

Sustainable Energy for All: The contribution of hydropower to a sustainable Energy Future



ORGANIZED BY / ORGANIZÉ PAR:

**ECOWAS Regional Workshop on
SMALL SCALE HYDRO POWER**

**Atelier Regional de la CEDEAO sur la
PETITE HYDROELECTRICITE**

SUPPORTED BY / SOUTIENÉ PAR:

The banner features a blue background with a photograph of a waterfall on the right side. The text is in yellow and white. The logos for ECREEE, UNIDO, and ESMAP are at the top left, and the logos for the Austrian Development Agency and cecid are at the bottom right.

Mahama Kappiah/ Aminata Fall, Vienna, May 16 2012



THE ECOWAS REGION

- **15 COUNTRIES WITH A LAND AREA OF 5 MILLION M²**
- **CLIMATE FROM SEMI-ARID TO HUMID TROPICAL**
- **POPULATION OF WITH 300 MILLION PEOPLE,**
- **60% OF POPULATION LIVES IN RURAL AREAS**
- **11 OF THE 15 COUNTRIES ARE LDCS AND HIPIC**
- **ALMOST 150 MILLION PEOPLE HAVE NO ACCESS TO ELECTRICITY**



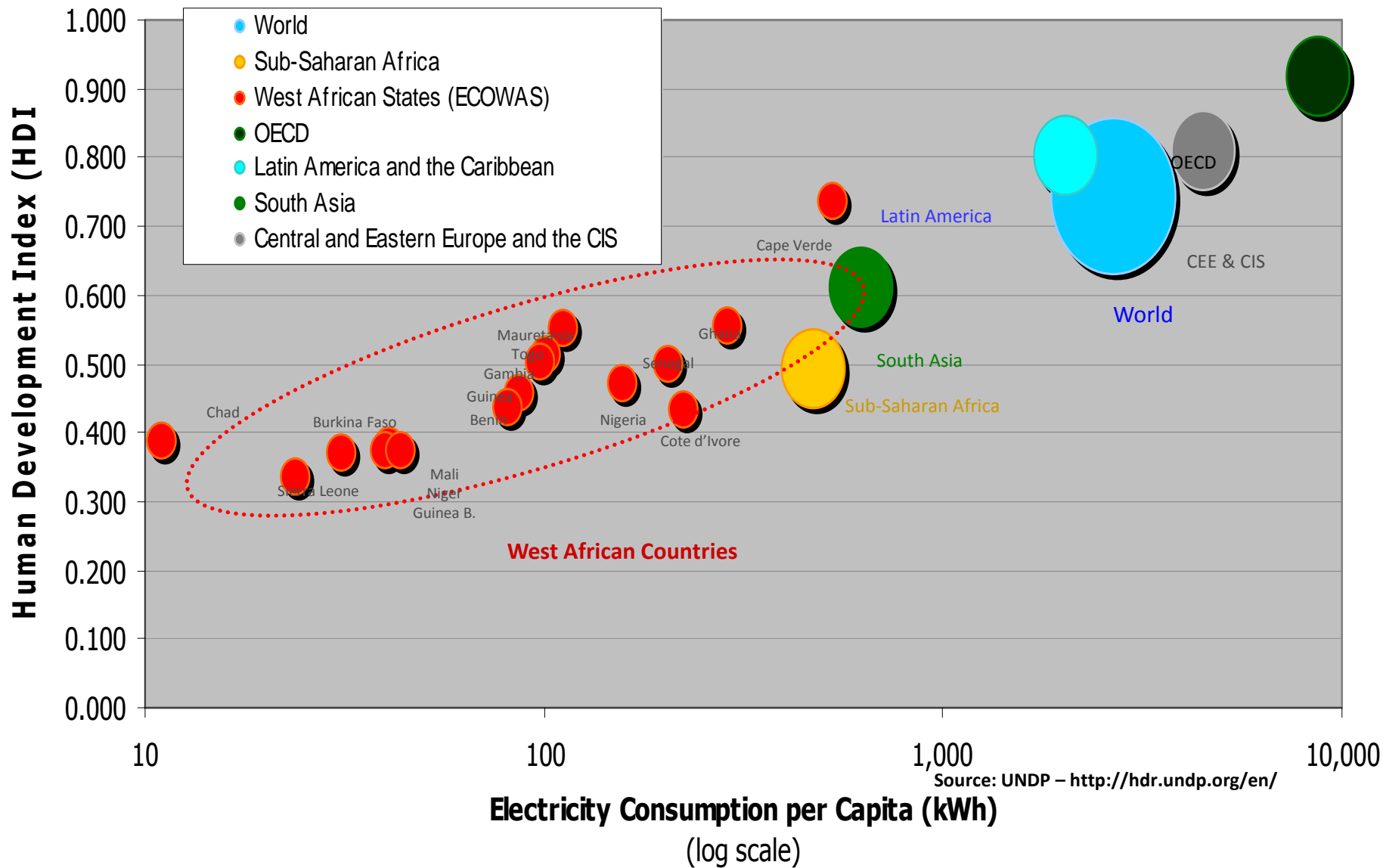


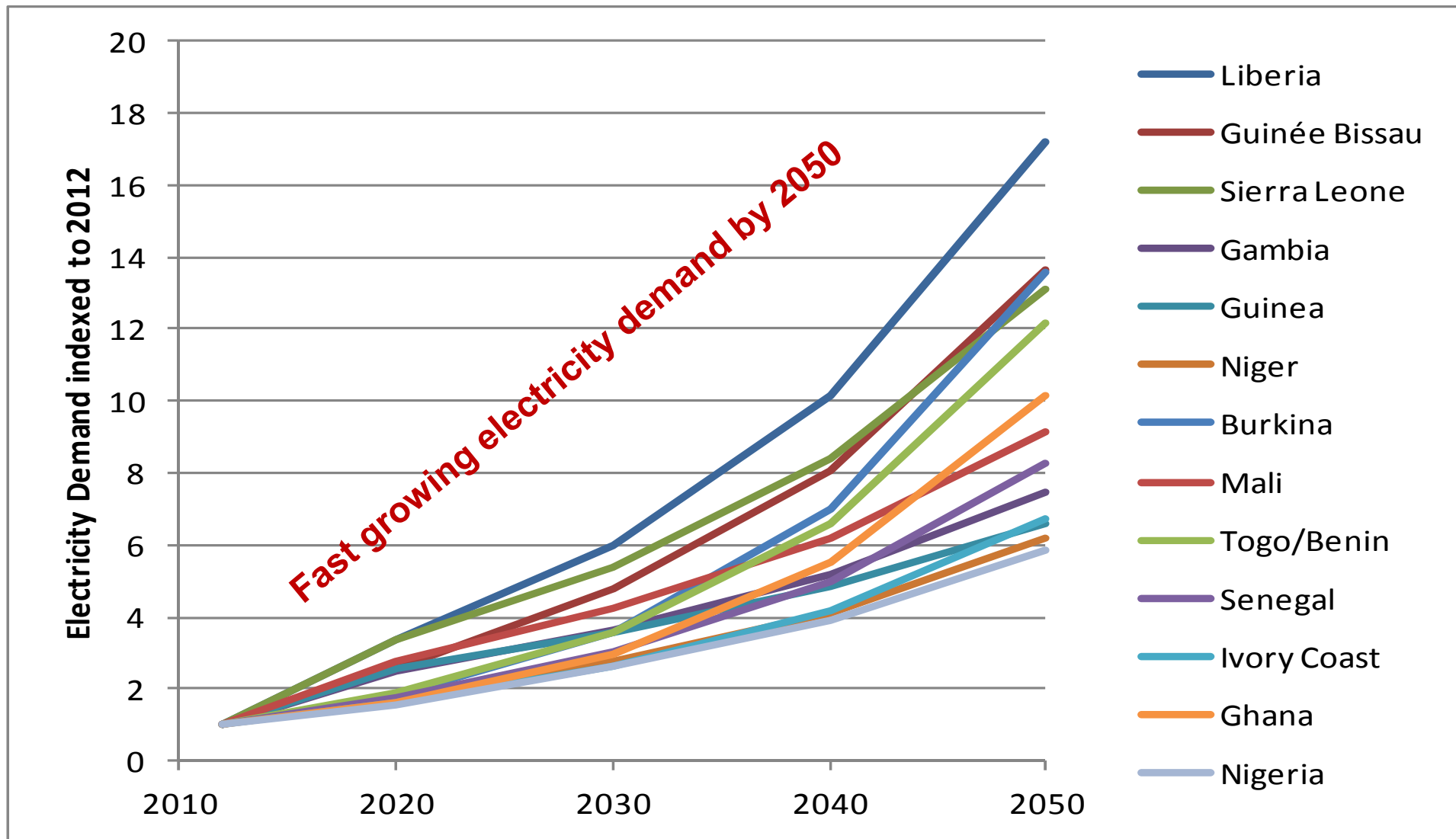
Energy Challenges

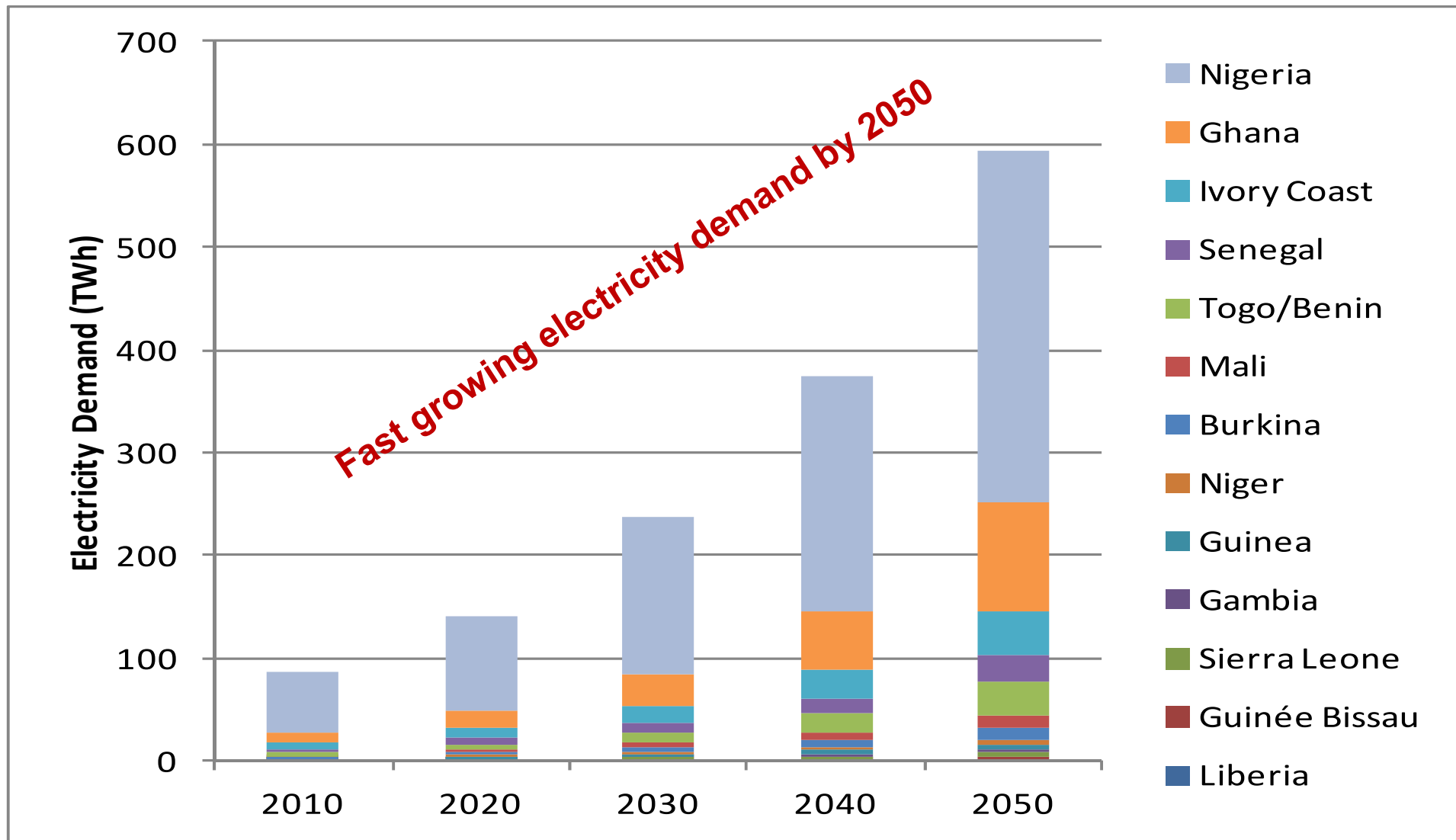
- **Interrelated challenges of energy poverty, energy security and climate change mitigation and adaptation**
- **Low Access to modern energy service**
 - One of the lowest energy consumption rates in the world;
 - The poor spend more of their income on low quality energy services;
 - Rural areas rely mainly on traditional biomass to meet their energy requirements;
 - Household access to electricity services is only around 20% (40% in urban and 6-8% in rural areas);
- **Energy security concerns**
 - High vulnerability to fossil fuel price volatility (60 % of electricity generation from oil)
 - Gap between rising urban energy demand, available generation capacities and limited investment capital;
 - High losses in the energy systems (e.g. high energy intensity and low demand and supply side efficiency);
- **Climate changes concerns**
 - Increasing energy related GHG emissions (new investments determine GHGs for the next 20 - 30 years)
 - Climate change impacts vulnerable West African energy systems (e.g. water flows, extreme weather events)



