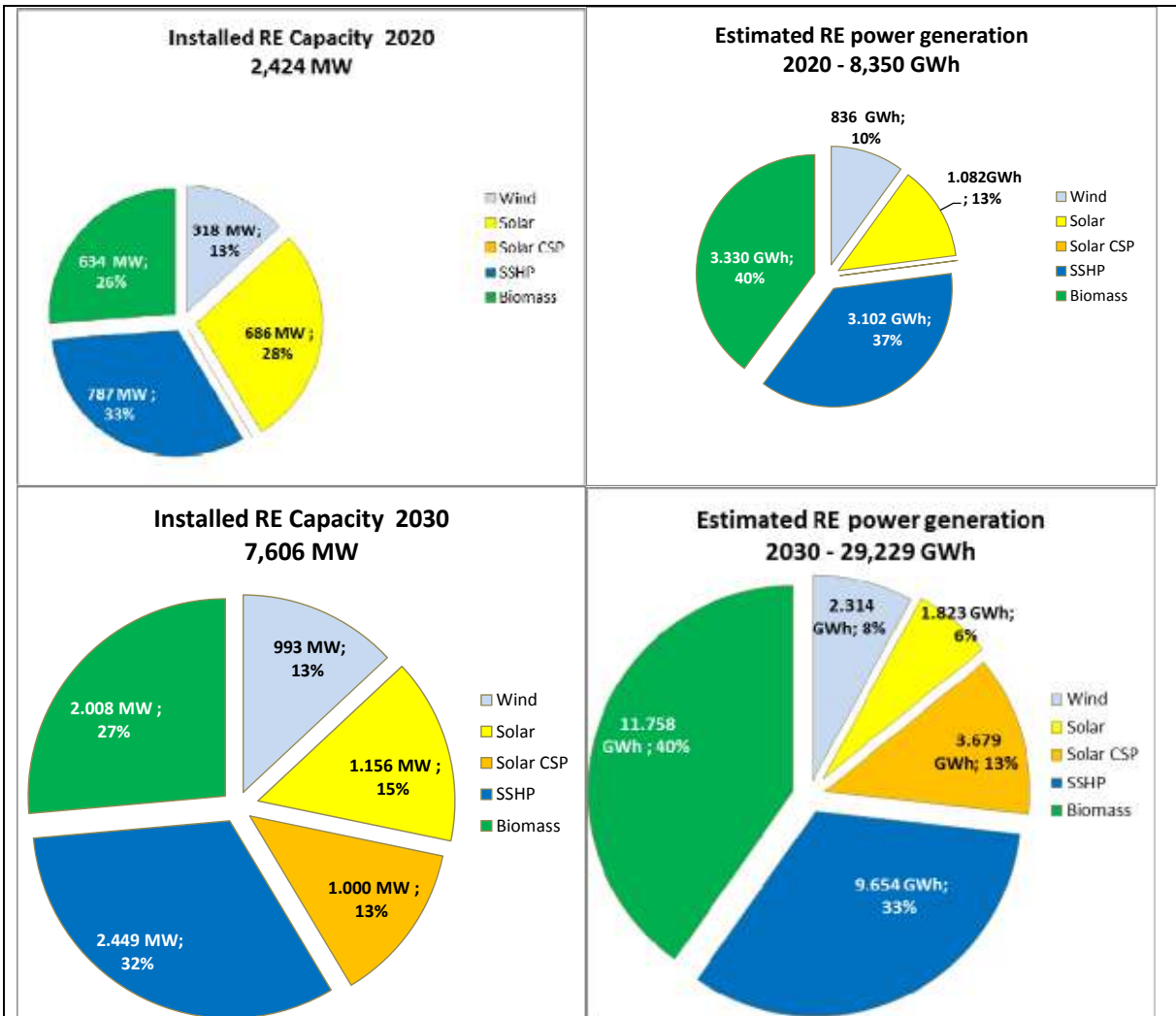


Figure 8: Grid-connected EREP scenarios

A tentative investment plan for the EREP scenario is developed in order to assess the financial viability of the proposal. As illustrated by the figures below, when it comes to initial investment, the cheapest technologies are large wind turbines and solar PV (it looks different when it comes to the economics). In general, the price for wind turbines or PV still remains higher than in developed countries due to certain barriers. Larger wind turbines (several MW) cannot be used in many cases in West Africa due to the lack of appropriate cranes. However, for both technologies it is expected that their investment cost will be close to €1 million/MW in 2030.

For biomass, it is expected that the size of the biomass plants will grow over time with the modernisation of agriculture, reducing considerably the investments costs. Stating a cost for small scale hydro is often difficult as the cost of civil works will depend on the specific condition of the selected location.



If the CSP has reached its technological maturity, its cost still reflects the fact that the technology is entering its commercial phase. It is expected that the cost of CSP with storage capacity, which is relevant for the ECOWAS region with a developing late evening peak load, will decrease over time to reach a level comparable to small scale hydro plants. That is the rationale for deferring the deployment of this technology to 2024 when the investment cost is expected to be €4 million /MW.

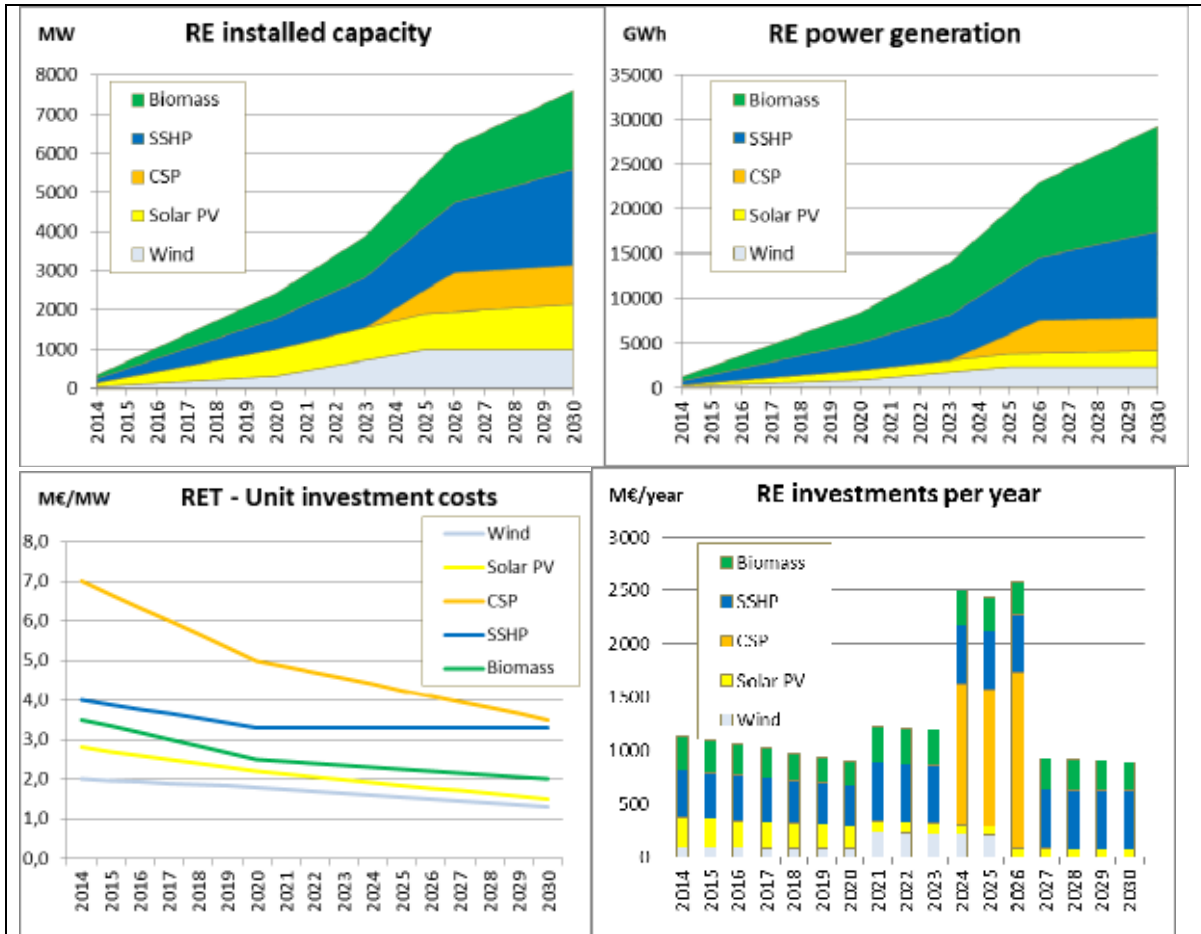


Figure 9: RE installed capacity and production 2014-2030, RE unit cost and investment needs 2014-2030

Economic least-cost assessment

A Least Cost Options Assessment (calculated as levelised cost of electricity) shows the competitiveness of the technologies applied in the EREP scenario compared to the envisaged marginal generation costs of the WAPP Master Plan Scenario as of 2018 and the LCOE for diesel production. The EREP options have to compete with the projected reduced generation costs in the individual countries after the implementation of the WAPP Master Plan priority projects mainly based on large hydro and natural gas.

Under commercial conditions, all the EREP renewable energy options are competitive with regard to diesel thermal generation. However, only biomass can compete with the WAPP marginal costs. On average, the EREP package is 2c€/kWh more expensive than the WAPP option. Wind power and small scale hydro power are the most competitive options apart from bioelectricity (as shown in Figure 10).



However, it should also be noted that the WAPP scenario shows an ideal case and it might be that, in the end, the marginal generation costs of the scenario are higher than projected or some of the projects are not implemented as planned.

Under soft loan ODA conditions (long repayment period 25 to 40 years, low rate of interest typically 1.5 to 2% and 5 to 10 years grace period), the EREP package is fully competitive with the WAPP, biomass and small scale hydro is cheaper than the WAPP options, the wind technology is competitive and only the solar options remains more expensive.

