



***BEYOND FOSSIL FUELS:  
Opportunities for Africa***

Washington, 7th october 2008



## I. Energy Context

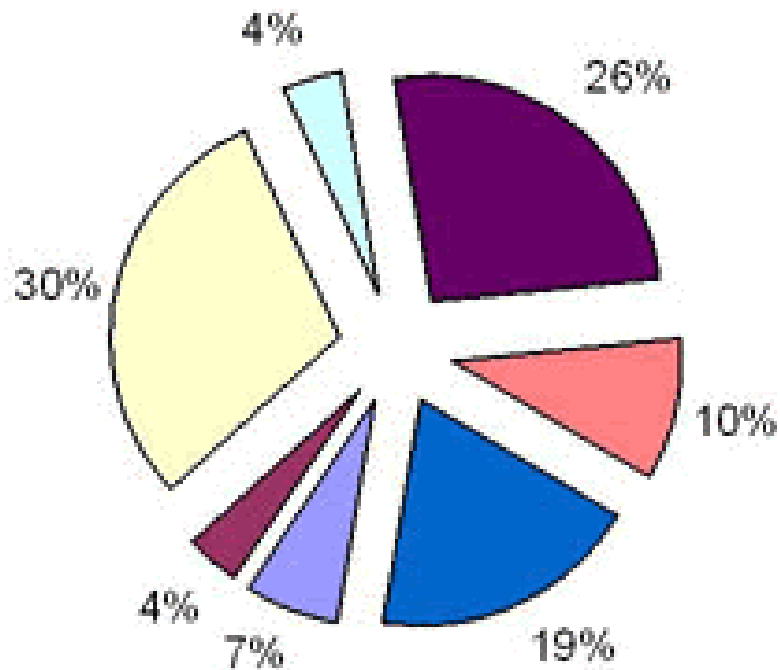
- **Energy Security:** Energy poses a major problem in sub-Saharan Africa, more so than anywhere else in the world.
  - The electrification rate < 16% in Africa
  - The primary energy consumption < 5% of the world total consumption
  - An increase in oil price \$10/barrel = 1.5% drop in GDP & up to 3% for very poor countries
- **Climate change:** The poorest countries that will suffer the climate change earliest and most
  - Hunger, water shortages and coastal flooding
  - The increase of production and exports of oil and gas cannot be an end in itself
- **Carbon market:** an additional revenue stream
  - Kyoto protocol and its local application : European Trading Scheme, CCX (USA), NSW (Australia)...
  - Carbon finance could raise \$4 billion by 2012 and up to \$14 billion thereafter (10 times greater than what is available than Official Development Assistance)



## I. Energy Context

### *World Energy consumption*

World Energy Consumption (b boe)