Lack of Electricity and Socio-Economic Development

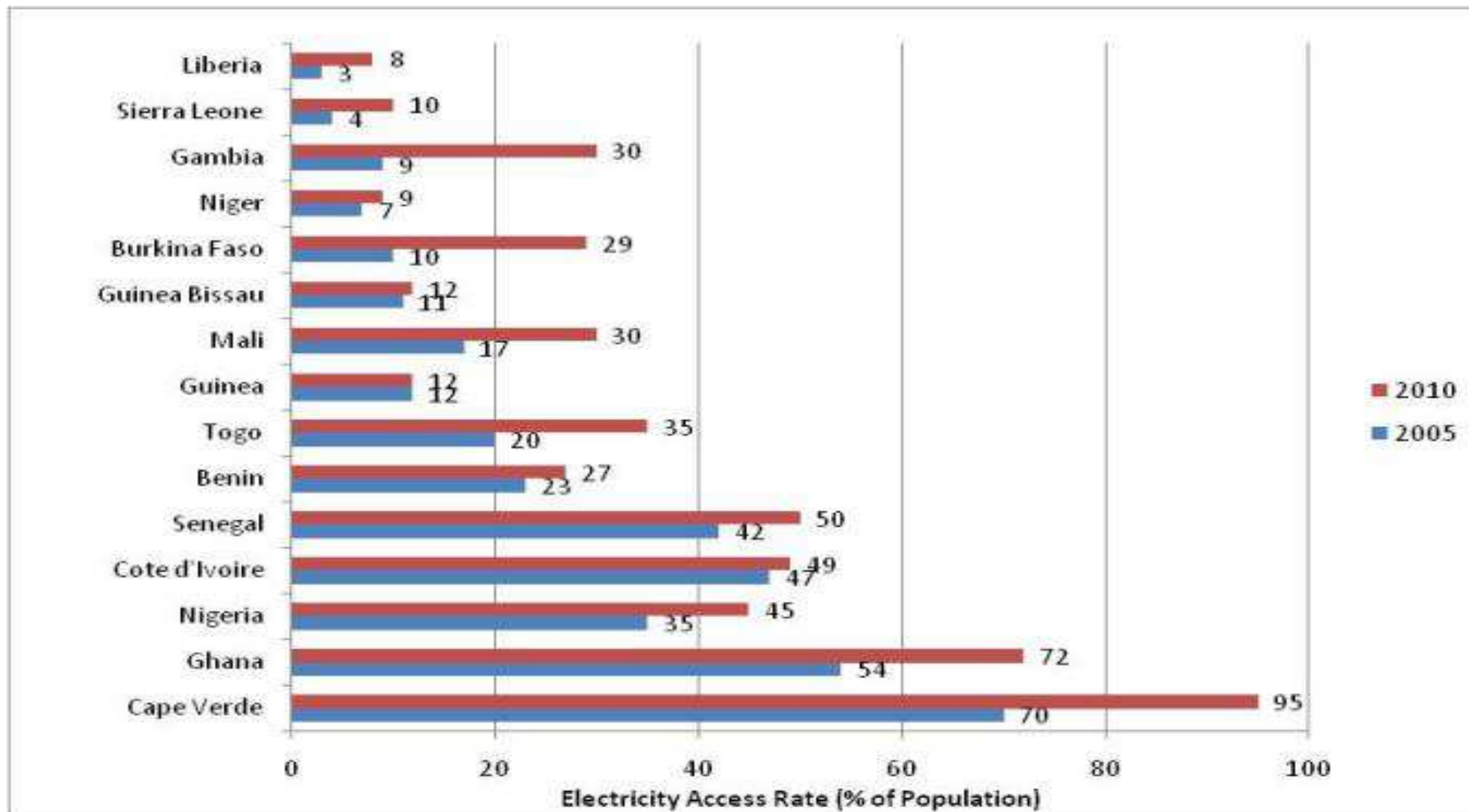








Electricity Access Trends (2005 to 2010)





- **ECOWAS Energy Protocol**
- **West African Gas Pipeline (WAGP)**
- **West African Power Pool (WAPP) and its Master Plan**
- **OMVS (Guinea, Mali, Mauritania and Senegal) and OMVG (Guinea, the Gambia and Senegal) project pipeline**
- **ECOWAS/UEMOA White Paper on Access to Energy Services in Rural and Peri-Urban Areas**
- **ECOWAS Regional Electricity Regulatory Authority (ERERA)**
- **ECOWAS Regional Centre for Renewable Energy and Energy Efficiency (ECREEE)**



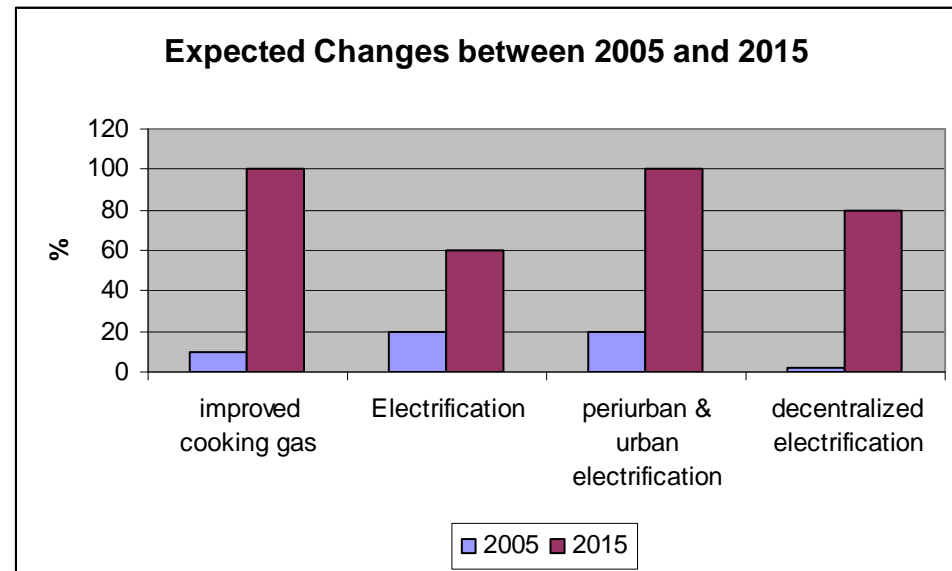
ECOWAS White Paper for Energy Access

Adoption of the White Paper in January 2006 in Niamey by the Authority of ECOWAS Heads of State and Governments.

Target: Provide, by 2015, access to modern energy services to at least half the population living in rural and sub-urban areas:

- 100% of total populations have access to improved cooking fuel
- At least 60% of people living in rural areas will reside in localities with access to motive power
- 66% of the population, will individually have access to electricity supply

At least 20% of new investment in rural areas originate from renewable energy sources



