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Development Potential of Modernised Bioenergy in The ECOWAS Region

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Empowered lives.
Resilient nations.

Support to Implementation of ECOWAS White Paper Expanding Access to Modern Energy Services

Context & Objectives of Study:

1. Provide relevant information on practices, policies and programs for developing bio-energy to expand access to modern energy services

2. Provide operational recommendations on bioenergy development and prioritization (to meet MDGs)

3. Link and advise on immediate potential of bio-energy use with the ongoing multifunctional platform programs in the Region

Support to Implementation of ECOWAS White Paper Expanding Access to Modern Energy Services (con't)

4. Provide information on financing and partnership models

5. Based on findings, make a set of recommendations; Policy, Capacity Development, Financing and Partnerships

Overview of current situation

1. Traditional biomass represent 52% to 90% of final energy consumption .
2. Low access to modern (fossil) cooking fuels
3. Low access to electricity; Cape Verde, Côte d'Ivoire, Ghana and Nigeria (50%) Burkina Faso, Gambia, Guinea, Guinea-Bissau, Mali, Niger and Sierra Leone (12%).
4. Besides Nigeria and Ghana (?), the countries are net of petroleum products

Approach

1. Review of literature and ongoing bio-energy initiatives in the ECOWAS
1. Launching of study with selected number of practitioners and countries
1. Case studies Burkina Faso, Ghana and Senegal
1. Guidance on Sustainability Issues defined by the UN-System (UN-Energy)

Figure 1 : ECOWAS member countries

Source : Sahel and West Africa Club

Sustainability issues of modern bioenergy

Bioenergy Sustainability Criteria (UN-Energy)

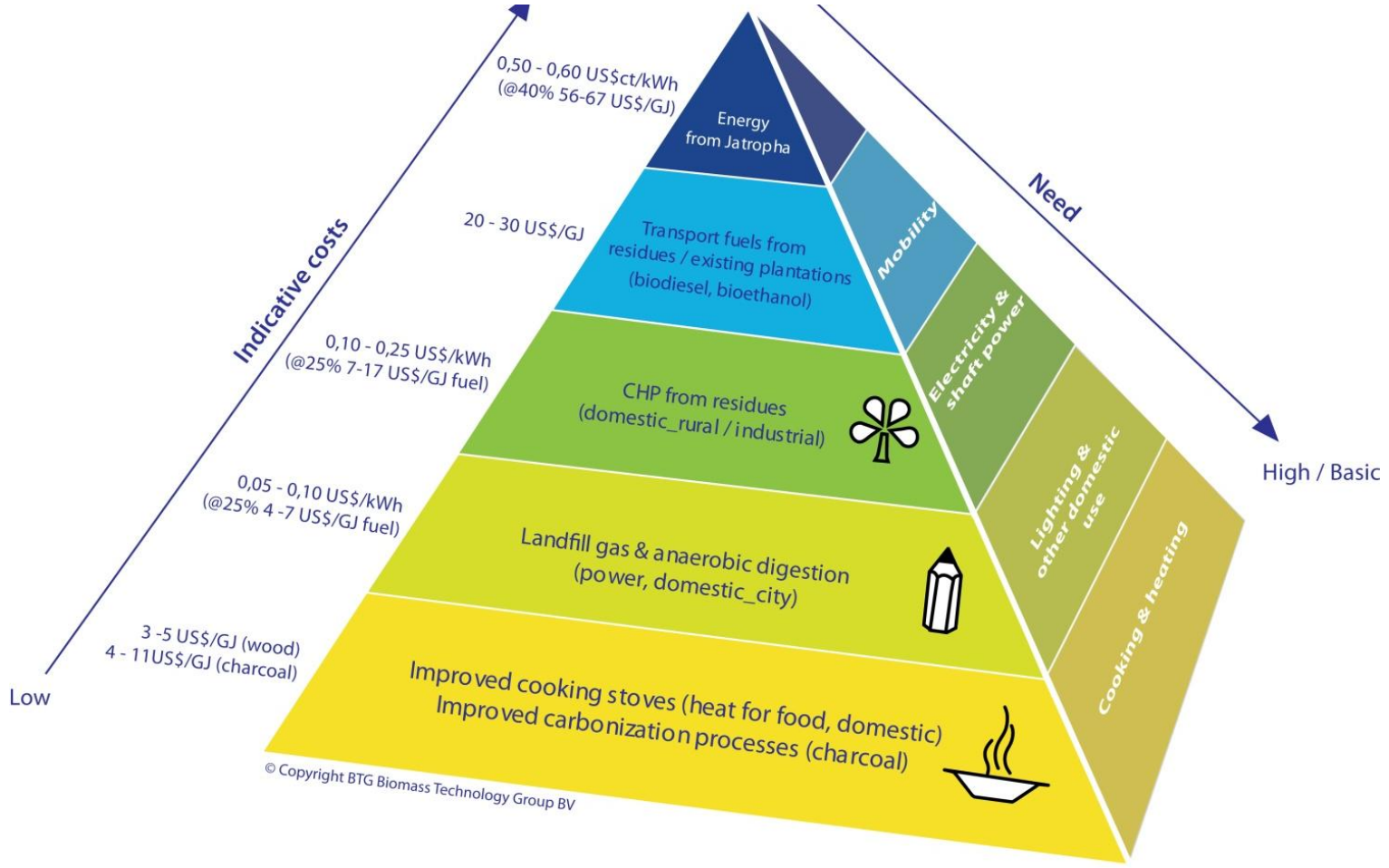
- Ability to provide energy services for the poor;
- Contribution to agro-industrial development and job creation;
- Impact on health and gender ;
- Impact on agriculture, land use;
- Impact on food security;
- Impact on government budget;
- Impact on trade, foreign exchange and energy security;
- Impacts on biodiversity and natural resource management;
- Impacts on climate change.