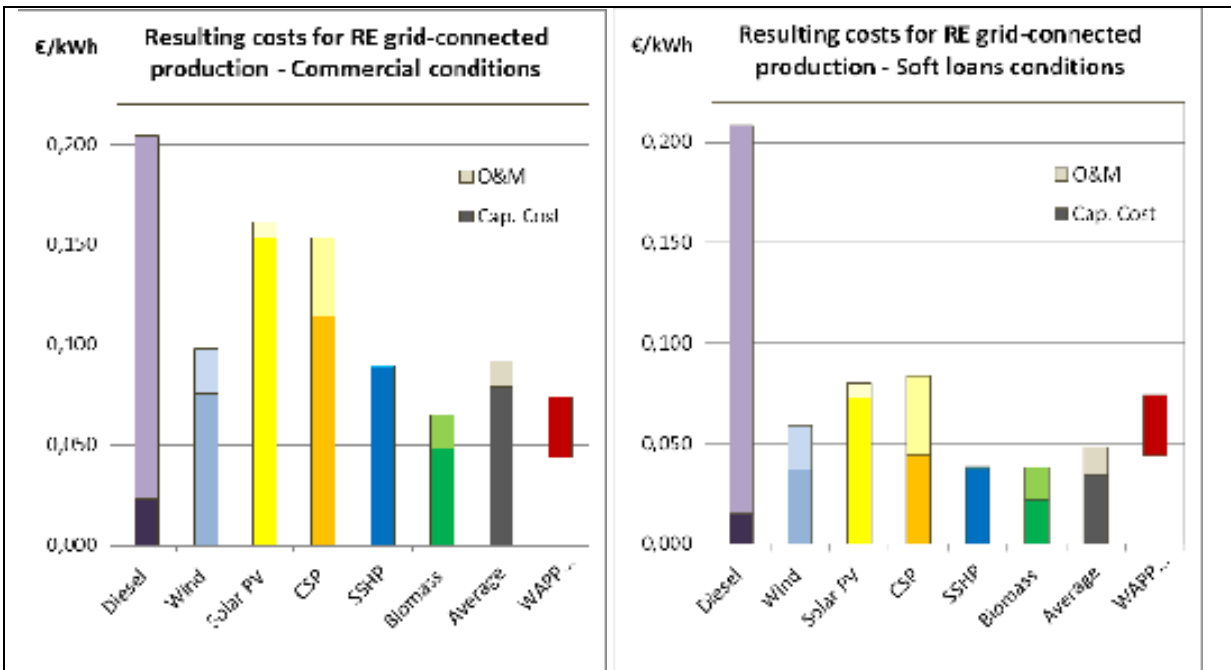


Figure 10: Cost simulation with commercial (left) versus soft loan ODA (right) financial conditions

The low part of the bars in the figure above represents the capital costs and the top the O&M costs. The figure below shows the competitiveness of the EREP scenario in relation to the WAPP Scenario but also to anticipated grid parity in individual country groups.

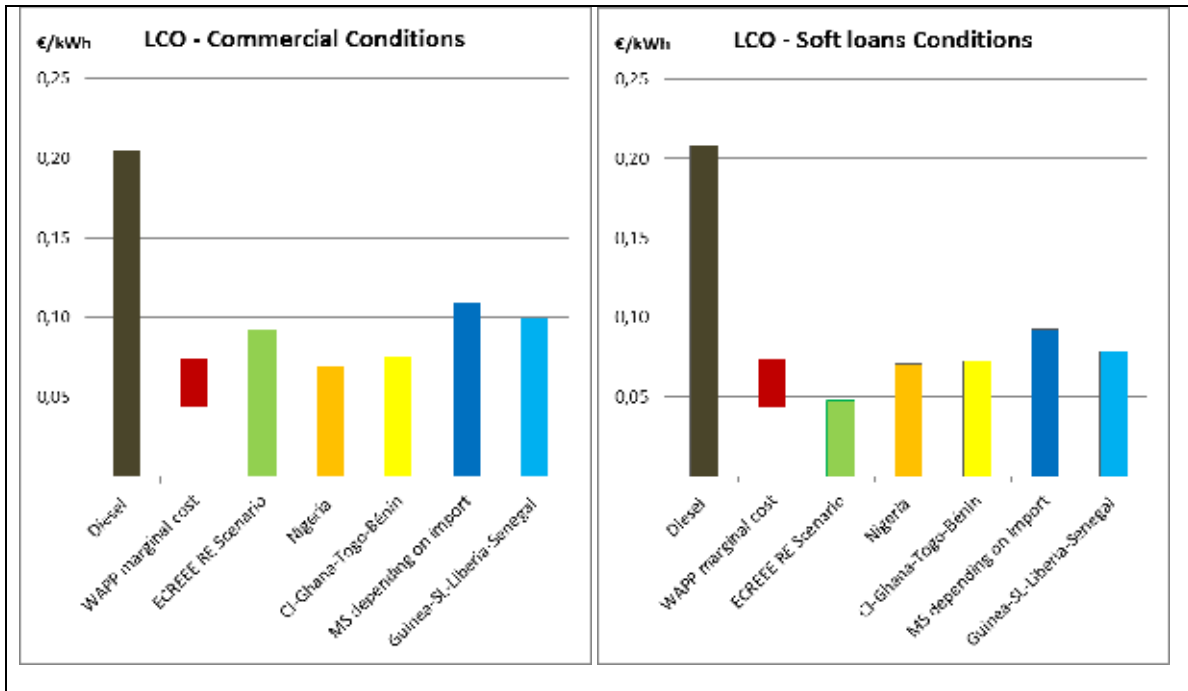


Figure 11: LCOE for the EREP scenario

The two first columns show the LCOE (levelised cost on a 25 years period) for diesel generation and the range of marginal costs for the WAPP options to the countries. The green columns represent the LCOE for the EREP scenario for all ECOWAS countries calculated on a 25 years period, the next (orange) is the LCOE for Nigeria; the yellow columns represent the LCOE for Cote d'Ivoire, Ghana, Togo and Benin, dark blue for the LCOE for Burkina, Guinea Bissau, Mali, Gambia, and Niger, and light blue for the LCOE for Guinea, Sierra Leone, Liberia and Senegal.

Under commercial financial conditions with the private sector investing in EREP renewable energy options, the EREP scenario constitutes a financially better option for all new capacity that can substitute oil-based thermal production to 2018 or later on when they have access to the WAPP options. The average benefit is 0.7 c€/kWh for the countries that will have the cheapest WAPP options due to their hydro potentials or a large coal production, and 1.7 c€/kWh for the countries relying on future WAPP interconnection. Due to the decreasing investment cost for all EREP renewable energy options during the period, some technologies will become competitive with the WAPP options.

Under ODAs' conditions, the EREP scenario is a financially better solution for all the ECOWAS countries. However, it cannot be recommended as the solution to finance the EREP. Nevertheless, by targeting a possible limited financial support to avoid that, EREP scenario could avoid to be a financial burden for countries like Nigeria, Ghana, Cote d'Ivoire, Togo and Benin. A sensibility analysis shows that a 3.6% reduction on the commercial conditions will be sufficient to bring the LCOE for EREP scenario in line with the WAPP marginal costs from Nigeria, Côte d'Ivoire, Ghana, Togo and Benin.

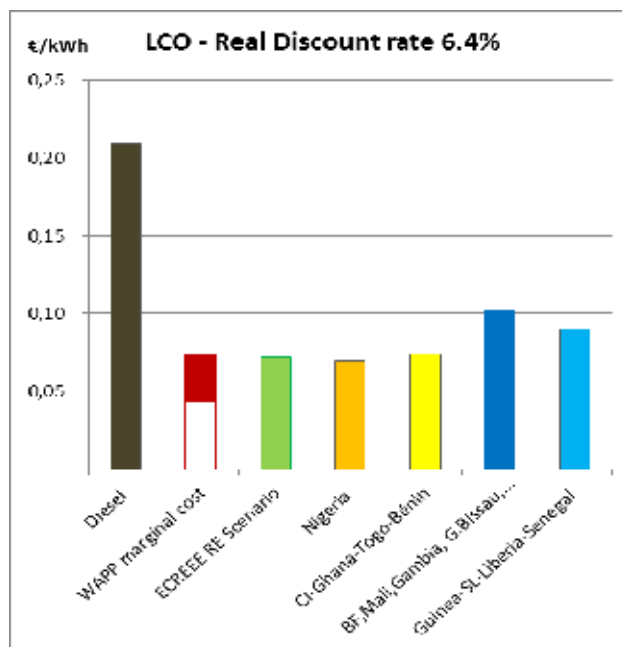


Figure 12: LCOE for softer conditions

Finally, accounting for the externalities in the LCOE calculation (See annex 3), the EREP scenario becomes competitive with the LCOE for Nigeria, Côte d'Ivoire, Ghana, Togo and Benin and is quite lower for the other countries. When considering the negative environmental externalities of conventional generation in the economic assessment (e.g. pollution GHG emissions), the ECREEE/EREP scenario becomes more attractive under commercial conditions. The LCOE is equivalent to the LCOE Nigeria and Côte d'Ivoire-Ghana-Togo-Benin (see Figure 13).

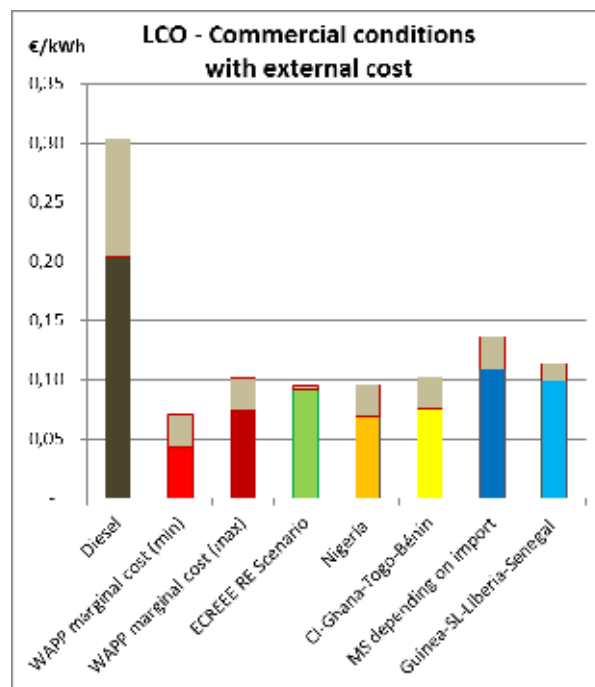


Figure 13: Analysis of the electricity access situation in the ECOWAS



Mini-grids, stand-alone or micro systems

Actual access rate in the ECOWAS region

The actual status of the energy access situation is summarised in the following charts. It relies on data from UNPD report on General Energy Access in ECOWAS Region - UNDP Dakar – Regional Energy Poverty Project – 2011, corrected for some factual and compilation errors; for example Mali's national access rate is 28% instead of 17% and the regional electricity access rate is 42% instead of 27%.

