BIOFUELS DEVELOPMENT IN AFRICA*
Technology Options and Opportunities for Africa

Mongameli Mehlwana
Regional Integration, Infrastructure & Trade Division

Presented at "Scaling up the Use of Renewable Energy in Rural Areas in ESCWA Member Countries" Workshop

Beirut, Lebanon – 1-2 February 2012

*From the findings of ECA-AUC study into prospects of developing regional strategy for biofuels in Africa (2011)

United Nations
Economic Commission for Africa

CREDITS

Special acknowledgement to Prof. Thomson Sinkala, retired professor from University of Zambia and currently working as a developer and consultant in biofuels, and who conducted this study of behalf of the UNECA

United Nations
Economic Commission for Africa

Global Energy Indicators

INDICATOR	WORLD	OECD	MIDDLE EAST	CHINA	ASIA	LATIN AMERICA	AFRICA
Population, (million)	6,688	1,190	199	1,333	2,183	462	984
Population, (%)	100	17.8	3.0	19.9	32.6	6.9	14.7
GDP, (billion 2000 US$)	40,482	30,504	945	2,844	2,417	2,053	876
GDP, (%)	100	75.4	2.3	7.0	6.0	5.1	2.2
GDP (PPP), (billion 2000 US$)	63 866	32,868	1,630	11,054	8,760	3,937	2,499
GDP (PPP), (%)	100	51.5	2.6	17.3	13.7	6.2	3.9
Energy Production, (Mtoe)	12,369	3,864	1,605	1,993	1,263	728	1,161
Energy Production, (%)	100	31.2	13.0	16.1	10.2	5.9	9.4
Net imports, (Mtoe)	-	1,765	-975	210	205	-133	-487
2008 Total primary energy supply (TPES), (Mtoe)	12,267	5,422	594	2,131	1,410	575	655
Shares TPES, (%)	100	44.2	4.8	17.4	11.5	4.7	5.3
2009 Crude oil prod., (Mt)	3 843	857	1,153	196	169	342	477
Shares crude oil prod., (%)	100	22.3	30	5.1	4.4	8.9	12.4
2009 Natural gas prod., (bcm)	3 101	1,144	416	90	316	149	202
Shares natural gas prod., (%)	100	36.9	13.4	2.9	10.2	4.8	6.5