In-out door pollution cause by wood fuel

Development potential of modernised bioenergy

Energy needs (Maslow pyramid)	Bioenergy solution
Maslow Bioenergy Pyramid for WA 1. Cooking and heating	a. Improved cooking stoves and improved/substitute charcoal production. b. Landfill gas and biogas systems at household or industrial level based power generation
2. Lighting and other domestic use (low voltage).	
3. Electricity and shaft power (industrial /economic al use).	a. Combined heat and power (CHP) production from agro- and wood residues
4. Mobility: transport fuels	a. Transport fuels (biodiesel, bioethanol), made from crops
5. Energy generation based on Jatropha oil	b. Jatropha oil-based bioenergy systems

Maslow Energy Pyramid applied to Energy Acces in ECOWAS region



Availability and use of biomass resources in West Africa

Types of resources

Woodfuels

- almost all woodfuels used are direct;
- Wood consumption is well above the annual increment (desertification);
- Residues (e.g. sawmills) are left unused;

Agrofuels

- Ethanol: sugar cane, sweet sorghum, cassava
- Biodiesel : palm oil , palm kernel oil, cottonseed oil, peanut oil, Jatropha oil, coconut oil and the Neem tree.

Groundnuts Senegal

Availability and use of biomass resources in West Africa

Types of resources

Agroresidues

- World largest producer of cocoa (7 to 9 tons of waste 1 ton of dry cocoa). Coffee, sheanuts, palm oil, rice husk, groundnuts, cotton, millet, sorghum, coconuts, etc.

Municipal by-products :

- Landfill gas for energy generation
- Avoid uncontrolled dumping

Dumped melasse in north Senegal (Demba Diop, 2004)

Modernised bioenergy use in the ECOWAS region

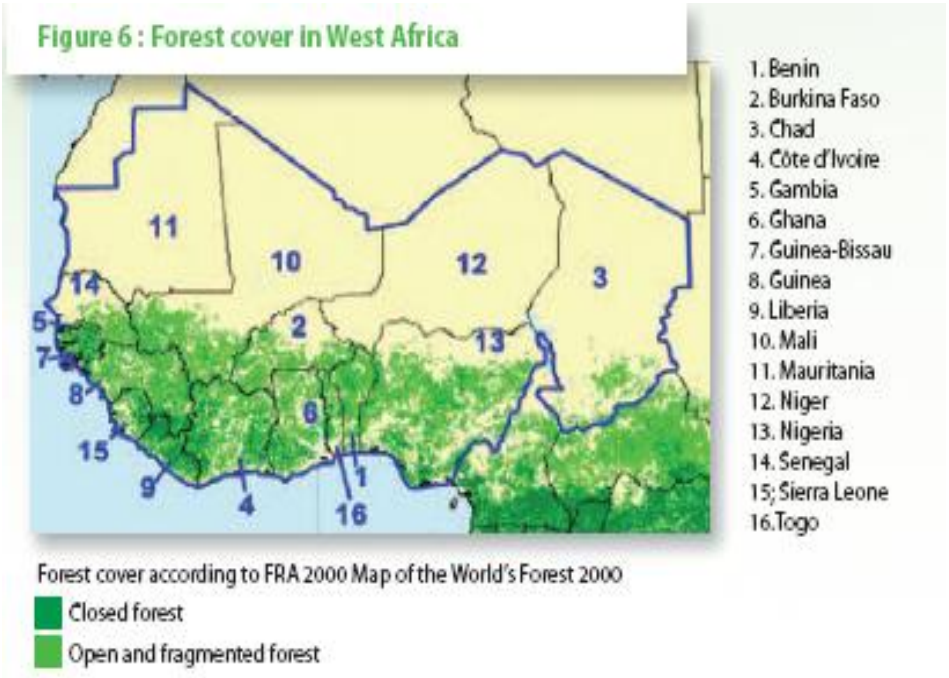
Energy Services Needs /Bioenergy technology categories

	Bioenergy technologies
Cooking and heating	1. Improved wood or charcoal stoves; 2. Improved and substitute charcoal production; 3. Other biomass-based cooking fuels: gel fuel, briquettes 4. Biogas for use as cooking gas
Electricity	1. Biogas for power production; 2. Industrial (combined heat and) power generation; 3. Landfill gas valorisation; Biomass gasification
mechanical power	Multifunctional Platforms (on liquid biofuels)
Mobility	Liquid biofuels (bioethanol, biodiesel, PPO

Gel Fuel cooking stove

Biomass resources in the ECOWAS region

- ECOWAS: 512 million ha; pop. of 280 million in 2007.
- 4 climatic zones: Guinean, Sudanic, Sahelian and Saharan.
- Agriculture: 30% share of GDP, (18% in Senegal to 61% in Guinea Bissau); subsistence farming with export-oriented agriculture
- Growing demand for woodfuel and increasing agricultural demand leads to continued reduction in forest cover.
- untapped biomass resources are: (i) Agricultural residues (ii) Dedicated energy crops, (III) Woody biomass and (IV) Aquatic biomass .