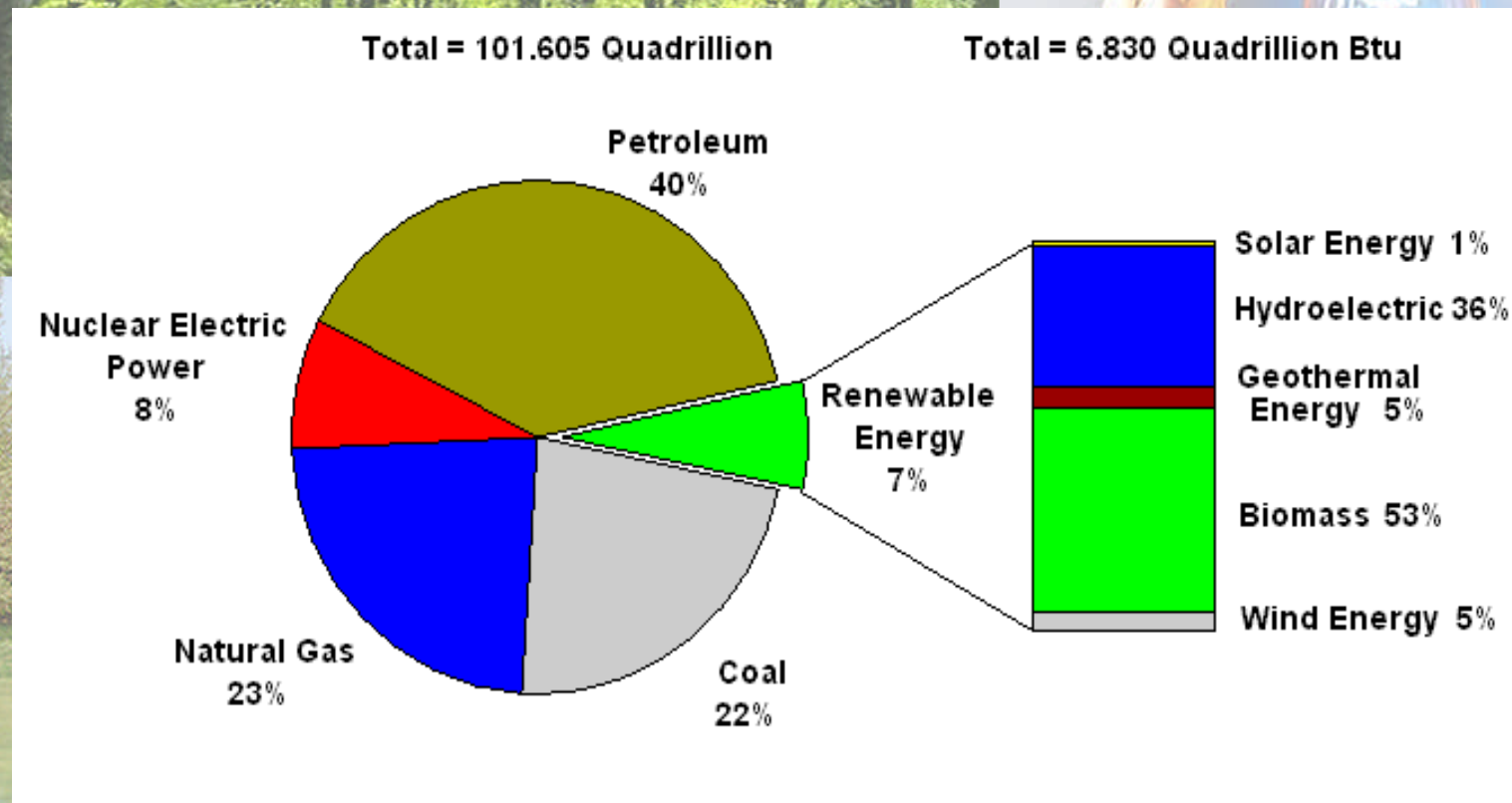
- Latin America & Caribbean
- Africa
- Asia & Australasia
- Middle East
- North America
- Former Soviet Union
- Europe

Source: IEA World Energy Outlook



## I. Energy Context

### *Africa Energy consumption*



Source: Energy Information Administration, May 2008



## II. Renewable Energies

- **Biofuel** : available land for Agriculture (69.8 million hectares in West Africa)
- **Biomass** : total of 650 million hectares in Africa (17% of the world's total forest cover)
- **Water (hydro power)** : 17 major rivers with catchments areas of greater than 100,000 km<sup>2</sup>
- **Geothermal** : example: on 80 km<sup>2</sup> of field there is enough steam to produce 200 TWh/year
- **Wind** : 9m/s of average wind speed per 80m
- **Solar** : average sunshine potential in West Africa represents 5 to 6 kWh/m<sup>2</sup> per day