FROM: www.iea.org/textbase/nppdf/free/2010/key_stats_2010.pdf

***EXCLUDING**: Former Soviet Union and Non-OECD Europe*

United Nations
Economic Commission for Africa

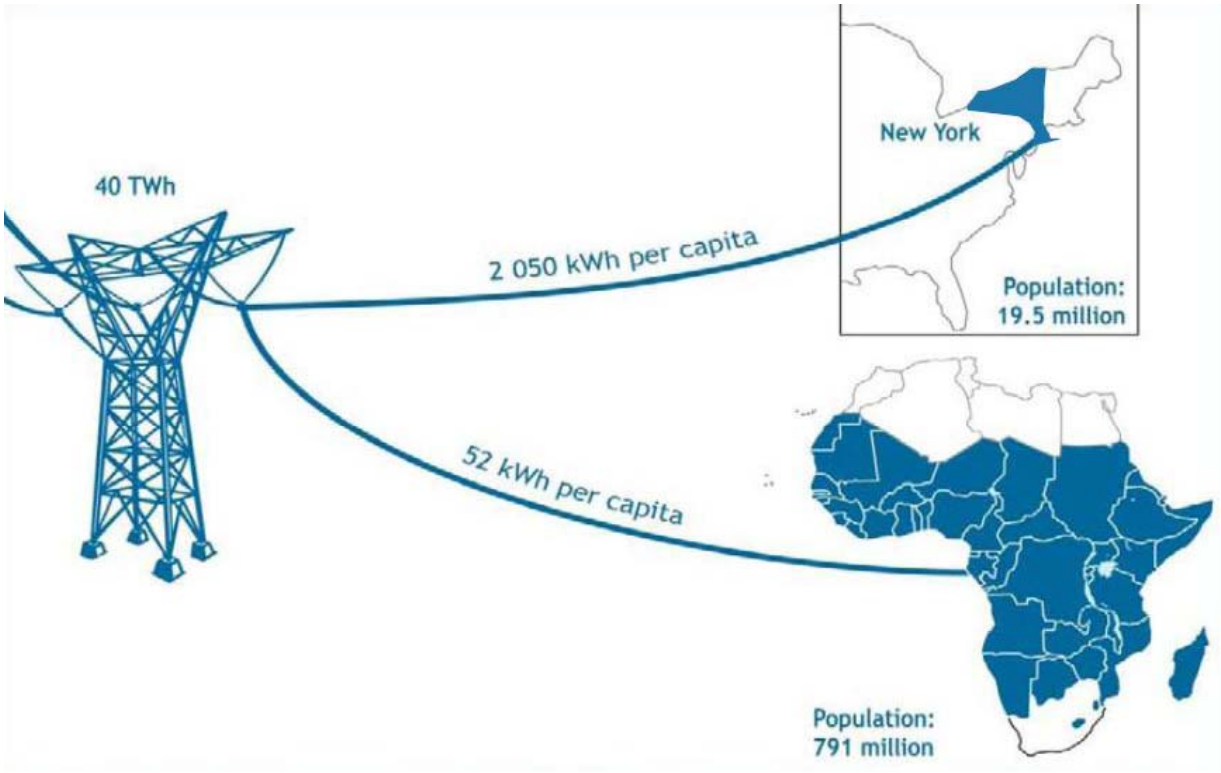
Global Energy Indicators (*continued*)

INDICATOR	WORLD	OECD	MIDDLE EAST	CHINA	ASIA	LATIN AMERICA	AFRICA
2009 Hard coal prod., (Mt)	5 990	1,432	0	2,977	875	78	252
Shares hard coal prod., (%)	100	23.9	0	49.7	14.6	1.3	4.2
2008 Hydro prod., (TWh)	3 288	1,378	10	585	253	674	99
Shares of hydro prod., (%)	100	41.9	0.3	17.8	7.7	20.5	3.0
2008 Refin. throughput, (Mt)	3 893	2,071	331	343	409	265	128
Shares refinery throughput, (%)	100	53.2	8.5	8.8	10.5	6.8	3.3
2008 Electr. Gen., (TWh)	20 181	10,676	767	3,491	1,836	1,070	626
Shares of electr. gen., (%)	100	52.9	3.8	17.3	9.1	5.3	3.1
2008 Total final cons., (Mtoe)	8 428	3,691	388	1,382	978	438	480
Shares of total (ALL ENERGY TYPES) final consumption, (%)	100	43.8	4.6	16.4	11.6	5.2	5.7
Electr. Consump. (TWh)	18,603	10,097	672	3,293	1,570	904	562
Electricity consumption, (%)	100	54.3	3.6	17.7	8.4	4.9	3.0
CO_2 emissions (Mt of $CO_{2)}$	29,381	12,630	1,492	6,550	3,023	1,068	890
CO2 emissions, (%)	100	43.0	5.1	22.3	10.3	3.6	3.0

***EXCLUDING**: Former Soviet Union and Non-OECD Europe*

United Nations
Economic Commission for Africa

Energy consumption per capita by New York compared to Sub-Sahara Africa



FROM: www.iea.org/weo/docs/weo2010/weo2010_poverty.pdf

United Nations
Economic Commission for Africa

The World Health Organisation estimates that more than 1.5 million people die prematurely each year from household air pollution due to inefficient biomass combustion.

Versus

United Nations
Economic Commission for Africa

CONTENTS

- The African Energy Challenge
- Known Opportunities for Biofuels Production in Africa
- Champions for Biofuels
- Way Forward to Increase Share of Biofuels in Africa

United Nations
Economic Commission for Africa

THE AFRICAN ENERGY CHALLENGE

United Nations
Economic Commission for Africa

The African Energy Challenge

- **Insufficient supply of electrical energy**
  - Lack of capital and operating costs for generation, transmission and distribution of electricity
  - Transmission and distribution of electricity more costly in rural areas.
  - High connection costs, low incomes and therefore low consumption of electricity in rural areas
- **The high cost of energy for the majority of the population**
  - 21% expenditure by unelectri-fied households compared to 19% for electrified households,
  - Versus Rule of Thumb budget limit of 10% of total expendi-ture or income.