Data source: FAO, 2009 and CIA, 2009

Forest areas in ECOWAS Countries

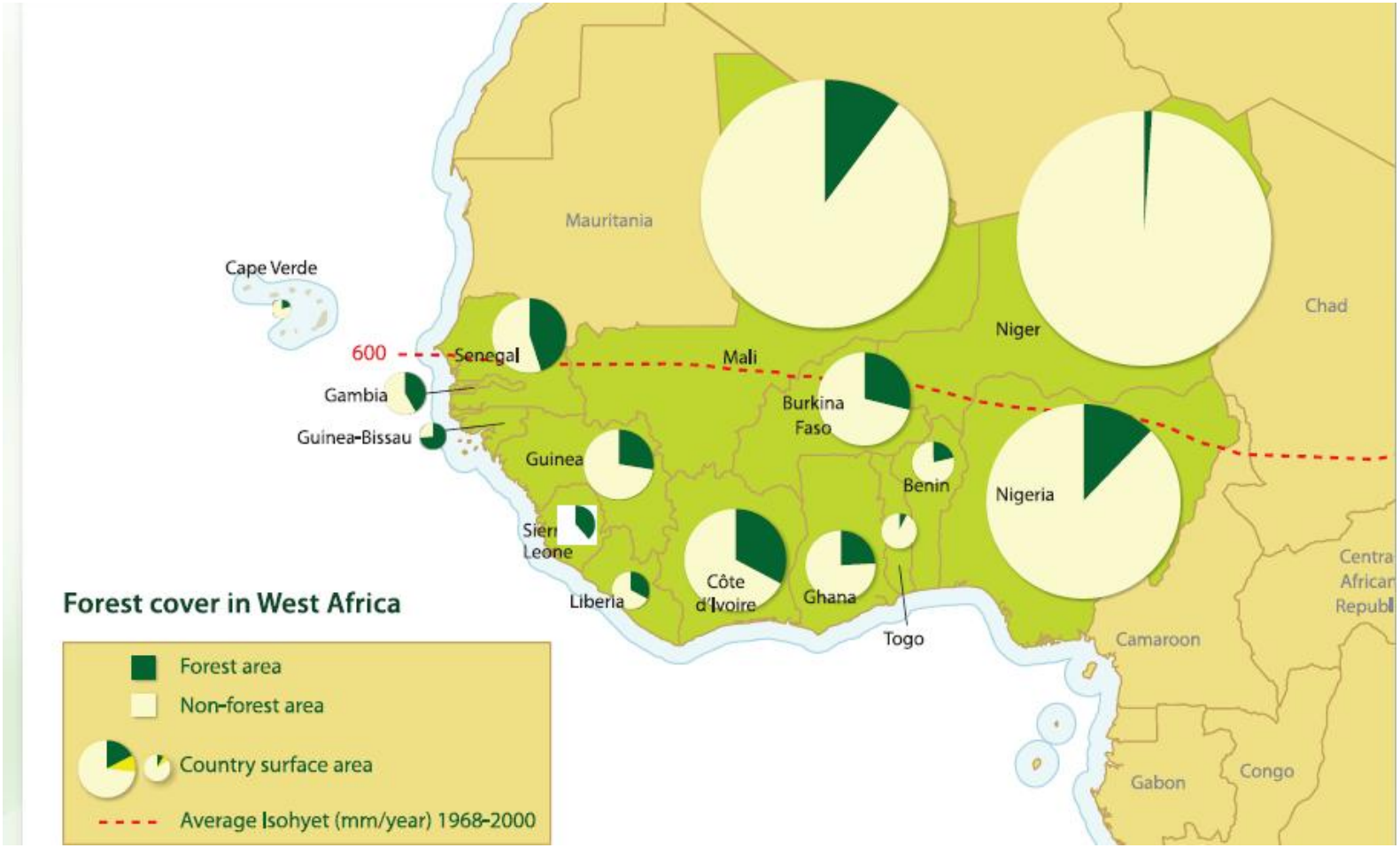
Forest areas in ECOWAS countries

	Forest area (1000 ha)	Annual Change rate (%)	% of land area (%)	Other wooded land area (%)	Other land (1000 ha)
Benin	2 351	-2.5	21.3	3.959	4.752
Burkina Faso	6 794	-0.3	29	-	-
Cape Verde	84	0.4	20.7	-	319
Côte d'Ivoire	10 405	0.1	32.7	2.626	18.769
Gambia	471	0.4	41.7	125	534
Ghana	5 517	-2	24.2	0	17.237
Guinea	6 724	-0.5	27.4	5.85	11.998
Guinea Bissau	2 072	-0.5	73.7	236	505
Liberia	3 154	-1.8	32.7	0	6.478
Mali	12 572	-0.8	10.3	-	-
Niger	1 266	-1	1	-	-
Nigeria	11 089	-3.3	12.2	5.495	74.493
Senegal	8 673	-0.5	45	5.001	5.579
Sierra Leone	2 754	-0.7	38.5	384	4.024
Togo	386	-4.5	7.1	1.246	3.807