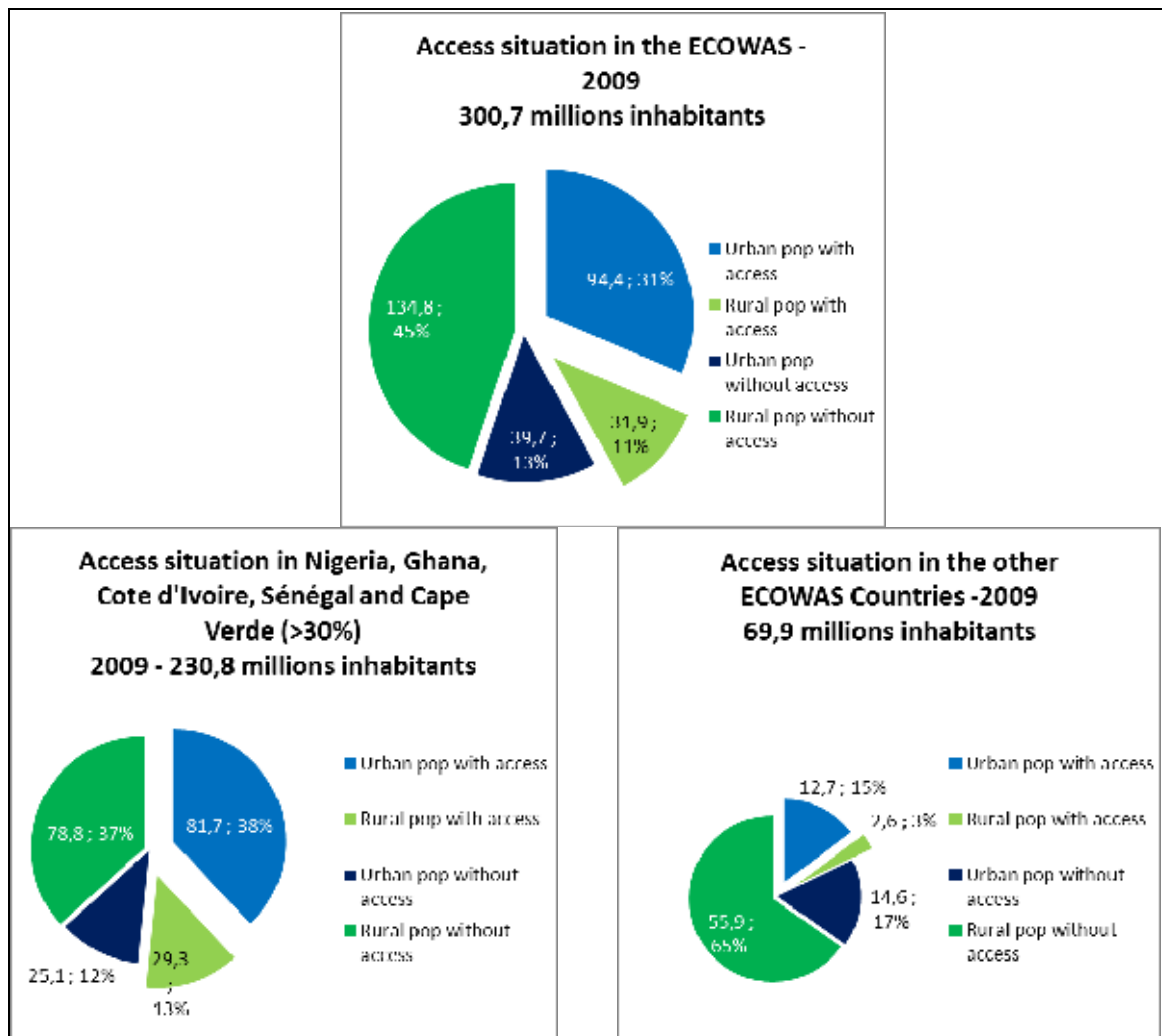


Figure 14: Analysis of the electricity access situation in the ECOWAS

For the ECOWAS region, 19% of the rural population have access, mainly the major rural centres and some localities under the lines. And 81% of their rural populations are left without access. Six countries already have a significant national electricity access rate in 2009, greater than 30%. These are Cape Verde (87%), Ghana (66.7%), Nigeria (50%), Côte d'Ivoire (47.3%), and Senegal (42%). For these countries 25.1 million urban people and 78.8 million rural populations had no access to electricity in 2009. For the remaining 10 countries, only 18% of the population in average had access



to electricity with most of them in urban areas (83%). 82% of the total population live without access among them 80% is rural.

Modelling the correlation population and localities for the WAPP

Another important parameter to take into account is the spatial distribution of the population according to the size of their settlements, as urban cities and large rural towns will be easier to be supply by the grid than smaller scattered villages in remote areas. As demographic data are poor at the regional level, especially regarding the number of localities, a model developed for this purpose gives the following pictures of the ECOWAS population distribution on 213,700 localities having a population higher than 200 inhabitants:

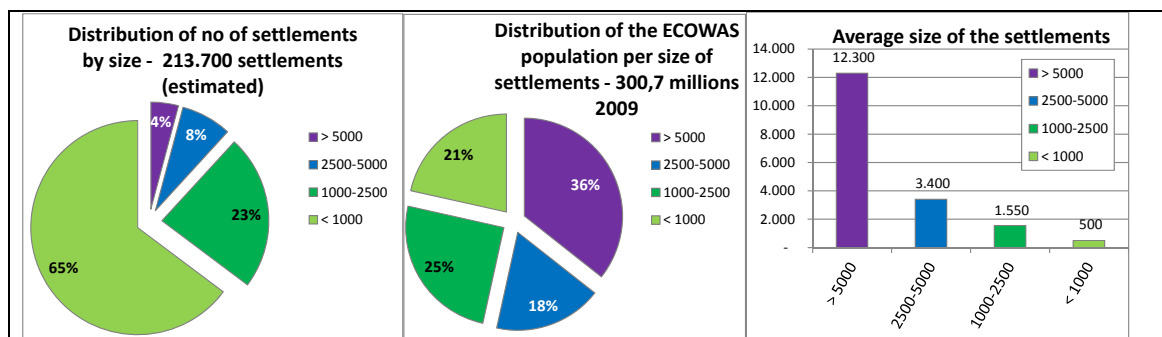


Figure 15: ECOWAS population and settlements (distribution by size of settlements)

Beyond these estimated 213,700 localities, there are a lot of smaller settlements gathering together few rural compounds with a total number of inhabitants smaller than 200. This population will be supplied through micro stand-alone equipment. Access through grid extension cannot reach all the localities as the cost of the line will be exorbitant in regard to the energy delivered. Based on this assumption and a correlation between the populations that have access to electricity (access rate) and the number of localities that are supplied (dispersion rate for grid connected localities), it will be supplied through the grid and those which will not be connected, such as localities with small population, those far from the grid or those in the periphery of the grid extension programme. These localities according to the UN universal access objective will benefit from renewable energy generation through mini-grid supply systems or through stand-alone equipment such as SHS, which will evolve to micro AC power system, household biogas plants and solar lamps.

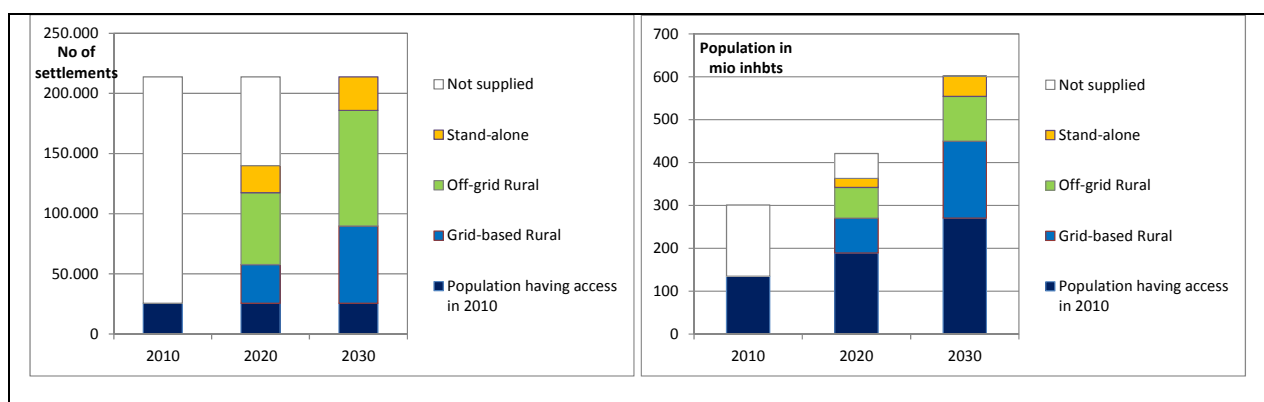


Figure 16 : Scenario for electricity supply in the ECOWAS region



The chart demonstrates clearly that even if 65% of the population in 2020 will have access to electricity through the grid, only 27% of the localities will be connected and 73% of the remaining localities will be without access if mini-grid solutions are not introduced.

Table 14 : Synthesis of the ECOWAS electrification modelling

	Population in millions inhabitants			Localities		
	2010	2020	2030	2010	2020	2030
ECOWAS	300.7	421.0	601.4	213,700	213,700	213,700
Grid connected supply (existing 2010)	135.2	189.3	270.4	25,666	25,666	25,666
New grid-based rural		81.3	179.5		32,055	64,110
Off-grid Rural		71.4	104.3		59,836 ³	96,165
Stand-alone Rural		21.0	47.2		(22,438) ²	(27,781)
Un-served population	165.5	58.0	0	188,056	73,726	0
	2010	2020	2030	2010	2020	2030
ECOWAS	100%	100%	100%	100%	100%	100%
Grid connected supply (existing 2010)	45%	45%	45% ¹	12%	12%	12%
New grid-based rural	0%	19%	30%	0%	15%	30%
Off-grid Rural	0%	17%	17%	0%	28%	45%
Stand-alone Rural	0%	5%	8%	0%	10%	13%
Un-served population	55%	14%	0%	88%	34%	0%

- 1) The real figure is 42% - statistical difference in model calibration
- 2) No. of settlements (< 200 inhabitants) but not exhaustive – registered differently country by country
- 3) Some of the off-grid localities as they have grown will be included in the grid extension and their EREP renewable energy options connected to the grid (support the voltage and reduce the community energy bill). The local distribution LV grid will be reused and extended.