The African Energy Challenge

- **Inefficient distribution approaches that are used due to**
  - Uneven distribution of resources, and
  - Distance between power source locations (ie hydro plants) from economic centres, thus resorting to expensive diesel generators.
- **The low security of supply,**
  - As most African countries import all crude oil for both transport and electricity generation,
  - Due to attacks on energy infrastructure by non-state actors (e.g. Nigeria),
  - As fossil fuels are point sources and therefore more vulnerable,
  - Due to peak oil issues associated with fossil fuels.

Access to Energy In Africa

Dominant Heating and Cooking Energy

- 657 million (67%) out of 984 million people depend on biomass (mostly wood and charcoal).
- 653 million (66%) of these are in Sub-Sahara Africa.

Access to Electricity

- 587 million (60%) people in Africa have no access to electricity
- 585 mil-lion (59%) of these are in Sub-Sahara Africa.
- Nearly 60% of people living in urban ar-eas in Sub-Sahara Africa also use biomass for cooking.

Clearly, even where modern energy is available, affordability to access modern energy is a dominant issue in Africa.

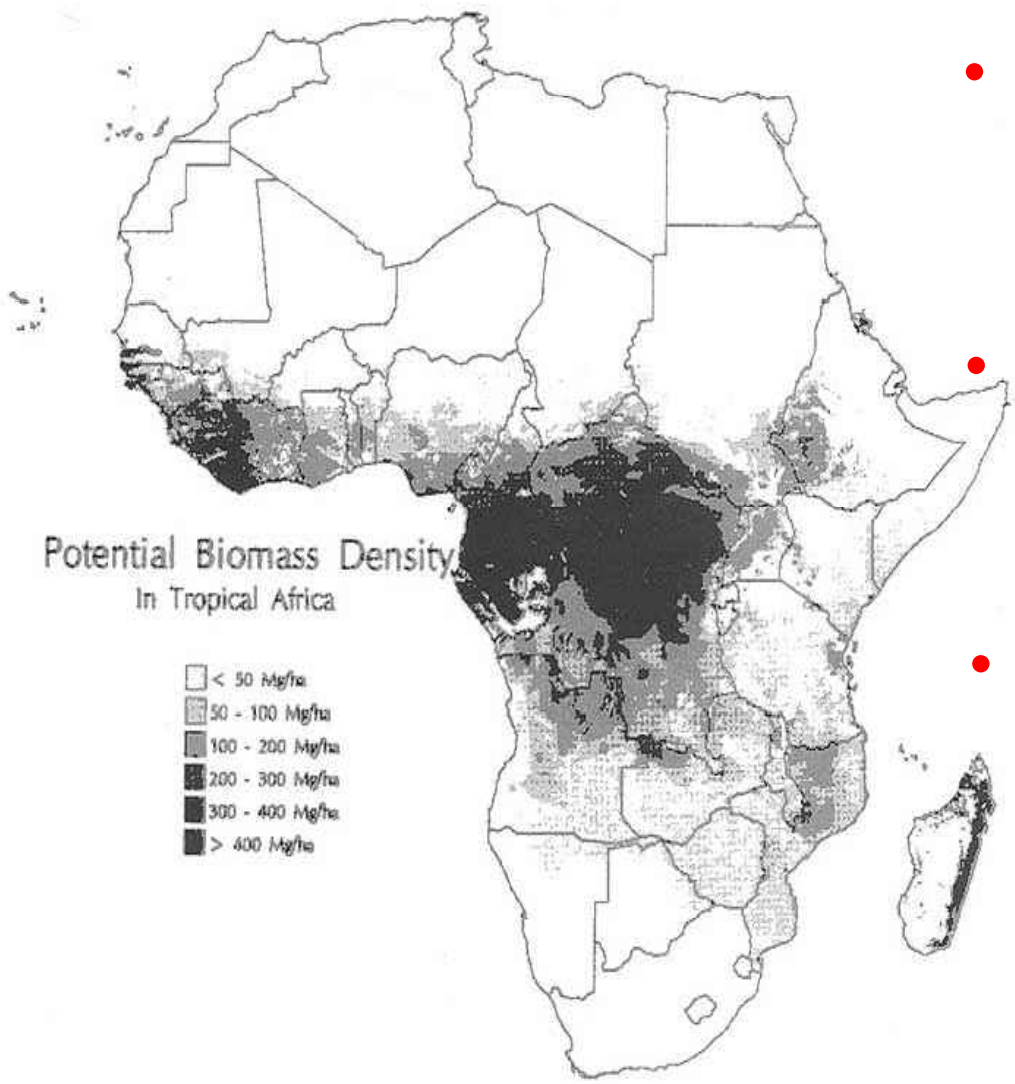
Most discussion will be on Liquid Biofuels because:

- **Coal, petroleum oil and gas, geothermal, ocean wave and hydro**
  - are from point sources (or exclusive due to scarcity, technology intensiveness and/or cost of exploitation and distribution)
- **Solar and wind**
  - technologies to harness them are sophisticated and expensive to an ordinary person, and are generally not participatory.
- **Wood and charcoal, which are the most commonly used, are**
  - inefficient (conversion from wood to charcoal results in 30-50% loss of wood energy, 470 million tons of wood in 2002 consumed in homes in SSA of which 26% is charcoal),
  - unhealthy (1.45 million prematurely dead annually), and
  - unsustainable in their current form of management and use in Africa.

KNOWN OPPORTUNITIES IN BIOFUELS PRODUCTION

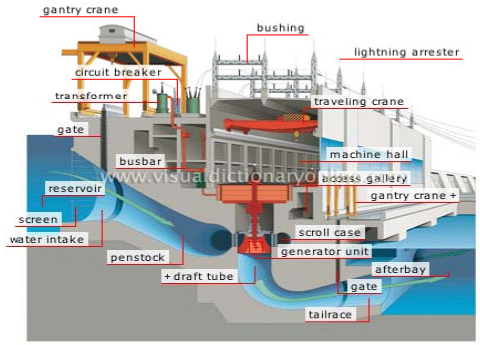
United Nations
Economic Commission for Africa

Bio-energy Potential in Africa

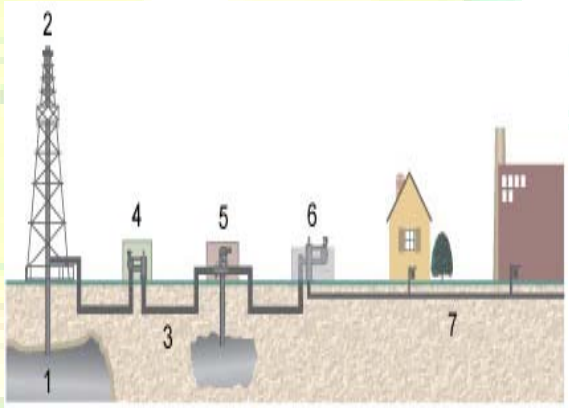


- Traditional biomass primarily for thermal, accounts for approx. 10% of total RE share
- Nearly 470 million tons of wood in 2002 consumed in SSA in the form of firewood and charcoal
- Apart GHG emissions – resulting indoor air pollution is responsible for 1.5 million deaths p.a. mostly of women and children.