Data source: FAO, 2009

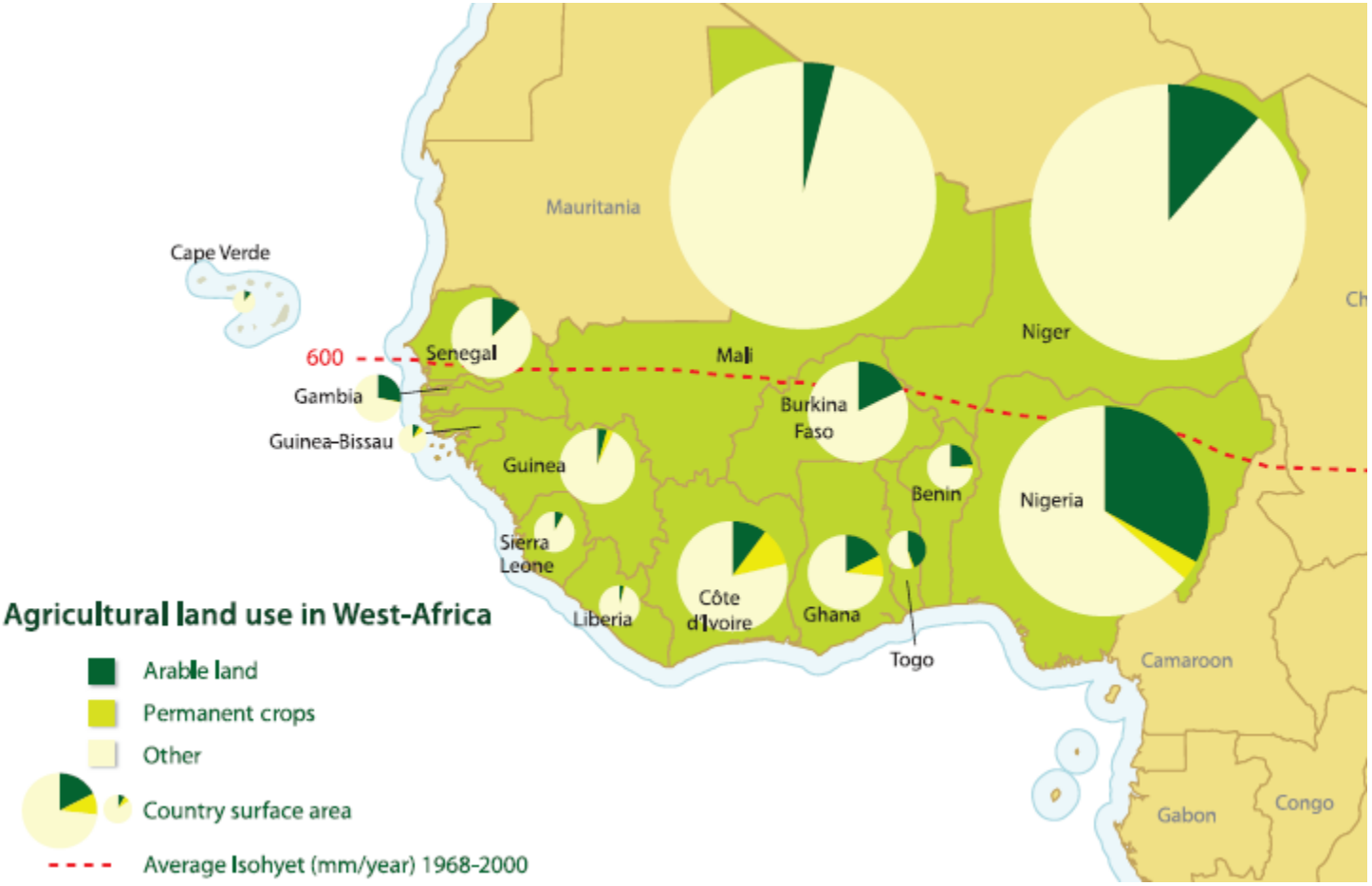
Forest distribution in West Africa

Data source: FAO, 2009 and CIA, 2009



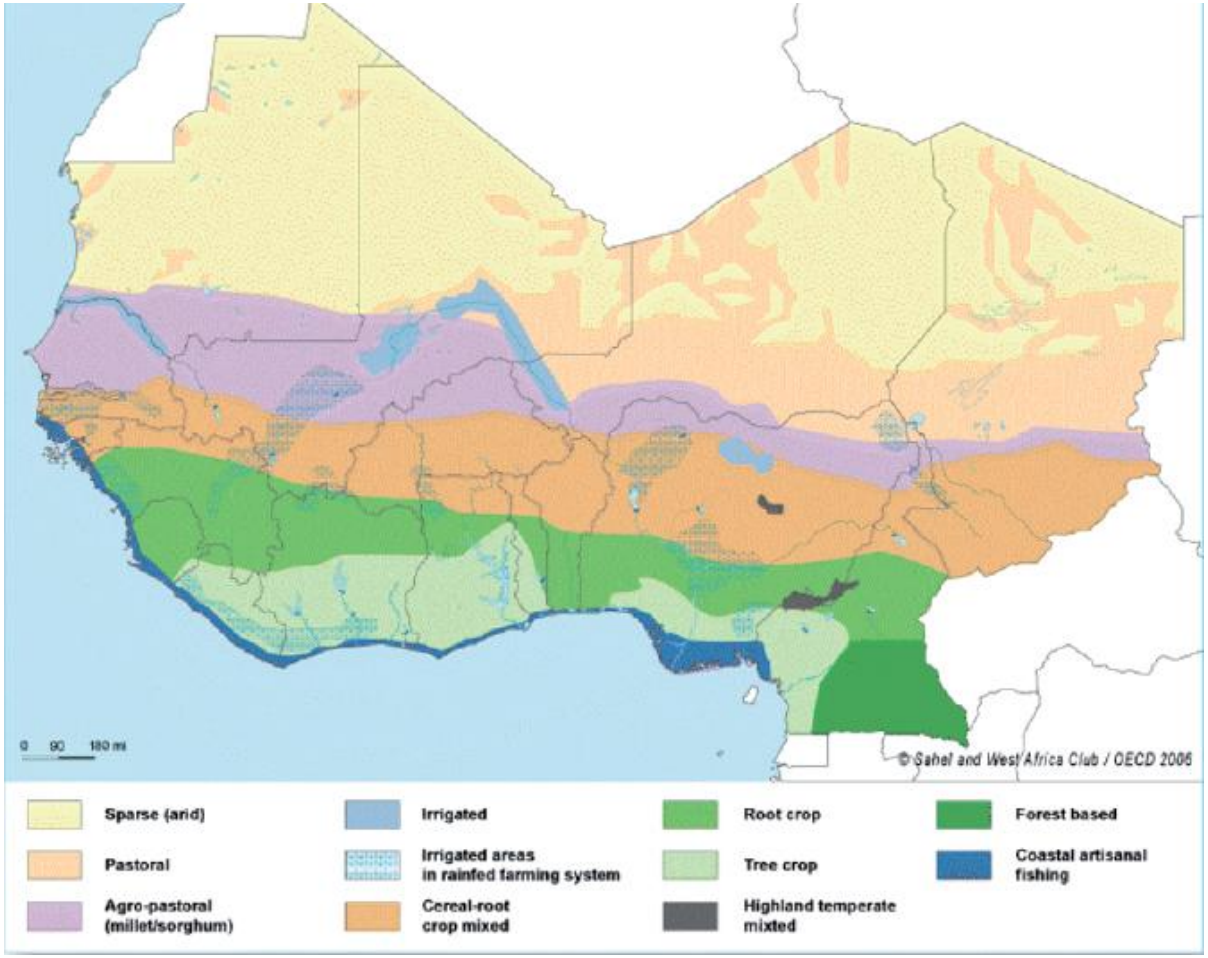
Agricultural land use in West Africa

(Data source: FAO, 2009 and CIA, 2009)



Production systems in West Africa

(Data source: FAO, 2009 and CIA, 2009)



Agro residues…

Agro residues and by-products have lower costs than purposely grown energy crops in the ECOWAS region:

- Cote d'Ivoire alone 42% of world production cocoa. Ghana and Nigeria other top producers ;
- Important palm oil and coconuts effluents;
- Nigeria world leading producer of cassava; cutting edge technology for increasing yields ;
- Large scale production of cotton, groundnuts, sorghum in the Sahel enables the use of the residues for energy generation;
- Irrigated agriculture along the Volta, Niger, Senegal, Gambia rivers provide enough rice straw, aquatic plants (typha) to contribute to the production of biogas or for electricity generation rather than being burned in the fields

Agro residues s (Con’t)

- Larges amount of residues from shea in Burkina Faso, Mali, Ghana, Togo. Only in Togo, about 18 000 tones of shea butter residues can be captured for energy generation
- Wasted cashew apple in Guinea Bissau, Ghana, Ivory Coast could serve for ethanol production.
- The region enjoy large population of tree bearing oil (neem seeds, baobab, etc) that can meet up a consistent part of the imported diesel in the Sahel countries.

Residues of sheanut at shebou factory, North Ghana

Electricity and Mechanical power

- Biogas for power generation (slaughterhouse, large scale farm, agroprocessing units);
- Bioliquids for power generation (MFP);
- Combined Heat and Power (waste heat recovery to feed steam turbines for electricity generation)
- Thermal biomass gasification and landfill gas valorisation

MFP, village of Dougounionain , Mali

Opportunities and risks associated with bioenergy development

Opportunities / Driving Forces	Risks / Concerns
Rural development and economic opportunities	Potential exclusion of small farmers and women
Employment opportunities	Increasing pressure on natural resources
Increased energy availability and access	Potential loss of agro-biodiversity
Increased energy security and better trade balance	Food security risks
Leveraging technology advances	Water availability
Supporting modernization & diversification of agricultural sector	Social impacts (Land use changes, land tenure and land rights)
Enhancing the role of women	Scale of production
Improving health benefits	Lack of infrastructure
Slowing land degradation	Research and development in embryonic stage
Improved waste management	Climate change and climate variability
Reduction in atmospheric pollution & greenhouse gases	
Other environmental benefits	Other environmental benefits

Data sources: UEMOA, 2008; Rossi & Lambrou, 2009; Cushion et al, 2010.