It is expected that 64% of the overall ECOWAS population will get access through the grid by 2020 corresponding to only 27% of the localities. The figures for 2030 will be 75% of the overall ECOWAS population having access through the grid corresponding to 42% of the localities.



Grid-connected rural electrification cost

Figure 17 illustrates the distribution cost for a 100 km rural distribution line (54.4 mm² Almelec) as a function of the population density served by the line on a 30 year period. For commercial conditions (10% on the chart) the cost of distribution is about 6.2 c€/kWh in an optimised configuration (all the localities under and in the vicinity of the line are connected). Generally this does not occur as the cost of transformers to serve small settlements are too expensive with regard to the electricity sales. In the case of non-optimised use of the line, the distribution cost can double to 12 c€/kWh. The minimum and maximum LCOE for a WAPP option are calculated to be 8 and 13 c€/kWh, respectively. This cost includes 15% losses up to the consumer. The resulting on-grid rural electrification cost can be assessed to be between 20 and 25 c€/kWh.

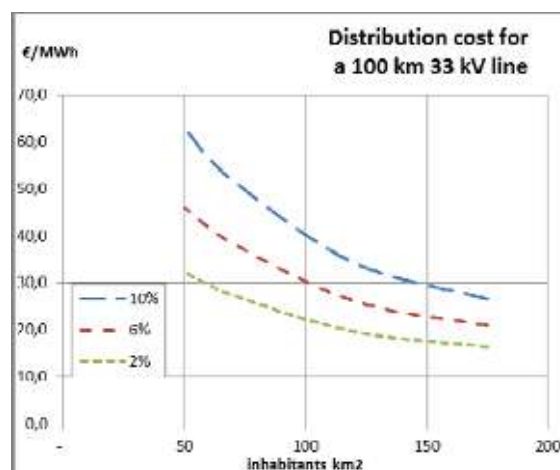


Figure 17: Optimised rural distribution cost for a 33 kV line

Diesel generation cost

With an average unit consumption of 350 g/kWh and a levelised price for DDO taking into account a constant price escalation of the barrel price of 1.84% up to 2020 and 1.19% after 2020 (IRENA assumptions), the fuel cost per kWh produced is about 33 c€/kWh. The capital cost can be estimated to 2-3 c€/kWh.



Mini-grid dimensioning and costing

Compared to the fuel cost to a diesel thermal production, the capital cost of the mini-grid per kWh is lower than the DDO cost of 33 c€/kWh, as shown in the calculation below. A simple return on investment shows that fuel expenses can pay back the investment in 7.2 years for the investments made during the period 2014-2020 and 5.2 years for the other investments.

Assumptions

Locality average size:	1200	inhabitants		
No of inhabitants/household	8			
No of household	150			
No of connections/km LV line	30			
Length of the LV grid	5	km		
Unit price in €/km	9,000	€	Grid investment cost	
			45,000	€
Average cost for generation			Investment in generation	
2014-2020	3,500	€/kW	175,000	€
2021-2030	2,500	€/kW	125,000	€
Unit load demand - 1.5 A @ 220 V	50	kW		

Total investment costs in M€	No of mini-grid	Invest per mini-grid	Total investment	
2014-2020	60,000	0.22	13,200	M€
2021-2030	68,000	0.17	11,560	M€
2014-2030			24,760	M€

Financial assessment

Energy production /unit	100	MWh	
Diesel consumption	35,000	kg	
DDO price /kg (Levelised)	0,94	€/kg	
Fuel expense	32,905	€/year	
Return on invest/fuel expenses	5.3	years	2014-2020
Return on invest/fuel expenses	3.8	years	2021-2030

Capital cost - 2014-2020	19	c€/kWh
Capital cost - 2021-2030	14	c€/kWh

Fuel cost for diesel generation	33	c€/kWh
---------------------------------	----	--------

WAPP LCOE max 15% losses	8	c€/kWh
WAPP LCOE min 15% losses	13	c€/kWh
Distribution cost	>12	c€/kWh
Resulting on-grid supply	20<<25	c€/kWh



Compared to a 'fictive' on-grid rural electrification tariff, since these localities will not be connected to the grid, the mini-grid is equivalent to a grid-connected solution over the period 2014-2020 and slightly more economic for the following period.

The stand-alone system's cost is calibrated on a 30/40 Wp solar home system which actually can be estimated to be €120. With an economic life time of 15 year and a maintenance cost of 60 € (1/2 of the investment) equally distributed on this period, the monthly fee to this service with a real discount rate of 10% is €1.42 or €17€/year.



Annex II: Scenario elaboration

Renewable energy sources assessment:

This assessment is based on several sources:

- The assessment done in the baseline report
- The ECREEE project pipeline
- Some national targets for countries having set such targets.

Baseline report's assessment

The potential for renewable energy resources in West Africa has been assessed in a separate renewable energy baseline report. The resources are generous and well distributed among the countries:

- Wind potential is concentrated on costal zones (Cape Verde, Senegal, Gambia, and possibly Ghana, Mali and Nigeria). The overall wind assessments provide only general information on the potential that need to be refined locally with a survey and a measurement campaign to verify the strength and the seasonal variation of wind regimes to state the financial viability of the potential.
- Small hydro potential is located particularly but not exclusively in the southern part of the region (Cote d'Ivoire, Ghana, Guinea, Guinea Bissau, Liberia, Togo and Sierra Leone) while solar resource is abundant in the northern regions (Niger, Burkina Faso, Niger and the northern part of Ghana and Nigeria).
- Except for Cape Verde and the Sahelian areas of Mali, Burkina Faso, and Niger, biomass resources are well distributed among the region, with a propitious potential in the Southern regions according to the pluviometry. When considering biomass resources, it is important to distinguish: (i) the diffused biomass resources from agricultural by-products, which are generally costly to collect and transport in large quantities, and for that reason can be used locally, and (ii) the concentrated resources at the agro-industry sites like rice husk, cotton seed shells, groundnuts and cashew shell, sawdust, manure and dung at dairies or slaughterhouses, which can constitute a proper resource for cogeneration. Under the same category are the urban wastes.
- Finally, solar resource is especially favourable in the northern desert areas of the ECOWAS region in Mali and Niger and in the North-Eastern part of Nigeria with a potential of 1700 kWh/installed kWp/year. The coastal areas of Liberia, Côte d'Ivoire, Ghana and Nigeria do not benefit to the same extent from this resource with an average potential of 1,200 kWh/installed kWp/year. For the remaining areas, the average potential is about 1,500 kWh/kWp/year.

Based on the data collected, a tentative matrix is presented in Table 15 showing a possible contribution of the potential energy resources for each country. This matrix is indicating the type of resources that are available and the share of these resources.



Table 15: Indicative ranking of RE resources by countries

	Wind	PV	Small scale hydro	Biomass
BENIN	10%	20%	50%	20%
BURKINA FASO	0%	60%	30%	10%
CAPE VERDE	90%	10%	0%	0%
COTE D'IVOIRE	0%	10%	50%	40%
GAMBIE	60%	30%	0%	10%
GHANA	25%	35%	30%	10%
GUINEE	0%	20%	50%	30%
GUINEE BISSAU	0%	20%	40%	40%
LIBERIA	0%	10%	50%	40%
MALI	10%	30%	30%	30%
NIGER	30%	50%	0%	20%
NIGERIA	10%	30%	30%	30%
SENEGAL	70%	10%	0%	20%
SIERRA LEONE	0%	10%	60%	30%
TOGO	0%	20%	50%	30%
Mines	0%	30%	70%	0%

The sum of the potential per country is 100%. 0% indicates that the resource is not available or not economically feasible, as for instance biomass and small scale hydro for Cape Verde. Three countries have good wind potential (Senegal, Gambia and Cape Verde), and therefore the wind resources are given a high ranking for these countries.

Countries like Mali and Nigeria, which have an equal distribution of their renewable energy resources, are given an average ranking of 30% for three resources (solar, biomass and hydro) and a 10% ranking for wind, as wind is more intermittent compared to the other resources. Even if there are good solar resources in Northern Mali, these resources cannot be fully exploited as it would require long transmission lines to transport the produced energy to the south. However, this resource can be used to supply the large cities in Northern Mali.

The line “Mines” shows that four countries with large mining potentials (Guinea, Liberia, Sierra Leone and Guinea Bissau) can draw advantages of their renewable energy potentials to supply directly their mining activities, which are located in remote areas far from the national grid. The two main sources are, by order of priority, the small scale hydro power and the solar PV. The mining activities generally need capacity between 30 to 150 MW.

These figures are indicative and have been used for the modelling of the EREP scenarios.



ECREEE's renewable energy projects portfolio

The ECREEE's identified renewable energy project pipeline has also been used to develop the EREP scenario (see Figure 18).

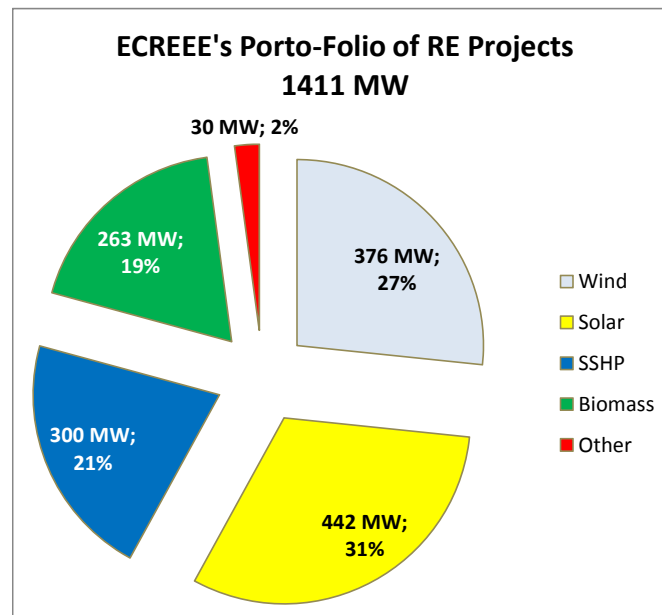


Figure 18: ECREEE's Port-Folio of RE projects

These projects have been identified by the NFIs and reflect the national priorities in terms of considered or discussed renewable energy projects. It has to be noted that the proposals from Nigeria with 259 MW does totally match with the size of this country.