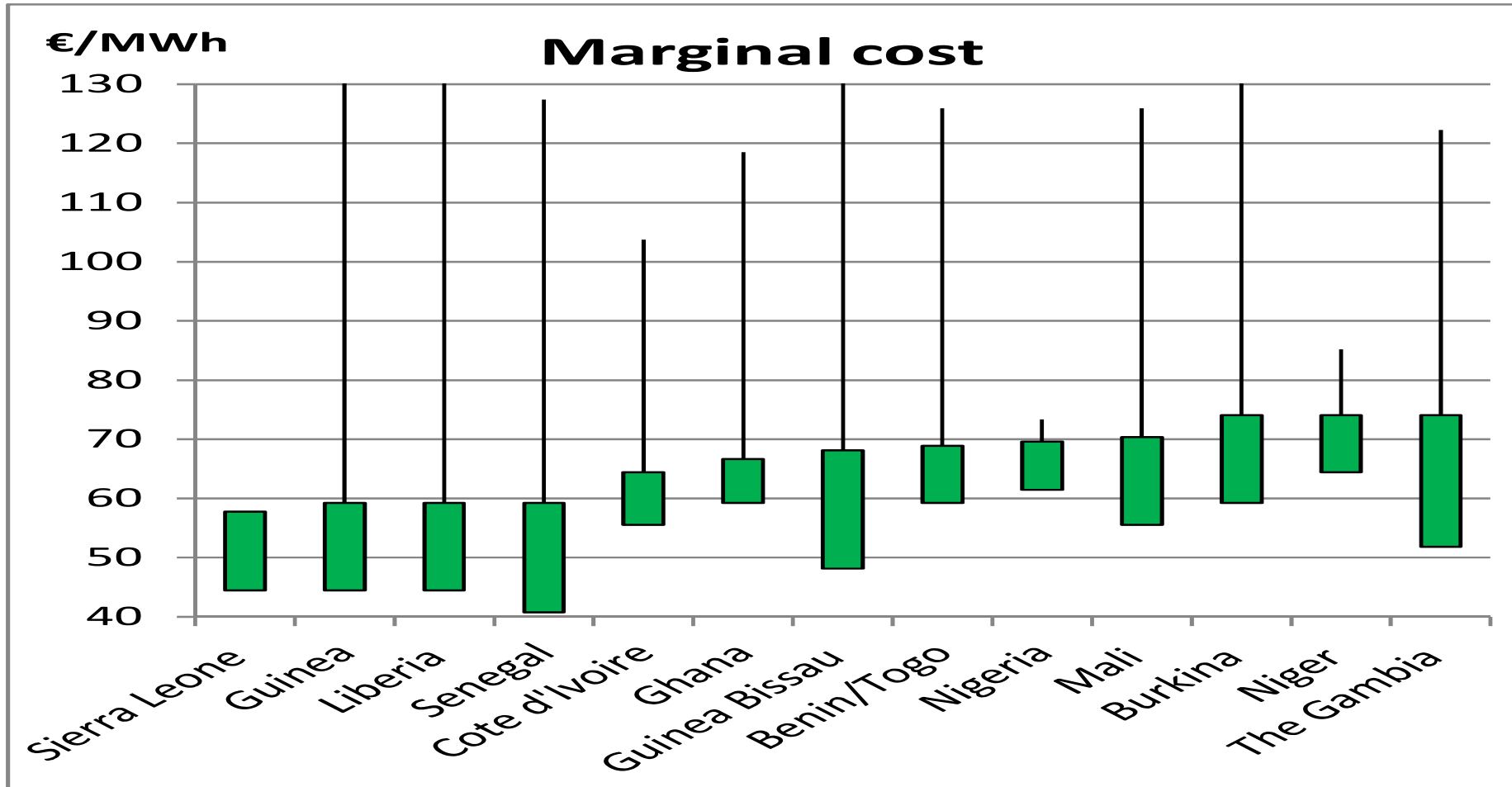


WAPP Master Plan Scenario by 2025



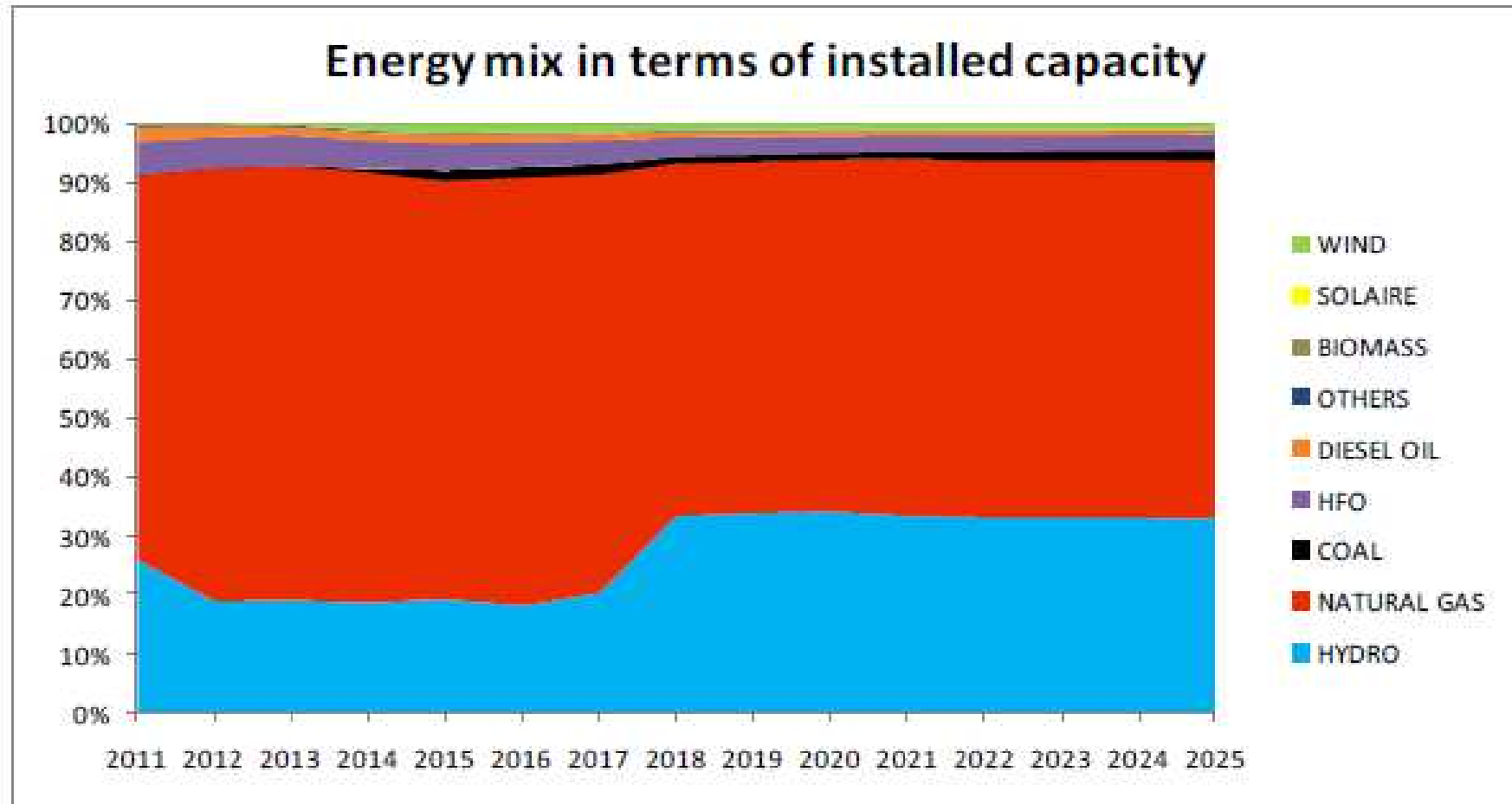
WAPP Master Plan Scenario

Objective 2020: between 4.5 to 7.5 EUR/cents marginal electricity generation costs





WAPP Master Plan Scenario



Scenario excludes a large extend SHP!