Commercial financing of bioenergy projects

Indentified sources of biomass project financing

1. Commercial sources of finance (debt, equity and lease financing but also micro- or small-scale financing)
2. Performance contracting (Energy Service Company, or ESCO financing)
3. Emerging financing structures (public private partnerships, carbon trading etc.)

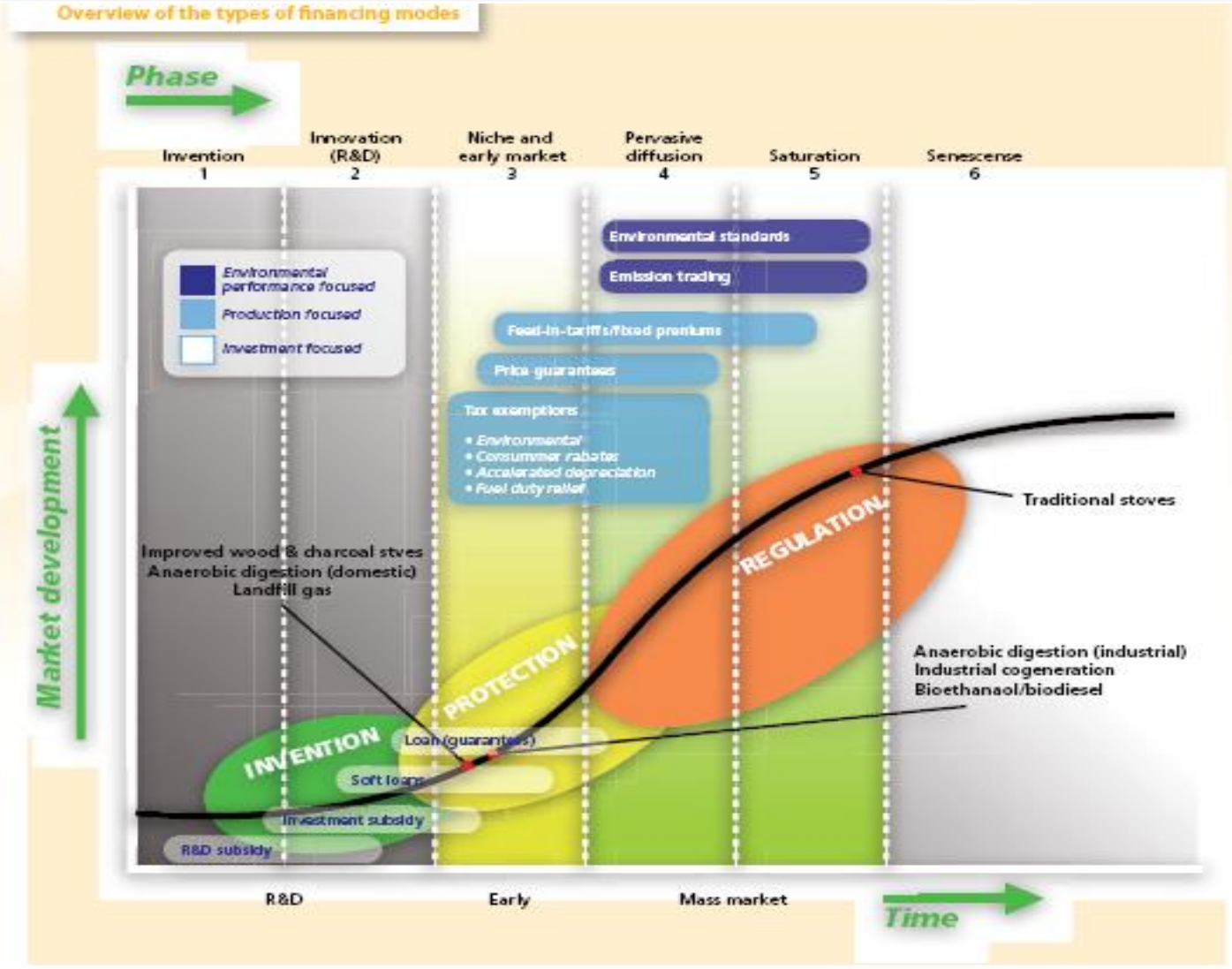
Perceptions that need to be removed

a. The investments are usually of a small scale;
b. Limited purchasing power;
c. Poor infrastructure;
d. No capacity to develop, implement, built;
e. High risks and low earnings;
f. Limited track record; and
g. No mature bioenergy market.