National Renewable Energy Targets

From the national surveys, targets for RE penetration have been collected and are summarised in the following table.

Table 16: National Renewable Energy Targets

Country/Target	Grid connected Electricity		Energy (heating, cooling)		Specific sector Target (off-grid/rural access/non-electricity/for health or agriculture etc.)
	Short Term	Long term	Short Term	Long term	
BENIN	16% (945 GWh ^a 2015)	37% penetration (1700 GWh ^a in 2025)	NA	NA	NA (Rural elec, 170 localities by solar PV)
BURKINA	NA	NA	NA	NA	NA
CAPE VERDE		50% Penetration			
COTE D'IVOIRE	5% 2015	NA	NA	NA	
GAMBIA	NA	NA	NA	NA	
GHANA		100% RE penetration 2020			
Guinea			By 2013: 5% coverage of solar thermal for hot water and cooling	20% by 2025	Rural elec through solar energy by 2013 (2% Moyenne Guinée; 4% Guinée maritime; 6% Haute Guinée (189 localités isolées)) Rural elec through solar energy by 2025: (6% Moyenne G; 12% G. Maritime; 18% Haute G; 1% G. Forestière) 1% oil covered after rural elec. based on energy. (By 2025: 2% Moyenne G; 3% G. Maritime; 3% Haute G; 1% G. Forestière) 5% of the demand in rural area covered by Biogas digestor in short term (2013). 30% by 2025. Biofuels production 2% of the demand by 2025
LIBERIA	10% RE penetration 2015	NA	10% of RE consumption 2015	NA	NA
Mali (1)		100% penetration by 2025		15% per by 2022	plus 10%/year year of 6%h generated from RE and per household from 2014 onwards
NIGER (1)		100% RE in energy mix 2020			Reduction of wood-fuel use from 68% to 20% (2013) as share of wood-fuel and agricultural wastes in the overall energy balance
NIGERIA (2)	5% 2015 (746 MW installed)	100% 2025 (2945 MW installed)	16% 2015	7% 2025	
SENEGAL		15% RE penetration in 2020 (all categories, Hydro, RE)			
SIERRA LEONE	NA	NA	NA	NA	NA
Togo	NA	NA	NA	NA	NA

^a Ces valeurs sont la part d'ECR dans la production d'énergie électrique

(1) SREP Mali Vol 1

(2) IL Master Plan Nov 2006 page 12 and IL Policy Guidelines

(3) Ministry of Natural Resources and Environment, 18 November 2013

Scenario building

The EREP scenario has been compiled as follows:

- The entry data are the load forecast for each country as computed by the WAPP revised master plan.
- The second step was to assess a possible penetration rate for EREP options corresponding to 2010 and 2020. A 10% and 20% have been discussed with ECREEE as entry point for the simulation.
- The targets are applied to the load forecast for each country, checking that the resulting capacity does not exceed 20% of the potential regulating capacity in regards for grid stability issues.



- Then, the proposed matrix for renewable energy resources ranking is applied to calculate the capacity for different energy sources and technologies. At this stage, the Concentrating Solar Plant is separated from the PV farm.
- The compilation results into a capacity to be installed in regards to the targets and the required investment.
- The EREP options have been separately and financially analysed in the base line report.
- The EREP renewable energy scenario is finally financially and economically assessed by using the LCOE method that involves the determination of the resulting levelised cost for the EREP scenario, covering both investments and operation and maintenance costs scheduled in the time according to the proposed investment programme. This LCOE is compared to a base-line LCOE without the EREP scenario i.e. a scenario for which each country is supplied at their actual marginal supply cost and at the WAPP marginal supply costs as of 2018. The LCOE exercise is developed for a 25 years period and applied to different market conditions: a commercial market condition with a real discount rate of 10% and an ODA's soft financial conditions for with a discount rate of 2%.



Annex III: Environmental externalities

In 2004, the average external costs of electricity production in the EU-25 were between 1.8–6.0 €/kWh. Electricity production causes substantial environmental and human health damages, which vary widely depending on how and where the electricity is generated. The damages caused are for the most part not integrated into the current pricing system and thus represent an external cost. External costs for electricity are those that are not reflected in its price, but which the society as a whole must bear.

The external costs are the sum of three components associated with the production of electricity:

- I. Climate change damage costs associated with emissions of CO₂
- II. Damage costs associated with other air pollutants (NO_x, SO₂, NMVOCs, PM₁₀, NH₃), i.e. impacts on health, crops, etc.
- III. And other non-environmental social costs for non-fossil electricity-generating technologies.

Marginal damage cost factors in the case of CO₂ are not country specific (i.e. all countries share the same marginal factors for CO₂, one for low, €19/tonne and one for high €80 /tonne).

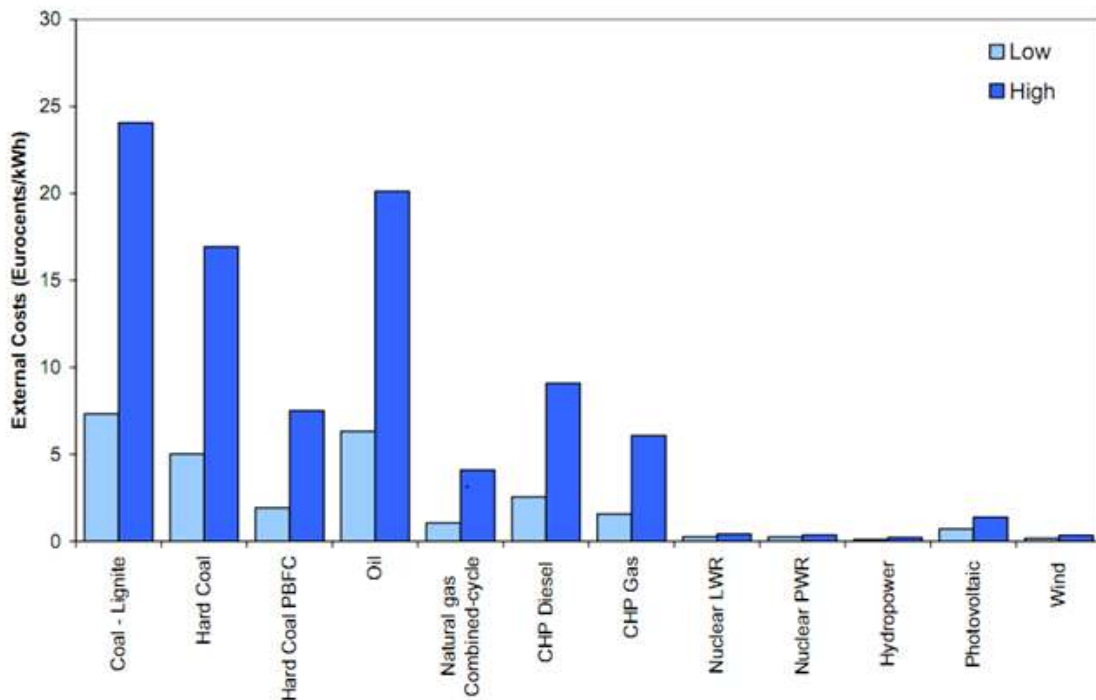


Figure 19 : Estimated average EU-25 external costs for electricity generation technologies

These external costs are not included in the conventional market prices for electricity, which contribute to inefficiencies in resource allocation decisions. By including external costs in market prices, such inefficiencies can be corrected.



For the purpose of the EREP the following marginal cost are considered

- Hard coal: 0,10 €/kWh
- Oil : 0,15 €/kWh
- CC and TAG natural gas 0,04 €/kWh
- Hydro: nil
- Wind: nil
- PV: 0,015 €/kWh

And for the WAPP with a mix of 3% RE, 5% coal, 55% gas, 37% hydro the resulting cost can be evaluated to = 0,0275 €/kWh

When considering the externalities, the ECREEE scenario LCOE is equivalent to the LCOE Nigeria and Côte d'Ivoire-Ghana-Togo-Benin

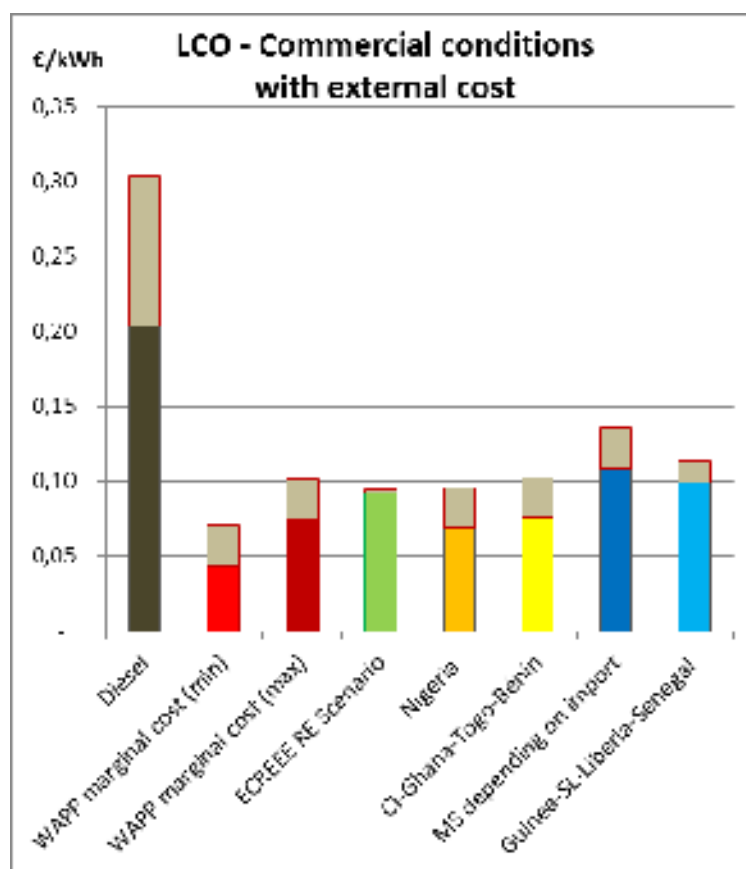


Figure 20: Impact of accounting negative externalities on production costs



Annexe IV: Domestic energy

Resources

The assessment of woody biomass resources is based on FAO Global Forest Resources Assessment done by FAO in 2005 (FAO – 2005). The forest area in the ECOWAS region is continuously reducing since 1990. With 133 million hectares in 1990, it was estimated as 116 million hectares in 2005, a 14% reduction over 15 years or in average 0.9% per year. These wooded lands cover both concepts of forest and woodland following the FAO categories.