Alternative WAPP RE Scenario

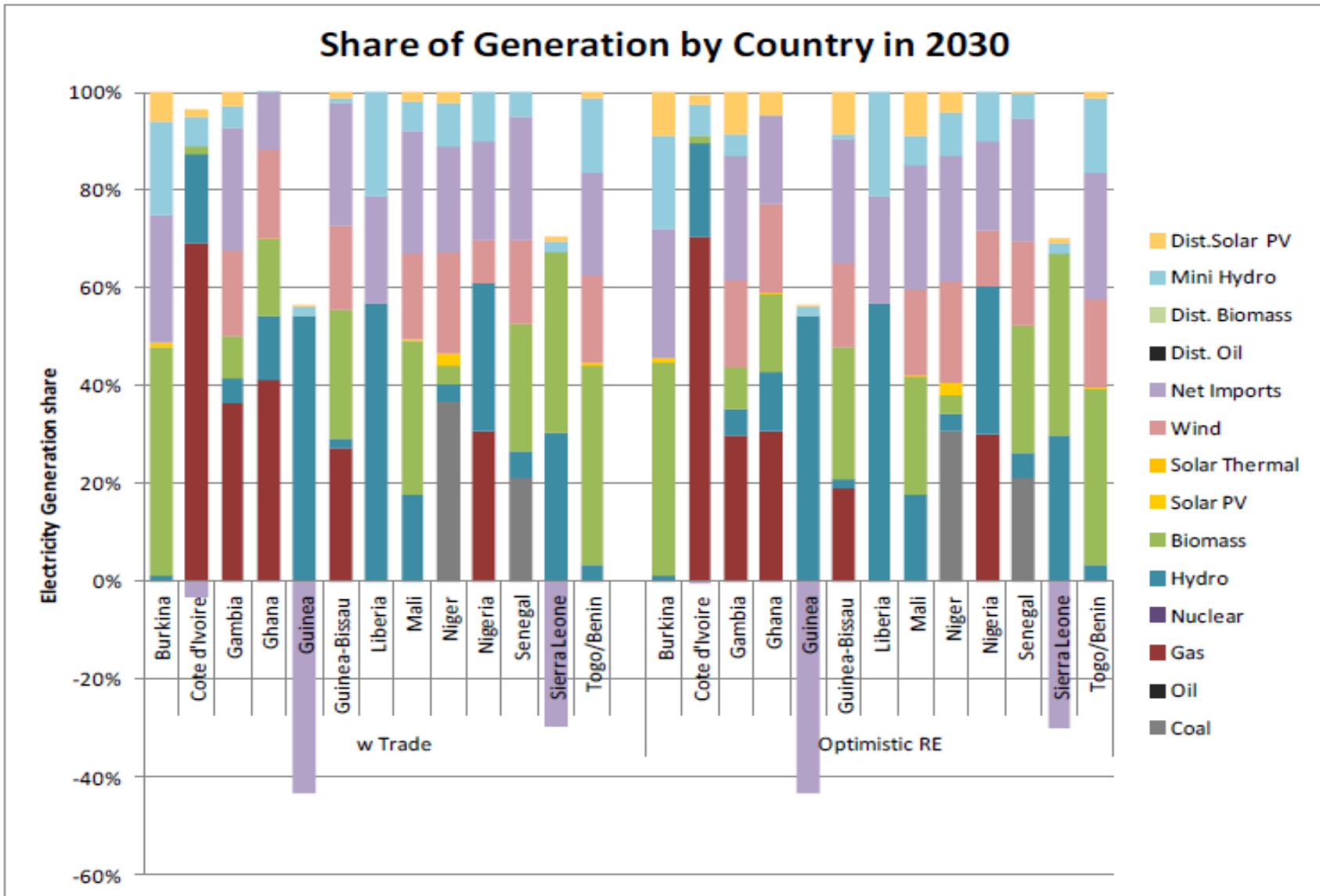
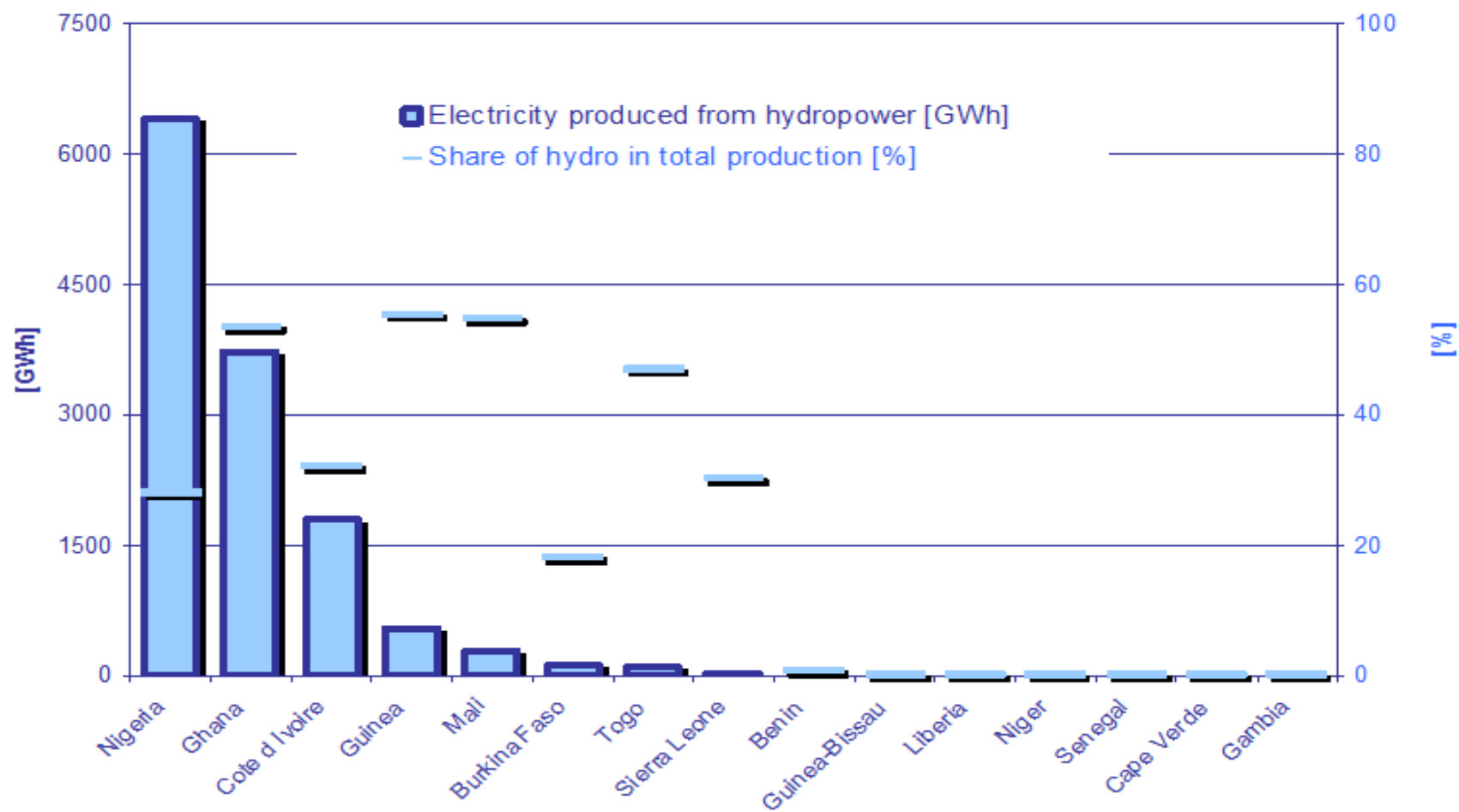