## IV. Biofuels Opportunities in ECOWAS region



Superficies : 5 million Km<sup>2</sup>  
Population : 260 million habitants



## III. Biofuels

### Feedstock diversity for ethanol production

Saccharyne

Amylaceous



Sugarcane



Corn



Cassava



Sugar beet



Common beet

### Fermentative Processes

Saccharyne, starchy and cellulosic materials are classified as carbohydrates

Ethanol

Acid or enzymatic Hidrolysis

**Cellulosic:** bagasse, sugar cane straw, grasses and other vegetable residues

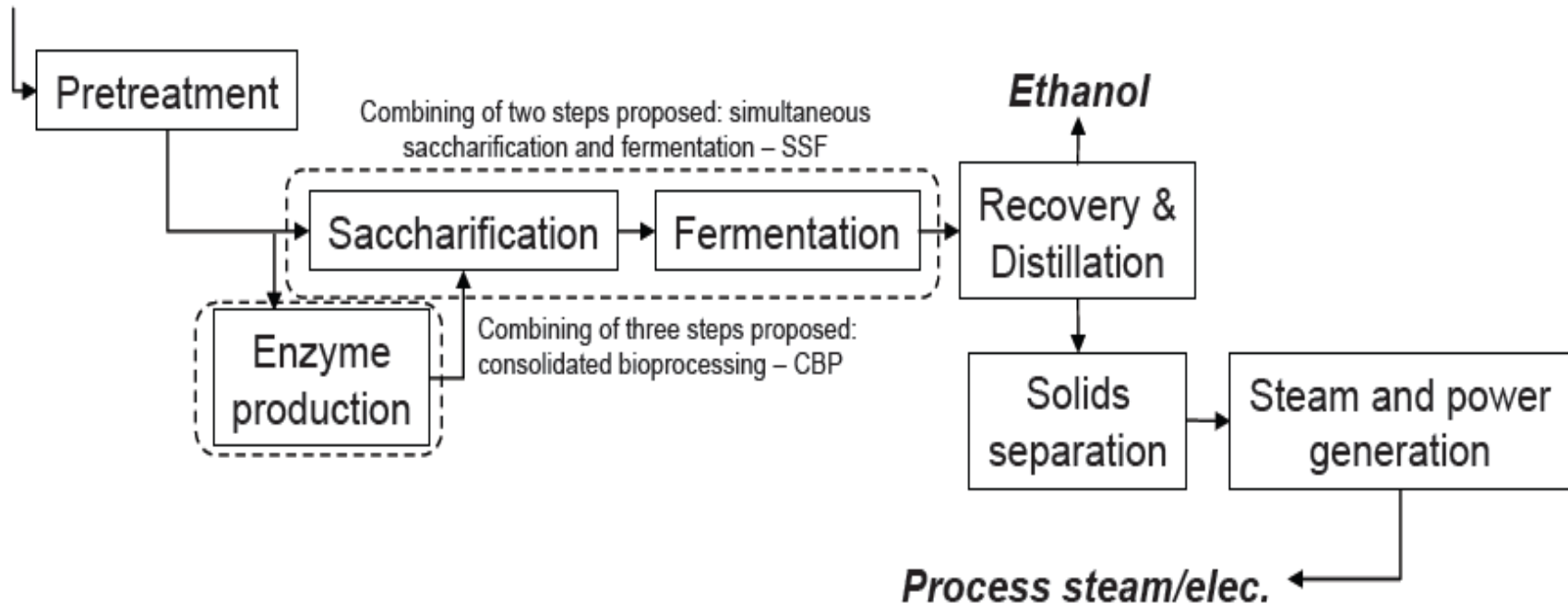
2<sup>a</sup> Generation



## III. Biofuels

### “Cellulosic Ethanol” (similar routes for butanol)

**Raw Biomass**





## III. Biofuels

### Feedstock diversity for biodiesel production



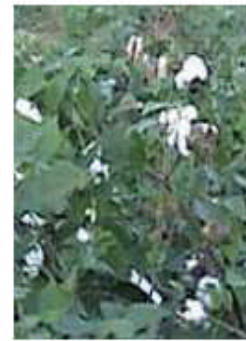
Soybean



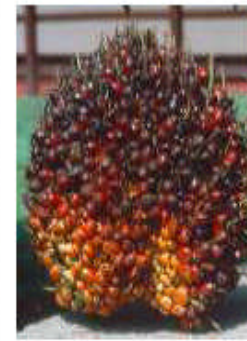
Sunflower



Castor bean



Cotton



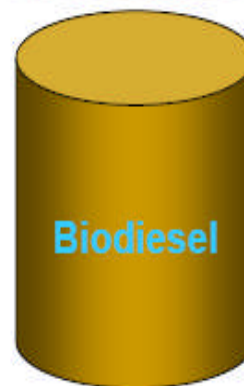
Oil Palm\*



Jatropha

Vegetable oil (transesterification, cracking) → Biodiesel

\*Oil Palm: dendê, macauba, buriti, inajá, babaçú and others



Fats, animal residues and other residues



## III. Biofuels

### Feedstock diversity for biodiesel



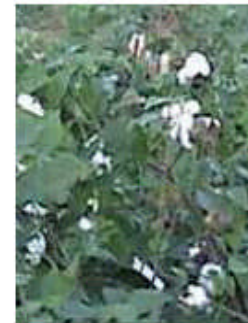
Soybean



Sunflower



Castor bean



Cotton



Dendê



Jatropha

Average Productivity (kg/ha )					
3.000	1.500	1.500	3.000	20.000	5.000*
Vegetable Oil Content (%)					
18	42	47	15	20	25
Vegetable Oil Production (kg/ha)					
540	630	705	450	4.000	1250
Brazilian Harvest in 2005 m <sup>3</sup> /ano					
56x10 <sup>6</sup>	23.000	90.000	315.000	151.000	-----

\*Estimated Value



## III. Biofuels

Biofuel	Energy Balance	Environmental Benefits	Maximum Matrix Substitution
Biodiesel (soybean)	1,94	59%	6%
Ethanol (corn)	1,25	88%	12%

**Energy Balance** = (biofuel combustion energy) / (energy requirement for biofuel production)

**Environmental Benefit** = (biofuel CO<sub>2</sub> emission) / (fossil fuel CO<sub>2</sub> e 1m 0i ,5ssion)

**Maximum matrix substitution** = fossil fuel fraction possible for substitution taking all allowable biomass

Source: PNAS, jul 2006