Under sustainable management, the sustainable logging per hectare varies depending on climate zone. In the Sahelian region, it is about 0.3 t / ha of forest, in Sudan it may be estimated as 1.1 tonnes / ha, and in equatorial zone it can exceed 1.8 t / ha.

Given the location of six ECOWAS countries (Mali, Burkina Faso, Niger, Cape Verde, The Gambia and Guinea Bissau) mainly in the Sahelian and Sudano-Sahelian zone, an average conservative assumption regarding sustainable logging quantities per hectare of forest for all ECOWAS region is set at 0.8 tonnes per hectare.

Based on this estimated sustainable logging ratio per ha, the potential volume of sustainable woodfuel for 2005 can be roughly estimated at 93 million tonnes, as an order of magnitude. Given the continuing decline in forest areas, the potential sustainable supply is estimated as 89 million tonnes in 2010.

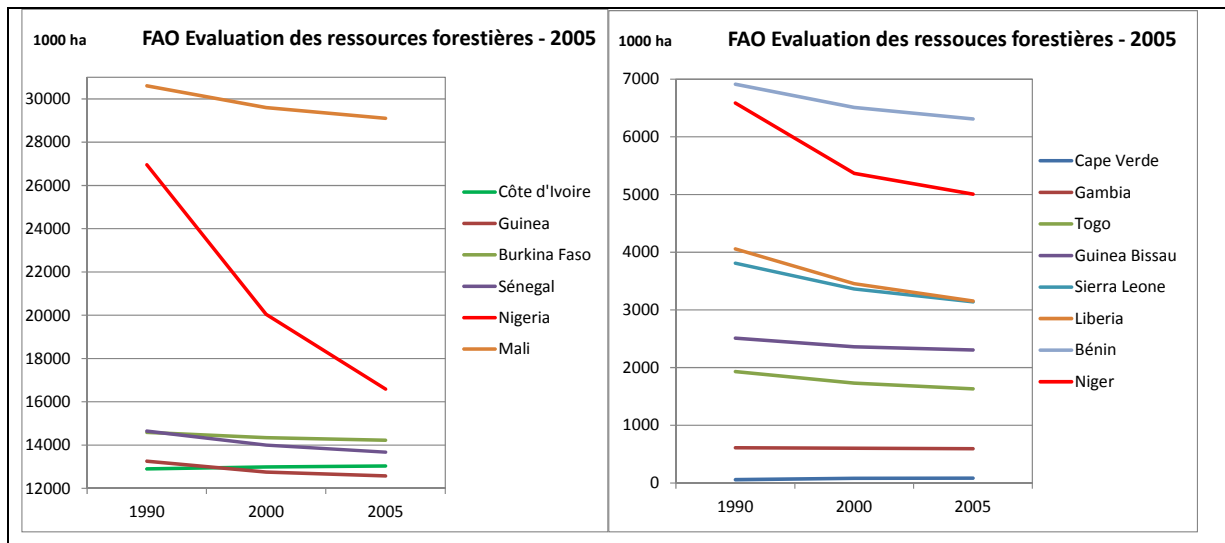


Figure 21 : FAO Global Forest Resources Assessment 2005

Four countries have maintained or increased their forested areas: Cape Verde, Cote d'Ivoire, Burkina Faso and the Gambia. For most of the other ECOWAS countries, these surfaces are strongly declining particularly Nigeria which has lost 62% of its forest area since the 90s.



As part of the evaluation of the CILSS firewood program (PREDAS), funded by the European Union, a number of conclusions have been drawn for six CILSS countries which are part of ECOWAS, namely Senegal, Mali, Burkina Faso, Niger, Cape Verde, and Guinea Bissau. As a general statement, forestry potential remains adequate in regard to meet the woodfuel demand of these countries, although tendencies to over-exploitation emerges, especially for countries such as Mali, Niger and, to a lesser extent, Burkina Faso. The analysis shows that, even if these countries are mainly Sahelian, it would be possible to restore the balance between supply and demand through a proactive policy of sustainable natural resources management involving the participation of the local population and by developing and implementing a policy for efficient use of resources through the promotion of improved stoves. This should be done through public-private partnerships and through a moderate support to a fuel substitution policy from woodfuel to LPG.

Modeling the demand for wood energy

The assumptions of this model are:

- The average vital need for food cooking for a human being is estimated at 600 MJ in terms of useful energy, this corresponds to 731 grams of firewood per capita per day for cooking yield by 14%.
- The current average yields applied in the modelling are :

Cook-stove- fire wood – urban dwelling	15%,
Cook-stove- charcoal – urban dwelling	20%,
Cook-stove- fire wood – rural dwelling	12%
Charcoal burning	12%

- The entry key data are demographic: a population of 300 million inhabitants, nearly 45% is urban. This population will double by 2030.
- The urbanization rate of 45% rises gradually to 50% by 2020 and 55% by 2025.
- The consumption of modern energies is estimated in the EREP baseline report at 300,000 tonnes of LPG and 666,000 tonnes of kerosene, mainly used in Nigeria. The cooking yield of these energies is estimated at 75%.

Due to urbanization, the share of consumption of charcoal in urban areas will increase from its current level of 50% to 80% by 2030. Currently, five countries are using charcoal as the first domestic fuel in urban areas - Senegal, Mali, Cote d'Ivoire, Ghana, and Benin. The migration from wood to charcoal is underway in Burkina Faso. Only Cape Verde and Niger use mainly firewood as primary energy. In the Gambia, the carbonization of wood is banned but The Gambia imports it from Casamance in Senegal.



Reference Scenario

ECOWAS POPULATION	2010	2020	2030
Population	300,7	421	600
Urbanisation rate	44%	50%	55%
Urban population	133,7	210,5	330,0

Unit consumption	0,6	GJ/cap/y
	0,731	Kg fire wood /cap/day

Cooking energy needs 10 ⁶ GJ	180,4	252,6	360,0
-urban	80,2	126,3	198,0
-rural	100,2	126,3	162,0

Modern fuel

LPG 10 ⁶ GJ	10,4	16,4	25,7
Kerosene 10 ⁶ GJ	20,8	32,8	51,4

Urban cooking energy 10⁶ GJ

LPG	10,1	15,9	24,9
Kerosene	13,9	21,8	34,2
Urban modern cooking fuel	24,0	37,7	59,1
Urban modern fuel %	30%	30%	30%
Woodfuel	70%	70%	70%
Urban Woodfuel 10 ⁶ GJ	56,2	88,6	138,9
-fire wood %	50%	40%	20%
-charcoal %	50%	60%	80%
-fire wood 10 ⁶ GJ	28,1	35,4	27,8
-charcoal 10 ⁶ GJ	28,1	53,1	111,1
-fire wood 10 ⁶ tonnes	12,5	15,7	12,3
-charcoal 10 ⁶ tonnes	5,0	9,5	19,8
Woodfuel 10 ⁶ tonnes	48,4	83,5	154,0

*Rural cooking energy*

LPG	0,3	0,5	0,8
Kerosene	6,9	10,9	17,1
Rural modern cooking fuel	7,2	11,4	17,9
Rural modern fuel %	7%	9%	11%
Woodfuel	93%	91%	89%
Rural Woodfuel 10 ⁶ GJ	93,0	114,9	144,1
-firewood %	95%	90%	80%
-charcoal %	5%	10%	20%
-firewood 10 ⁶ GJ	88,3	103,4	115,3
-charcoal 10 ⁶ GJ	4,6	11,5	28,8
-firewood 10 ⁶ tonnes	49,1	57,4	64,0
-charcoal 10 ⁶ tonnes	0,8	2,1	5,1
Woodfuel 10 ⁶ tonnes	55,0	72,1	100,8

Overall Woodfuel 10⁶ tonnes	103,4	155,6	254,8
Needs of 10 ⁶ ha sustainable forestry	129,21	194,54	318,55
Forest and wooded land 10 ⁶ ha	111,40	102,02	93,43
Sustainable production 10 ⁶ t	89,12	81,62	74,74
Deficit in 10⁶ tonnes	-14,25	-74,01	-180,10
Afforestation index	-16%	-91%	-241%

	2010	2020	2030
Efficient wood cook-stove - urban	15%	15%	15%
Efficient charcoal cook-stove c	20%	20%	20%
Efficient wood cook-stove - rural	12%	12%	12%
Efficient charcoal burning	14%	14%	14%
1kg charcoal = kg firewood	7	7	7

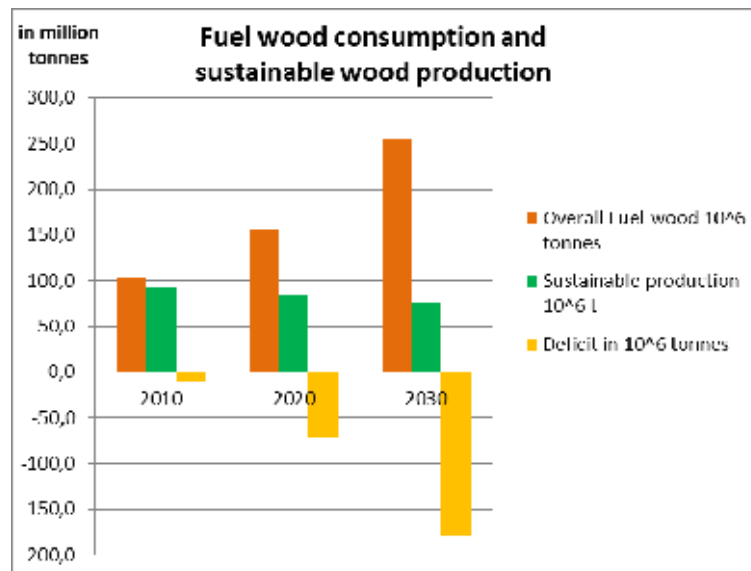


Figure 22: Reference scenario

In the reference scenario, the penetration of modern cooking fuel and cooking equipment is kept at their 2010 level, while the assumption of the consumption shift from firewood to charcoal is applied.

In this case, the total demand for tonnes of wood to meet the demand for firewood and charcoal grows from 103.4 million tonnes in 2010 to 155.6 million tonnes in 2020 and 254.8 million in 2030.