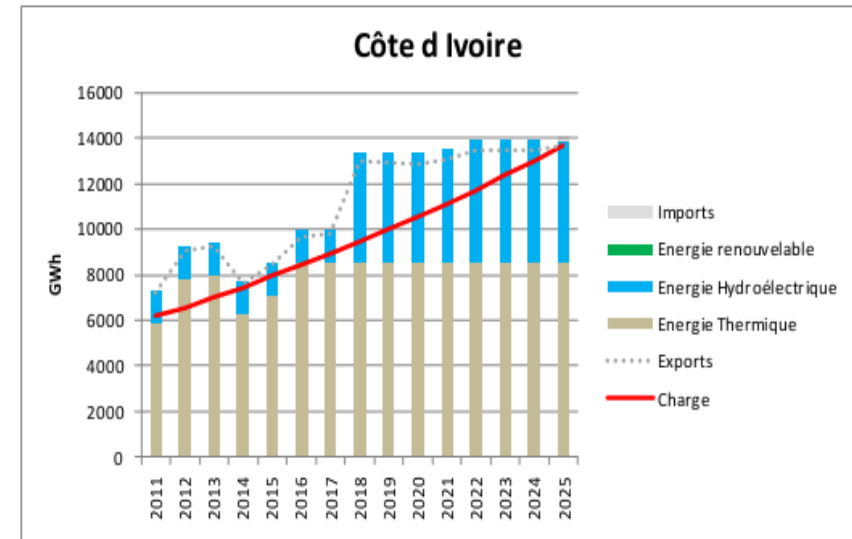
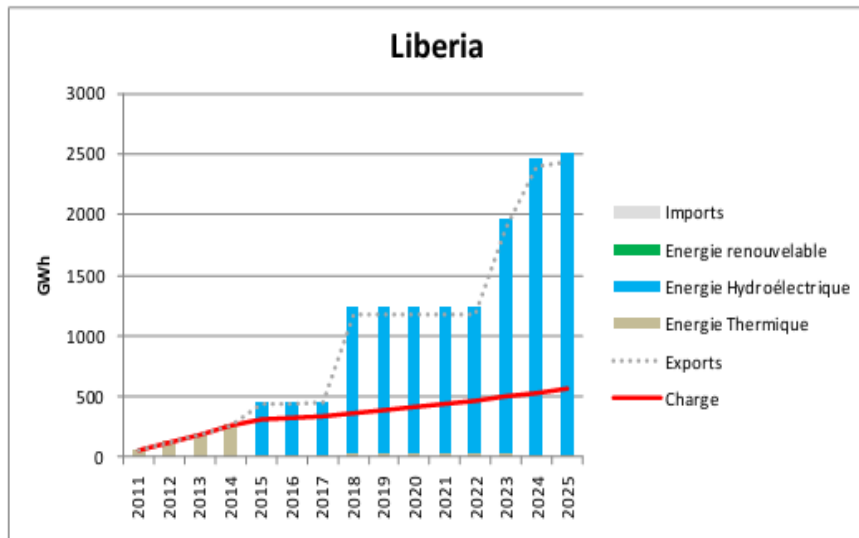
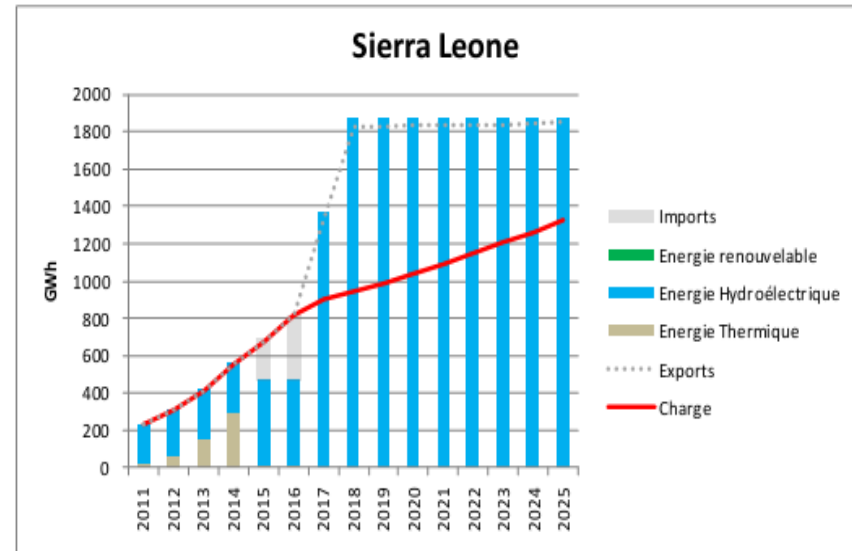
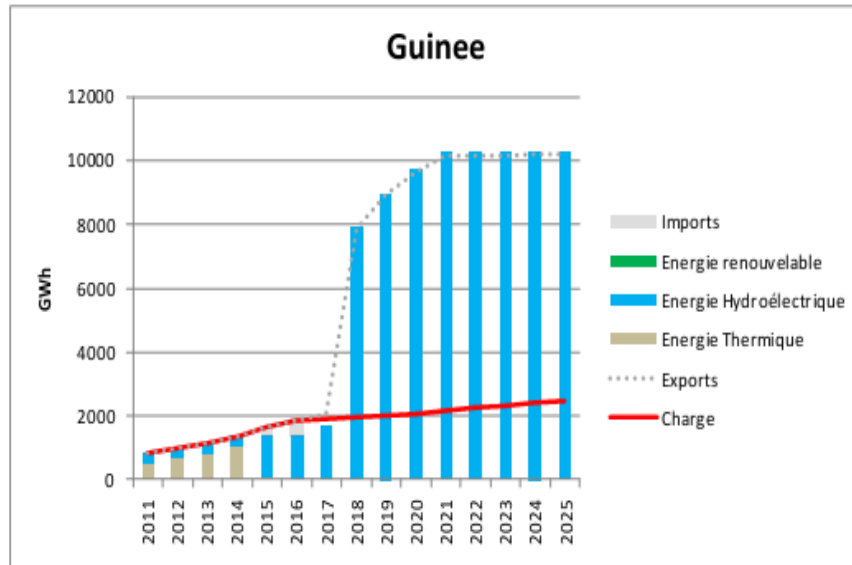
Figure 7 Share of Generation by Technology by Country in 2030: Reference vs Optimistic RE Costs

Figure 1 – Hydropower production in ECOWAS countries as of 2007





Theoretical Hydro Net Exporters





26.000 overall HP potential? 6000 MW SHP potential?

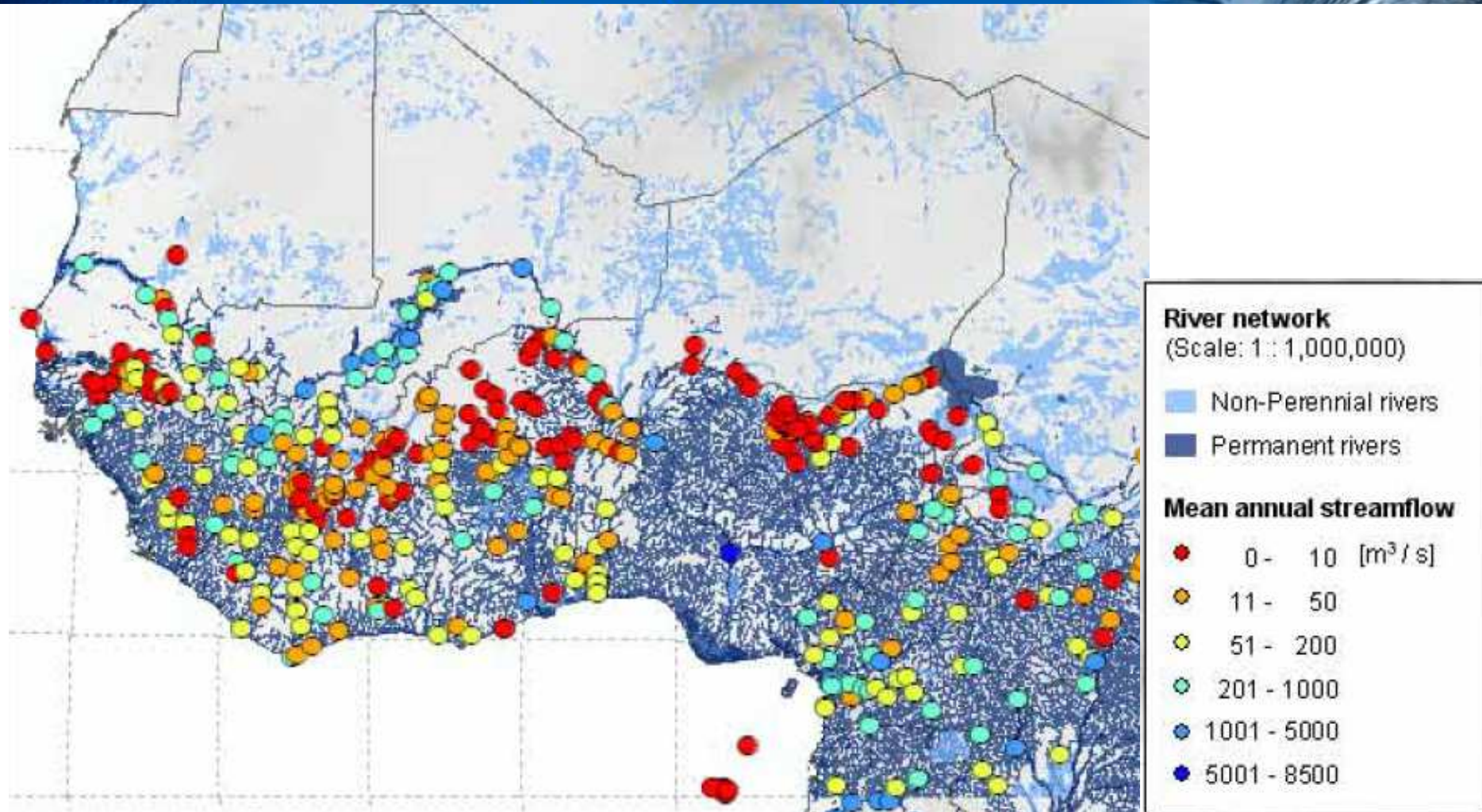
Table 2 Non-Large-Hydro RE Potential Rough Estimates