## III. Biofuels

### First Generation (from sugars, grains, or seeds)

- **Biodiesel (fatty acid methyl ester; fatty acid ethyl ester)**
  - Rapeseed (RME), soybeans (SME), sunflowers, jatropha, coconut, palm, recycled cooking oil
- **Pure plant oils (straight vegetable oil).**
- **Alcohols (ethanol, butanol)**
  - From grains or seeds: corn, wheat, potato
  - From sugar crops: sugar beets, sugarcane

### Second Generation (from lignocellulose: crop residues, grasses, woody crops)

- **Biological fuels**
  - Ethanol (or butanol) via enzymatic hydrolysis
- **Thermochemical fuels (most made via “gasification”)**
  - Fischer-Tropsch liquids (FTL)
  - Methanol, MTBE, gasoline
  - Dimethylether (DME)
  - Mixed alcohols
  - Green diesel



## III. Biofuels

*Biofuel projects in the pipe line*

	Jatropha	Palm oil	Cassava	Sugar Cane	Other	Total
<b>Biodiesel Production</b>	3	3			2	8
<b>Bioethanol Production</b>			3	5	3	11
<b>Total</b>	3	3	3	5	5	19



## III. Biofuels

### *Other projects in the pipe line*

Agri	Biomass	E. Distr	E. Eff	Fossil Fuel	Hydro	Aff / Ref	Solar	Solide Waste	Wind	Total
2	9	1	5	4	19	3	2	1	1	47

Agri = Agriculture

E. Distr = Energy Distribution

E. Eff = Energy Efficiency

Aff / Ref = Afforestation / Reforestation



## ***FINANCING STRATEGY:***

***African Biofuel & Renewable Energy Fund  
(ABREF)***





## I. Presentation

In November 2006, the ECOWAS Bank for Investment and Development (EBID) and the United Nations Conference on Trade and Development (UNCTAD) organized a regional conference in Accra, Ghana, on the financing of bio-fuels and Jatropha cultivation in Africa, and on the development of the carbon market.

During the conference the initiative was launched to establish an African Fund for the development of bio fuels and other renewable energy.