Already in 2010 the sustainable ECOWAS woodland's woodfuel potential is less than the actual demand which means an overexploitation of the resource that can be assessed at an 'over-exploitation's index of 16%, corresponding to the gap between demand and sustainable resource over this sustainable resource. If nothing is done, this index will increase rapidly to reach a value of 91% by 2020 and 241% by 2030, with rapid potentially irreversible deforestation as consequence.

Impact assessment of the improved cook-stoves

The first measure tested on this model is the reduction in woodfuel demand by implementing a policy of energy efficiency through the promotion of improved stoves for firewood and charcoal and seeking a substantial energy efficiency gain. The objectives of this policy are summarized in the following table:

	2010	2020	2030
Efficient urban wood cook-stove	15%	23%	30%
Efficient charcoal cook-stove	20%	28%	35%
Efficient rural wood cook-stove	12%	18%	25%

The objective is to significantly improve over a period of twenty years the efficiency of the stoves using firewood and charcoal. The development of regional standards and labels for quality efficient cook-stoves has to be carried out to have a common reference. The second action is to agree on a common regulatory framework by prohibiting manufacturing and sale of inefficient stoves by 2020 in order to avoid inefficient use of the resource.



In terms of actions, it is necessary first to promote the know-how needed to ensure the efficient production of good quality cook-stoves. This knowledge exists already. However it has to be compiled and disseminated. The craftsmen manufacturing these stoves need to be informed on the impending ban and offered support with the entrepreneurial approach in order to adopt models similar to the Malian one should be considered. In a short transition period, micro-credit schemes for low-income households should be available to support the behaviour shift in purchasing cooking stoves at a cost of €4-6. Nevertheless, it is essential to achieve a regional consensus on the obligation to manufacture and sell only improved stoves and to ban the inefficient ones. The longevity and efficiency of the improved stoves will, in the long term, generate a profit for the user. It is also necessary to avoid any idea of subsidizing this activity which should develop on commercial basis. In terms of results, this scenario has significant effects on the forest resources over-exploitation index as shown in following figure.

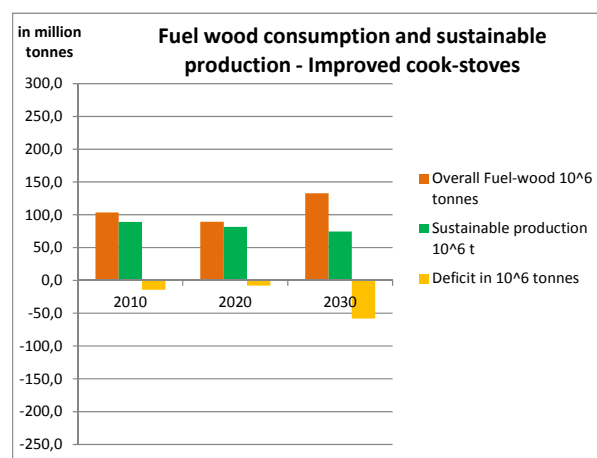


Figure 23: Efficient cook-stoves measures

The 2030 index that was of 241 % in the reference scenario is reduced to 86 %. Following the decision of banning the inefficient products from the market in 2020, the demand is dramatically diminished, reducing the pressure on the natural resources.

Efficient charcoal burning

The second measure tested is the performance improvement of carbonization which could increase from 12% today to 25% by 2030. A yield of 12% means that it takes 7 kilos of wood for a kilo of charcoal while a yield of 25% reduces the need for wood to 4 kg per kg of charcoal.

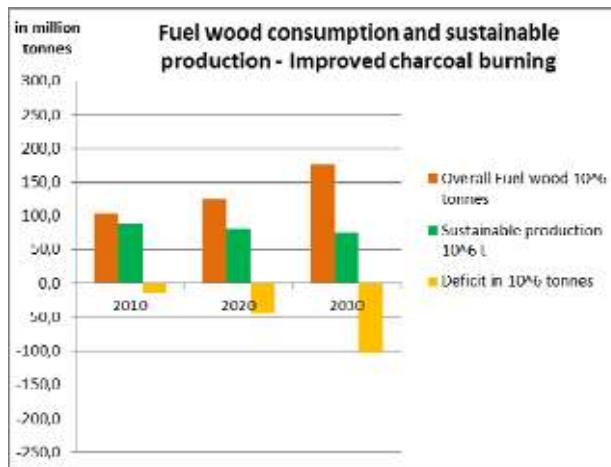


Figure 24: Efficient charcoal burning

This measure is also effective and helps to shift the forest overexploitation index of 241% to 136% by 2030. The implementation of this measure is more complicated than the previous one since it requires both a training component of charcoal burners to more efficient techniques, and at the same time, monitoring to ensure that these new skills are being effectively applied by charcoal burners. Illegal charcoal has to be controlled and eradicated. Since part of the production of charcoal is actually not controlled, this measure should be integrated as part of a policy for sustainable management of forest resources involving more directly the responsibility of the local population.

Combining both efficient cook-stove and efficient charcoal burning

By combining both identified measures (banning of inefficient cook-stoves in 2020 and inefficient carbonisation in 2030), the index for overexploitation is reduced considerably. From an overexploitation index of 11% in 2010, this trend could be stopped by 2020, as illustrated on the figure no 25, by a negative index of -15%, but will return to a value of 15% by 2030. As the woodfuels resources are not equally distributed, the issue of severe deforestation remains for Nigeria, if massive use of modern cooking fuel is not promoted.

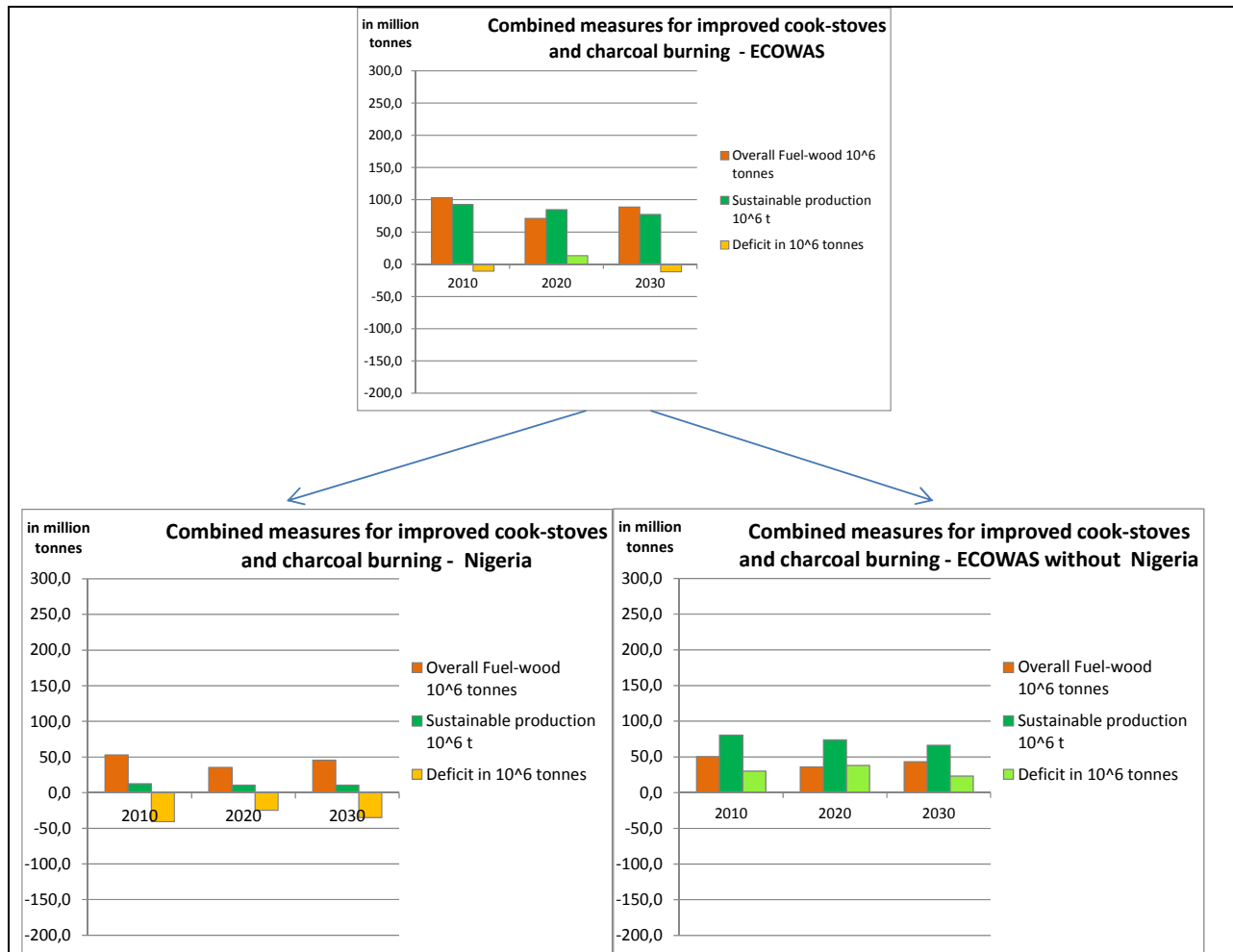


Figure 25 : Impacts of combining both previous measures

Substitution of woodfuels by modern fuels

The last practical measure that can be raised is to increase the share of modern energy in the mix of domestic energy in the ECOWAS. If utilised in a correct way, one of the benefits of modern energy is its high energy efficiency with a yield of 75%. Its drawback is the fact that they are petroleum products such as butane, kerosene, whose prices are relatively high if consumption is not subsidized. An alternative is to use biofuels produced locally, but prices are still not really competitive. Past policies have been subsidizing this type of energy. Increasingly, taking Senegal as example, governments are moving away from subsidies to pursue a policy of true prices. Burkina Faso, which still applies a large percentage of subsidies on the LPG cylinders under 12 kg, must pay under the finance law the subsidy amount of more than €10 million per year for the sale of 30,000 tonnes LPG, covering only 5-6% of the national domestic energy.

The actual baseline for modern cooking fuel is a penetration rate of 17% due to the large use of kerosene in Nigeria accounting for 2/3 of the 17%. The penetration rate is 12% for LPG in the ECOWAS countries excluding Nigeria, and 22% for kerosene in Nigeria.