Max Capacity (MW)	Mini Hydro	Solar Thermal	Solar PV	Biomass	Wind 25%	Wind 30%
Burkina	140	20,000	20,000	2,250	0	0
Cote d'Ivoire	242	2,700	2,700	1,530	0	0
Gambia	12	450	450	23.75	5,000	5,000
Ghana	1	6,800	6,800	1,133	5,000	5,000
Guinea	332	2,400	2,400	656	5,000	5,000
Guinea-Bissau	2	20	1,000	71	5,000	0
Liberia	1,000	0	1,000	459	0	0
Mali	67	20,000	20,000	1,031	5,000	5,000
Niger	50	20,000	20,000	1,115	5,000	5,000
Nigeria	3,500	20,000	20,000	10,000	5,000	5,000
Senegal	104	20,000	20,000	475	5,000	5,000
Sierra Leone	85	14,400	14,400	166	0	0
Togo/Benin	336	5,400	5,400	957	5,000	5,000

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Estimation of mean annual streamflow data





Economics of SHP in ECOWAS (Initial Investment Costs)

Table 3 The two scenarios of investment cost projections for RE technologies

	2010	2015		2020		2030	
	\$/kW	Ref.	Opt.	Ref.	Opt.	Ref.	Opt.
Small Hydro	4,000	3,901	3,804	3,804	3,618	3,618	3,272
Biomass	2,500	2,377	2,260	2,261	2,043	2,150	1,847
Geothermal	4,000	3,709	3,616	3,439	3,268	3,271	2,956
Wind On-shore	2,000	1,785	1,717	1,624	1,513	1,396	1,236
Solar PV (utility)	3,500	3,006	2,854	2,787	2,580	2,457	2,218
Solar PV (roof top)	5,000	4,077	3,869	3,501	3,155	2,934	2,578
PV with Battery	7,000	5,708	5,416	4,901	4,416	4,108	3,609
Solar thermal no storage	4,500	3,914	3,864	3,493	3,318	3,080	2,711
Solar th. with Storage	11,000	9,229	8,784	8,236	7,543	7,263	6,163
Solar th. with gas co-firing	1,968	1,860	1,825	1,791	1,735	1,725	1,650

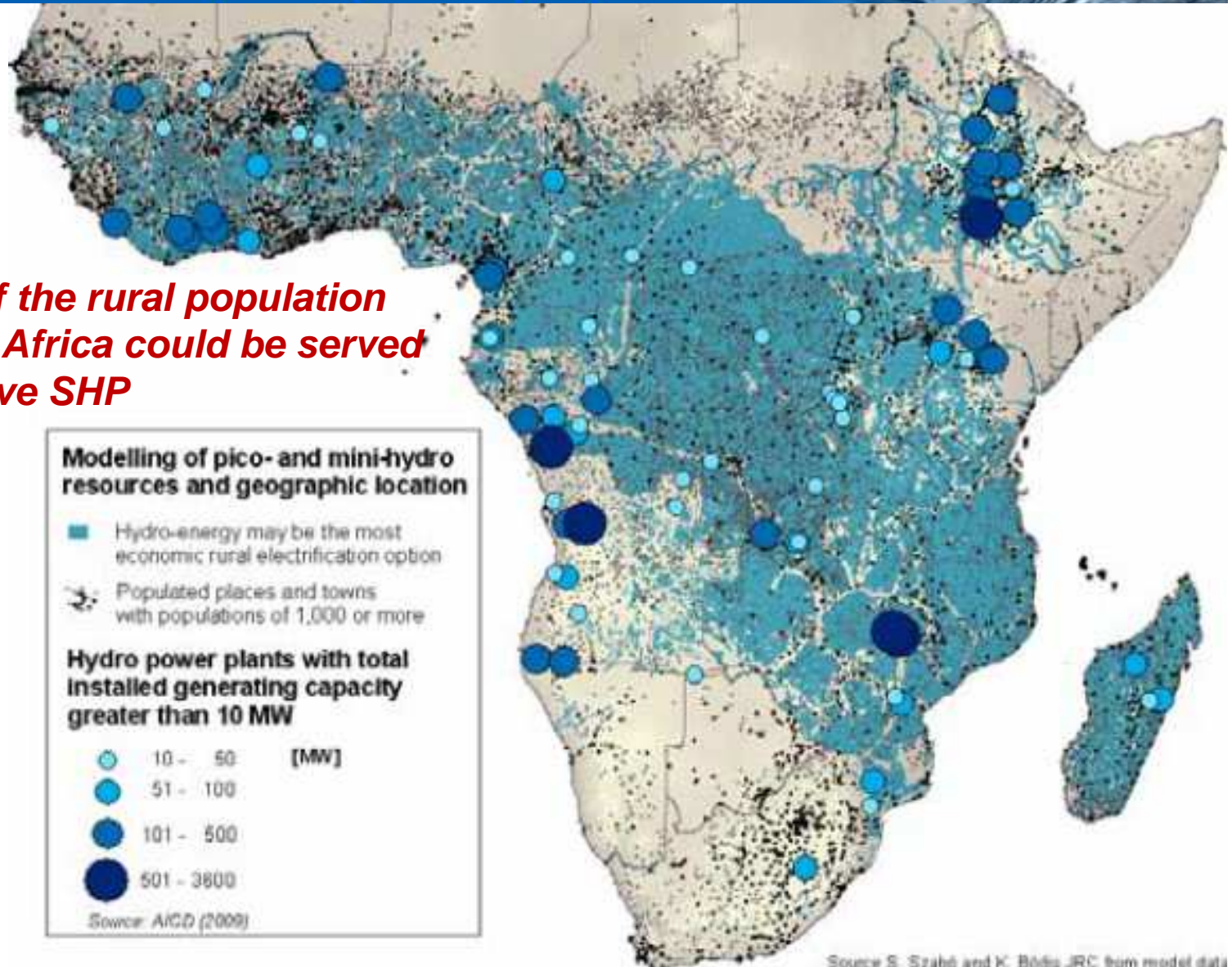
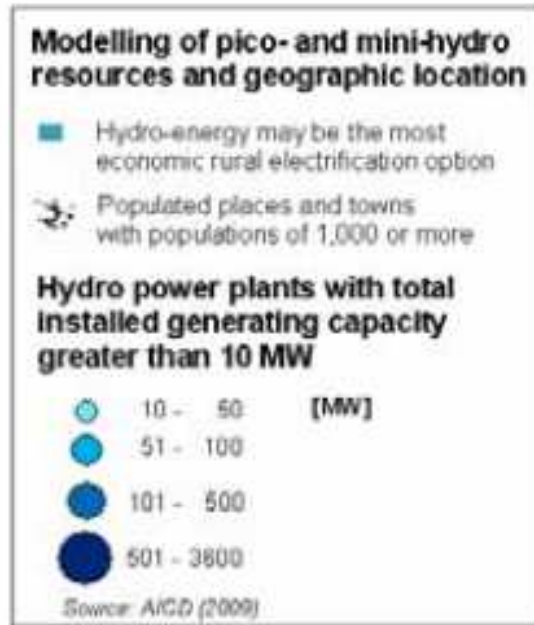