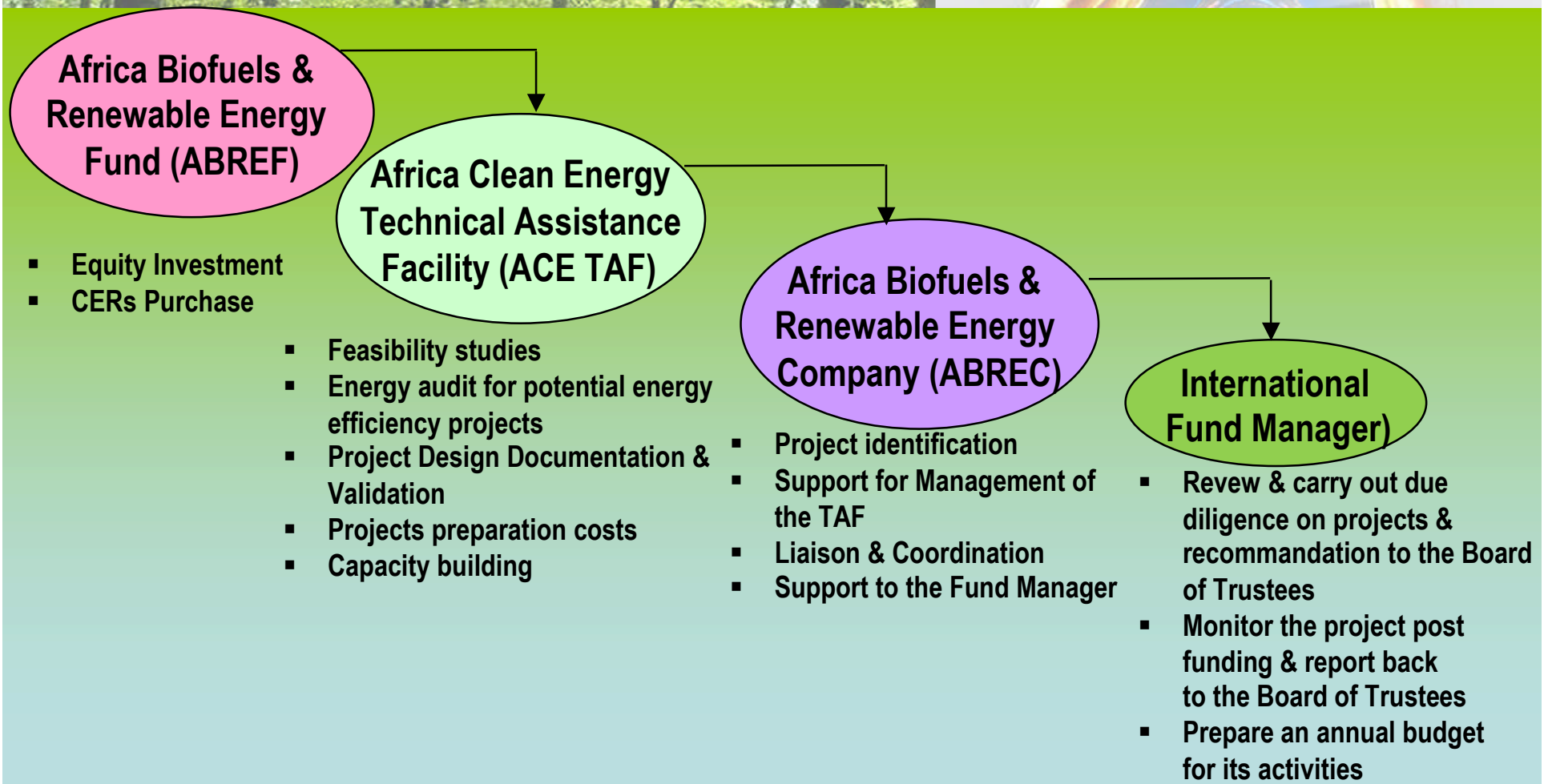
## II. Objectives of the Fund

***The Fund will :***

- **Contribute to the development of the biofuels and renewable energy industry in the African regions, with a particular focus on West African countries**
- **Provide investors with superior returns through investments in biofuels and renewable energy projects which generate Certified Emission Reductions (CERs).**



## III. Structure





## IV. Size & Shares

### *Fund Size*

- ***ABREF Equity investments : € 200 million***
  - ***€ 150 million (75%) of the Fund's capital for equity investments in specific projects***
  - ***€ 50 million (25%) to purchase CERs***
  