Economical model for biomass energy

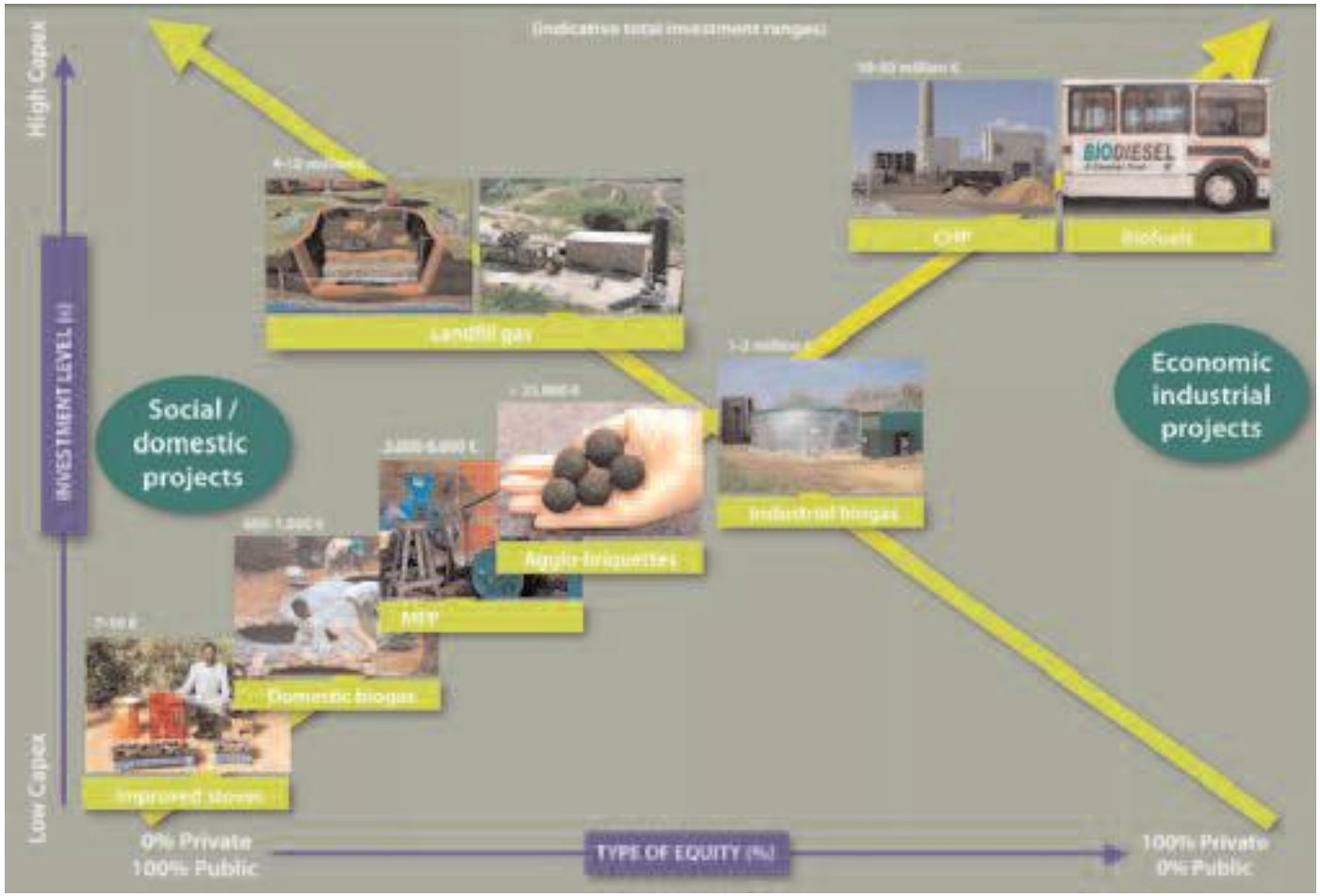
- **Improved stoves:** the market for improved woodfuel stove for the 45 million is estimated at USD 500 million
- **Landfill gas valorisation:** LFG valorisation system for 500 tonnes/day are in the order of USD 5-10 million,
- **Power production from biogas or solid biomass:** Typical investments in industrial biomass power systems EUR 30-50 million with pay back times of 5-8 years provided the feed in tariff is at least USD 130/MWh.
- **Liquid biofuels** Production costs of bioethanol are in the range of 0,40-0,65 USD/litre.