Maintaining the level of penetration for modern cooking fuel will not be sufficient in the case of Nigeria even if both previous measures are fully applied. For the other countries, the overexploitation of the woody resources will again speed up at the end of the period. Therefore the targets for modern cooking energy are set to restore the balance between sustainable woodfuels production and demand. In that case the use for LPG in the ECOWAS countries (except Nigeria) should grow from 12% by 2010 to 20% by 2030 and the use of kerosene in Nigeria from 22% by 2010 to 60% by 2030. The resulting aggregated targets are 17% by 2010, 36% by 2020 and 41% by 2030.

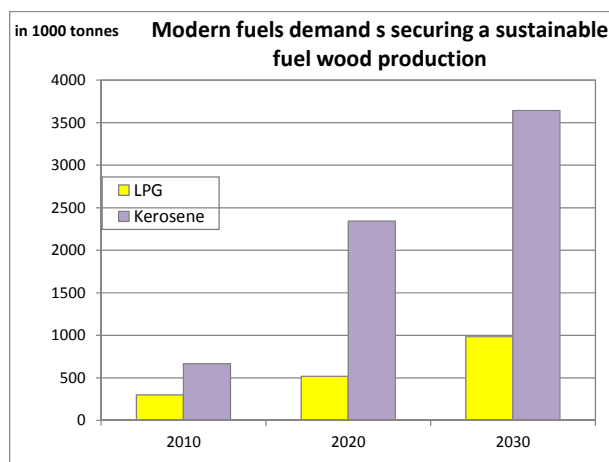


Figure 26: Resulting needs for modern cooking fuels

EREP Scenario for domestic energy

EREP scenario for domestic energy is to combine the three measures proposed. However, it must be noted that the second measure on improving yields of carbonization is part of a policy of natural resource management which is under the supervision of the Ministries in charge of environment and sustainable development, and that the third measure can only be sustainable if the shift from wood energy to modern energy occurs on a basis of non-subsidized prices. The combination of the three measures does lead to a return of the balance between supply and sustainable forest cover energy demand of the people.

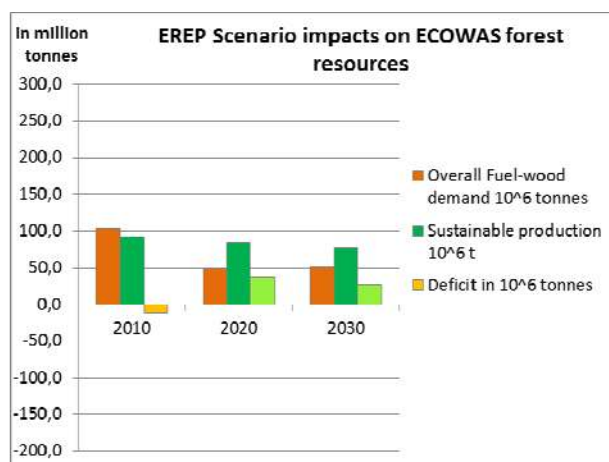


Figure 27: The ECREEE scenario for domestic energy



Annex V: Panel of tools according to the selected modus operandi

For grid connected applications

Several modus operandi can be considered:

1. A mandatory approach can be selected through the so-called **Renewable Portfolio Standard (RPS)**. This is generally responsibility of the regulatory authority that is mandated to implement the policy. Based on the national policy and strategy for renewable energy, the national regulatory authority shall develop a Renewable Portfolio Standard to be submitted for the approval of the national governments, setting, according to the NREP, the renewable energy capacity to be added to the power production mix. The RPS would specify what percentage of the total power that utilities supply should be renewable energy over specified periods of time, either by generating themselves, or by buying the power produced by IPPs. These IPPs would have been invited through a tendering procedure or they would have decided to invest in renewable energy power generation according the propitious market conditions offered. As alternative, the utilities can avoid this investment by paying compensation to a national renewable energy fund to support other renewable energy activities. (as is the case of Ghana).
2. Monopoly utilities would have to compulsorily buy all the Renewable Energy produced. The major issue here would be the ability of utilities to pay as the power from renewable energy may be higher.
3. The Member States can select a more consensual approach through **tendering the required capacity as IPP** after an agreement between the Member States government and its utility or TSO that can be sealed through the recurrent rolling programme agreement signed between the Government and its utility.
4. A third opportunity is an open procedure that will fix the feed-in tariff and provide the legal and regulatory framework for renewable energy production business as well as launch an open tendering for investors attracted by this opportunity. The decision will be on the investor side. When the conditions are too restrictive, few investors or none will respond. If the conditions are favourable, many and possibly *too many* will be interested by this open offer.

Concerning grid connected renewable energy production, main tools include:

- **Feed-in tariffs:** To ensure a stable pricing policy, ECOWAS Member States shall introduce feed-in tariffs for small hydro schemes not exceeding 30MW, all biomass cogeneration power plants, solar and wind-based power plants, irrespective of their sizes. Specific tariff regimes formulated by National Regulatory Authorities based on a common guideline developed by the Regional Electricity Regulatory Authority (ERERA), shall, in the long term, be guaranteed to buyers under standard contract and provide reasonable rate of return.
- **Norms for determining feed in tariff for different renewable energy technologies:** These would ensure a reasonable return to investors, but designed not to provide undue profits. Therefore, they would also include frequency or rationale for revision. Sometimes they should decline as in case of solar PV. In other cases, like biomass, there could be an escalation factor for the fuel component. For hydro, there may be differential tariffs for the



initial debt period, declining subsequently. Based on these norms, regulatory authorities would declare feed in tariffs.

- **Development of a Standard for Power Purchase Agreements (PPA).** The PPA sets the terms for the technical and commercial delivery of the energy produced by an IPP. It shall determine the delivery location, power characteristics, price, quality, schedule, and terms of agreement and penalties for breach of contract. It shall, among other things, ensure that prices provide an adequate return on investments for renewable energy; standardizes and simplifies contractual relationships; and protects investors, utilities and consumers.

The WAPP Permanent Secretariat has already developed in cooperation with ERERA appropriate standard or model for PPAs for larger gas-based or hydro power IPPs. These standards and models should be revisited to ensure their applicability to renewable energies. A lighter model shall be developed for smaller IPPs. Standards and models have to be validated by the national utilities and the national regulatory authorities, which will have the duties of controlling and monitoring these contracts.

- **Tariff regulation.** The national regulatory authority shall specify the terms and conditions for the determination of tariffs, and, by doing so, it shall consider all tariff elements that are favourable or hindering the promotion of renewable sources in electricity production.
- **Tax exemption:** In order to reduce the impact of the capital cost on the consumer's final tariff, it is agreed that all equipment imported for renewable energy production purposes will be exempted of import taxes and duties.
- **Tax holidays:** In order to attract foreign investors, a 100% reduction on income taxes could be granted to the renewable energy production plant during the first five years, followed by a 50% reduction on the following five years. From years 11 to 15, a 25% reduction on income tax will remain.
- **License:** An IPP shall necessarily have a license to produce and inject this production on the grid. The license will determine the technical and financial conditions for energy delivery to the grid as well as the eventual connection fees or contribution to grid reinforcement. The TSO will determine the access point to the grid that has to be within a reasonable distance to the IPP planned installation.
- **Net-metering:** The NREP should open for net-metering or distributed renewable energy production on trial basis and as a pilot project to test and monitor the resilience of the LV distribution network to this type of application. Therefore, authorisations should be granted to private installations connected to the grid having an overall capacity less than 20 kVA. The utility will be committed to monitor the trial within 5 to 10 LV transformer distribution areas to assess the gain in term of reduced load on the transformer but also in terms of impact on the stability on the LV and MW systems. A Feed-in Tariff shall be granted to the renewable energy installation owners for the excess power injected on the grid.

For off-grid applications

- **Mini-grid concessions**

Small power renewable energy systems shall play a key role in supporting expansion of electrification in ECOWAS particularly due to the scattered and isolated nature of rural electricity demand, which makes mini-grids the least cost solution in many cases complying with the distributed nature of renewable energy resources. Private producers bring finance and management expertise which is needed for operation and maintenance of such systems.



Therefore, the national regulatory authority and/or the rural energy agency shall develop light-handed measures for awarding renewable electricity concessions for the production and distribution of electricity for a locality or a cluster of localities connected with a single grid. The distribution will be done through mini-grids. Ideally, there should be only light distribution license required for the size of the mini grids proposed. The upper limit for a mini-grid concession is set to 1 MW renewable energy production. Above that limit, the promoter has to apply a normal rural electrification concession.

By developing mini-grid concessions, the national regulatory authority and/or the rural energy agency will outsource the energy supply of a specific geographical location with obligation to serve all customers that request service to a private company. The authority shall probably provide subsidies or incentives and shall regulate the fees and operations of the concession to ensure an acceptable end-consumer's tariff. The concession can be given for a single locality or a cluster of localities connected together with a local distribution networks. The concession should stipulate the minimum share of given renewable energy sources to enter in the energy mix.

Commercially-based development of small-scale renewable energy power generation will be facilitated by implementing a standardised transactional framework for contract, pricing and regulation.

▪ **Quotas for larger rural electrification concession**

In case of a rural electrification, which is based on larger territorial delimitation or carried out by the national utilities, the national regulatory authority should determine Renewable Portfolio Standard (RPS) for off-grid renewable energy applications respecting the principles of all-inclusive rural electrification planning, which should seek the fulfilment of the NREP's targets and selected least cost options.

Monitoring and enforcement of RPS could be facilitated through obligations specified for the rural electrification concessionary company or for the national utility via their contractual arrangement with the state or the renewable energy agency/fund, to apply a given quota of renewable energy technologies in their supply strategy. Incentives and penalties should support the implementation of the quotas. Models and guidelines would be developed at the regional level with the support of ECREEE assisted by ERERA.

▪ **Stand-alone systems standards**

Technical specifications and codes for stand-alone solar PV, small scale hydro and wind power will be developed as well as a process of certification for technical personnel. The national regulatory authorities should develop standard credit scheme arrangements together with the financial institutions and the renewable energy sector organisations to ensure:

- 1) Access to credit and subsidies
- 2) Financial risk management
- 3) Sustainable after-sales service.

An alternative to the credit scheme delivery is the creation of Renewable Energy Services Companies. Standard contracts could also be developed by the national regulatory authority, based on a template developed at the regional level.



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