- ***Debt facility : US \$ 1 billion***
  
- ***ACE TAF : € 10 million***
  - ***Contributions from governments***
  - ***Voluntary contributions from private sector***



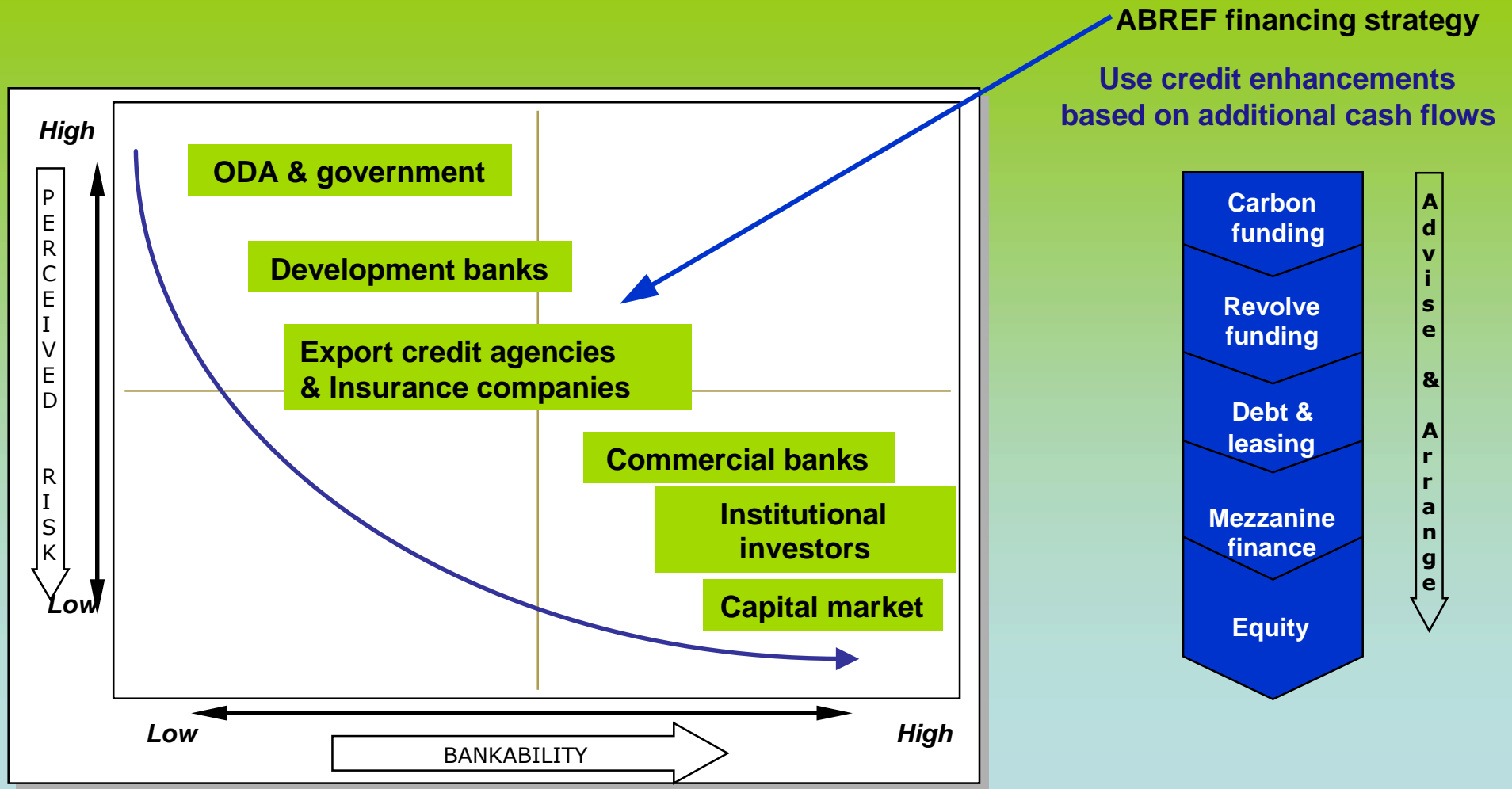
## IV. Size & Shares

### *Category of Shares*

- *Private Investors , Share A*
- *Governments, Share B*

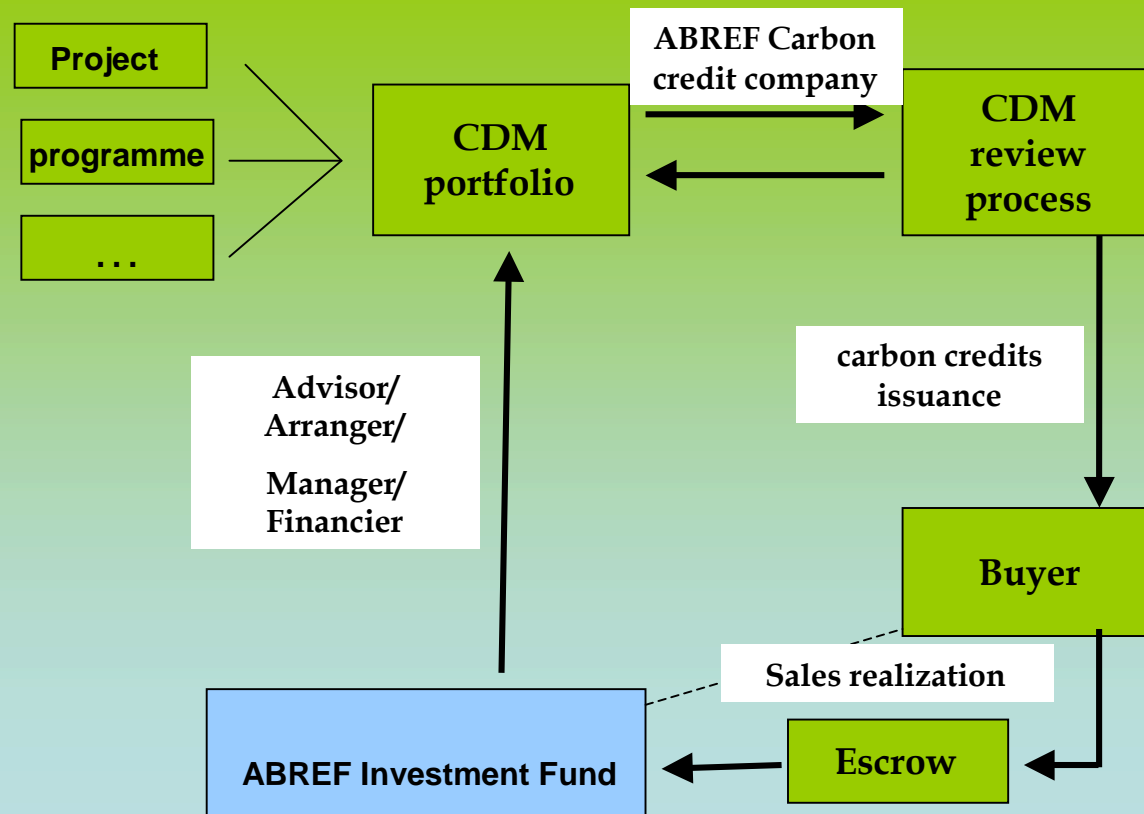


## V. Strategy of Financing





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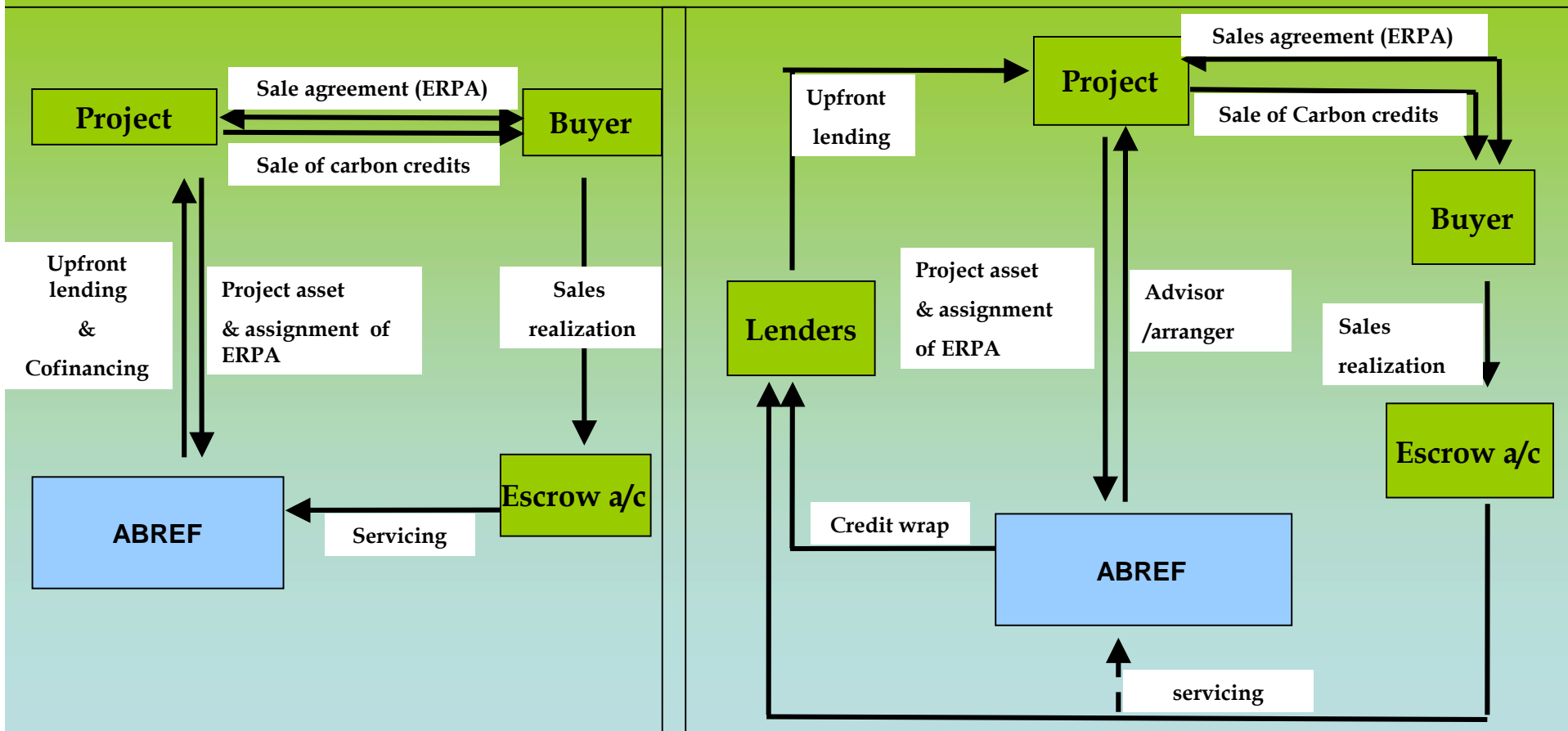




## V. Strategy of Financing

Option 1

Option 2



# BIOFUELS & RENEWABLE ENERGIES IN AFRICA



**Ecowas Bank for  
Investment & Development**

**United Nations  
Conference On Trade & Development**

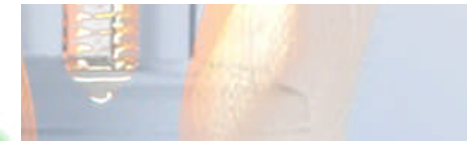
**World Bank  
Carbon Finance Assist**

**Economic Community  
Of West African States**

**ECOBANK Group**



**Fonds Africain de Garantie et  
de Coopération Economique**



**ECOSUR**

**Energy.Environment.  
Innovation**

**Alien Energy**

**Empresa Brasileira de  
Pesquisa Agropecuária**

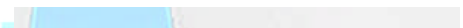
**FIRST CLIMATE**

**Union Economique et  
Monétaire Ouest Africaine**

**Agence Nationale d'Appui  
Au Développement Rural**

**Communauté  
Electrique du Bénin**

**DENTON WILDE SPATE**



# BIOFUELS & RENEWABLE ENERGIES IN AFRICA



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**THANK YOU FOR YOUR KIND ATTENTION**