Economics of SHP in ECOWAS (LCOE in 2030)

	Ref	Opt	Opt+Tn D	Opt+Tn D+25C O2	Opt+Tn D+50C O2	Opt+Tn D+100C O2	Ref	Opt
	LCOE \$/MWh						Ranking	
Diesel	340	340	340	359	378	416	18	18
HFO	216	216	243	264	285	326	17	17
OCGT	161	161	181	198	215	249	14	15
CCGT	102	102	115	125	136	157	7	7
Supercritical coal w CCS	149	149	167	172	176	186	11	13
Supercritical coal	92	92	103	127	150	197	4	6
PWR nuclear	111	111	124	124	124	124	8	8
Hydro	62	62	70	70	70	70	1	1
Small Hydro	93	85	85	85	85	85	5	4
Biomass	95	86	86	86	86	86	6	5
Bulk Wind (25% CF)	89	81	91	91	91	91	3	3
Bulk Wind (30% CF)	76	69	77	77	77	77	2	2
Solar PV (utility)	144	132	148	148	148	148	10	10
Solar PV (roof top)	208	186	186	186	186	186	16	16
PV with Battery	160	142	142	142	142	142	13	12
Solar thermal no storage	151	135	152	152	152	152	12	11
Solar thermal with Storage	185	159	179	179	179	179	15	14
Solar thermal with gas co-firing	121	119	134	144	153	172	9	9

Electricity consumer tariffs in some ECOWAS countries exceed 45 USD/cents per kwh today!!

Around 30% of the rural population of Sub Sahara Africa could be served by cost-effective SHP



The ECOWAS Small Scale Hydro Power Program: A Five Year Framework (2013 to 2018)



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ECOWAS-SHP Definition

<i>Term</i>		<i>Power output</i>
Pico hydropower	“Small-scale” Hydro-power “SHP”	< 5 kW
Micro hydropower		5 - 100 kW
Mini hydropower (MHP)		100 – 1 000 kW (=1 MW)
Small hydropower (normally “SHP”)		1 MW - 30 MW (!)
Full scale (large) hydropower		> 30 MW

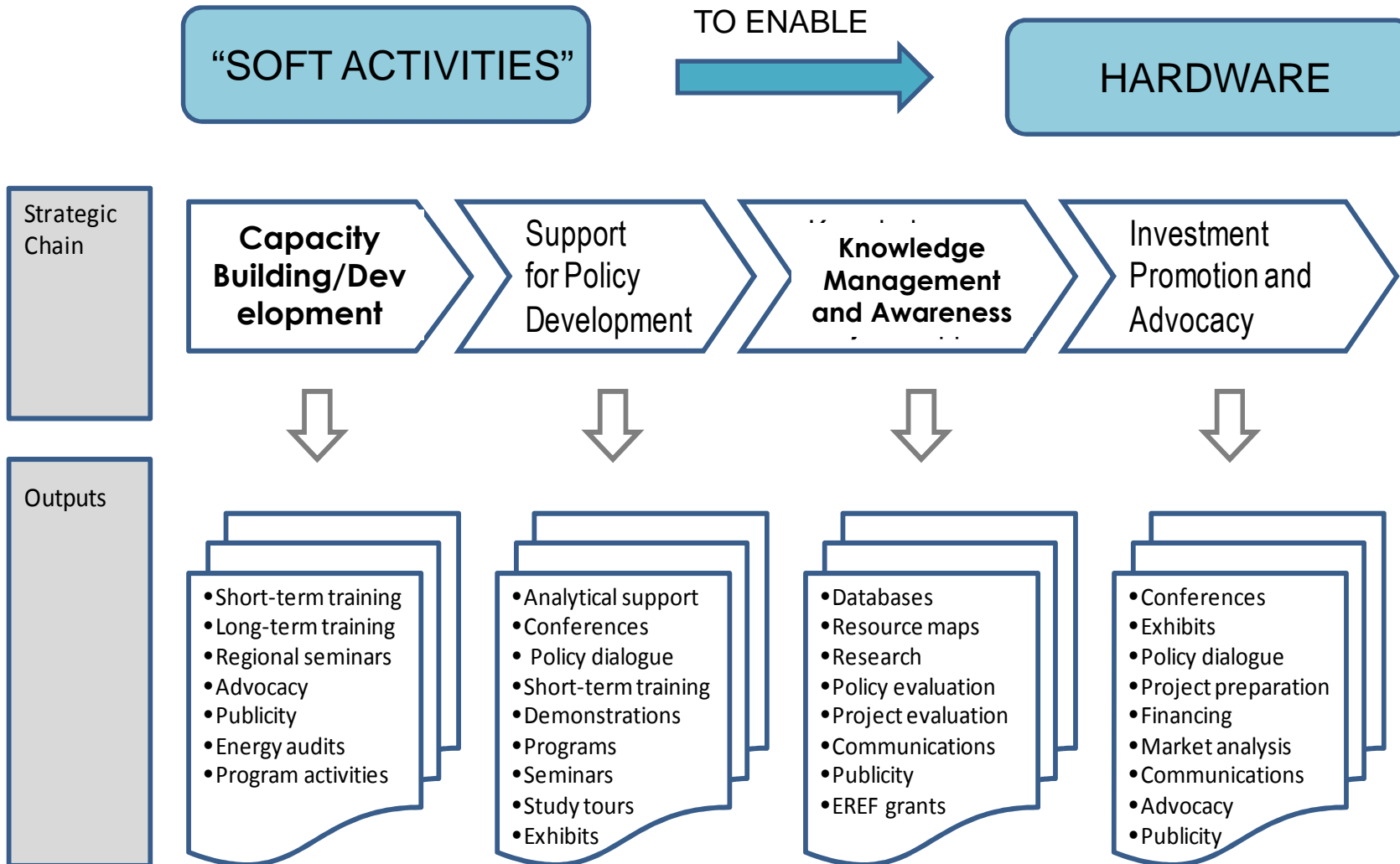


ECOWAS SHP Program

- 5 year planning and monitoring framework
- Budget of 4 to 5 million Euro
- ECREEE as overall coordination agency implements in coordination with NFIs and technical partners (e.g. UNIDO-SHP Centre, consultants)
- Overall Objective: Promote Access To Electricity Services by the deployment of small scale hydro power technologies and services
- Initial core partners: UNIDO, ESMAP, Austria, Spain



Logic and Components of the ECOWAS SHP Program (2013 to 2018)





The way forward

Activity	Date
Validation of SHP Draft Program Document (Prodoc) by the NFIs and international and local ECOWAS experts	16 to 20 April 2012, Monrovia (Liberia)
Incorporation of received feedback and suggestions	23 April to 22 May 2012
Final review and clearance of Prodoc by the NFIs (non-objection principle)	15 June to 06 July 2012
Adoption of SHP Program at the ECOWAS High Level Forum and fund raising	8 to 10 October 2012, Accra
Start of implementation	Beginning of 2013



Thank you! Merci! Muito obrigada!



*ECOWAS Regional Centre for
Renewable Energy and Energy Efficiency*

*Centre Régional pour les Energies Renouvelables
et l'Efficacité Energétique de la CEDEAO*

*Centro Regional para Energias Renováveis e
Eficiência Energética da CEDEAO*

**Achada Santo Antonio,
2nd Floor, Electra Building,
C.P. 288, Praia – Cape Verde
Tel: +2382624608, +2389225454
info@ecreee.org**