FINANCING MODES

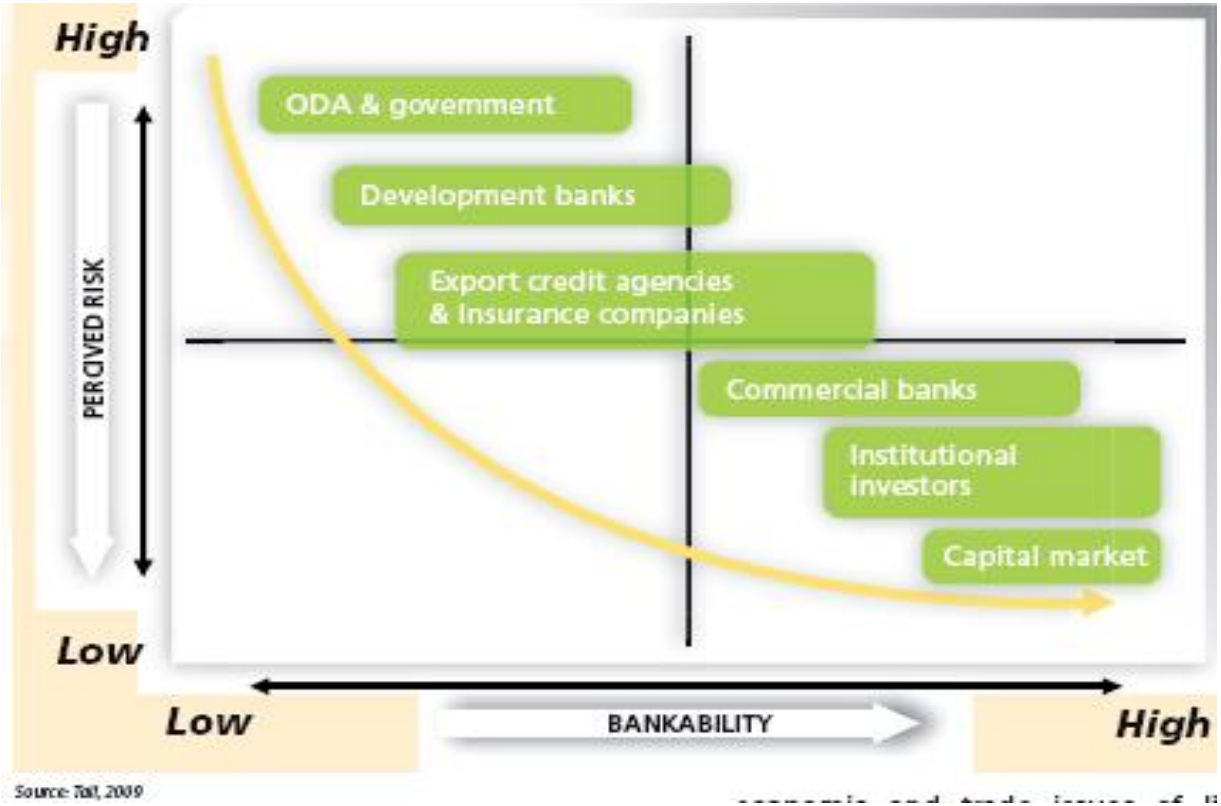


Source: Author -after (IEA, 2009); adapted from (Ros et al, 2006)

Model for Public and Private Equity for Bioenergy



Strategic Financing Position of different types of financers



Source: Tall, 2009

Market Development

The study recommended the following priorities

1. Wide scale dissemination of improved cooking stoves;
2. Biogas at a domestic scale and landfill gas generation.
3. Power generation or cogeneration based on biomass residues both for domestic rural and industrial applications.
4. Greater dissemination of the Multifunctional Platforms with gradual replacement of fossil oil to biodiesel.
5. Liquid biofuels should be used to satisfy local need first.
6. Besides Jatropha, the Region has competitive advantages with cassava (Nigeria tops the academic research on cassava), Sugar cane (Senegal has the production per ha worldwide) and other residues (cocoa, sheanut, peanuts, palmoil effluents, rices and coffee husk).

General Recommendations

1. Energy efficiency improvement remains as important as renewable energy production including bioenergy.

1. Focus on low capital intensive & low operational costs first.

1. Low risks option: technically and commercially proven.

1. Work primarily with local investors, entrepreneurs and diaspora finance as drivers.

1. Use preferably the existing infrastructure instead of establishing a new one (upscaling, increased efficiency, etc).

2. Use successful projects as building stone for further roll out.

General Recommendations (cont.)

1. Waste management to generate bioenergy

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1. Link bioenergy policy with the MDGs goals.

1. Find the niche-markets and develop the best bioenergy pilot projects first.

1. Develop a coherent and stable bioenergy policy for West Africa with short-, medium- and long-term goals.

1. Bundles of small projects to scale up; PPP financing

1. Focus on cheap readily-available residues instead of more expensive energy crops.

Policy

1. Prioritize policy choices and related programs using the Maslow Bioenergy Pyramid

1. Establish clear regulatory and legal framework for IPP and FIT
2. Blending policy and tax exemptions to create a market for the transportation sector to .
3. Make use of experience of the Bioenergy Policy Support Programme for East Africa; (BEST, GTZ) improved cook stoves (e.g. DGIS/GTZ), the “Biogas for Better Life Initiative” on domestic cooking gas (SNV, DGIS, GTZ) and the Multifunctional Platform programmes(UNDP and others), to support policy and program development.

Capacity Development

1. Develop more local expertise on bioenergy systems.

2. Consider a "Bioenergy Capacity Building Programme – BIOCAB" as under consideration at UNIDO as well.

1. Support training and exposure on bioenergy aspects for key policy & decision makers.

1. Enhance understanding Carbon credit market and potential as source of financing

1. Update the relevant websites on bioenergy policies in West Africa.

Financing

1. Address the concerns of investors regarding bioenergy (doing business climate).

1. Facilitate investments by a legal framework that provides a long-term stable market.

2. Develop appropriate and specific financial incentives for the prioritised bioenergy options for West Africa;

3. The niche markets need investment subsidies and/or soft loans,

4. The mature market segments need FIT and tax exemptions .

Financing

1. Donor finance: Improved biomass cooking stoves, biogas for domestic use, MFP, landfill gas production and utilisation need.

1. Private investors : Industrial biogas, cogeneration and liquid biofuel bioethanol/biodiesel production should be the focus of the.

1. Governments are recommended to stimulate bioenergy based PPP .

1. Avoid mistake by learning from countries or regions that are just a little bit ahead regarding the implementation of bioenergy.

Technology transfer and R&D

1. Avoid immature technology. Only commercially proven technologies dissemination perspective.

1. Consider a working group on bioenergy through an Internet platform that serve as data quality filter.

1. Utilize the know-how and experiences on bioenergy available at the donor organisations and private sector.

1. Consider technology transfer from other emerging countries.

1. Focus on the applications side and not on the development of the technologies itself.
2. Develop O&M Capacity. Each projet should have a O&M budget for the long term.

Merci