Programme for Infrastructure & Development in Africa



Hydro electric power



Natural Gas pipelines

THE NEW PARTNERSHIP FOR AFRICA'S DEVELOPMENT

Oil refinery

Transmission lines

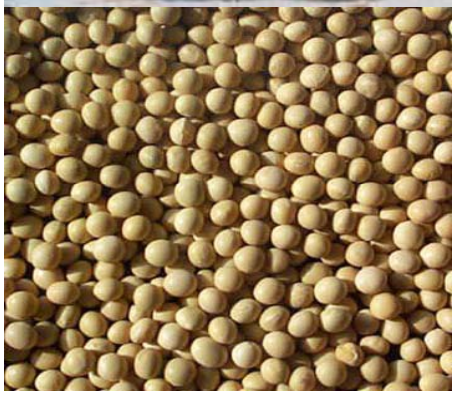
Bioenergies

Opportunities (liquid biofuels)

- **Already existing crops**
  - **Sugarcane (presently 14 countries); Sisal (presently 7 countries) can grow in nearly all countries; Sweet/grain sorghum even in desert countries (West Africa and Kalahari); Cassava, Soy and Jatropha in most African countries.**
- **Low input, low start-up investment crops such as sweet sorghum, cassava, castor and jatropha.**
- **Expansion of the agricultural base to improve food security (grain sweet sorghum, cassava, maize, soy, groundnuts)**

United Nations
Economic Commission for Africa

Opportunities (liquid biofuels)

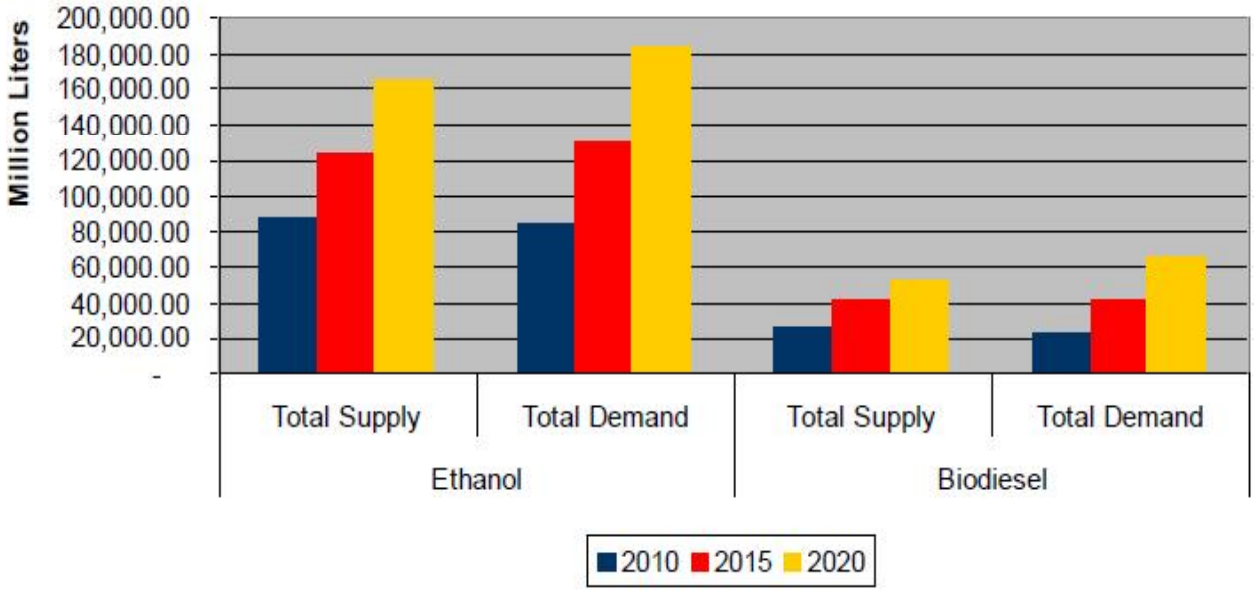


- **Existing regional demand for fuels and byproducts**
  - **Fuels (9.65 billion L/yr at B5 & E5 together in Africa)**
  - **Electricity (only 51% urban and 8% rural population connected by 2008)**
  - **Solid fuel e.g. pellets (more than US$5 billion market for urban people utilising wood and charcoal)**
  - **Biogas (power generation and cooking)**
  - **Fertilisers**

United Nations
Economic Commission for Africa

Opportunities (liquid biofuels)

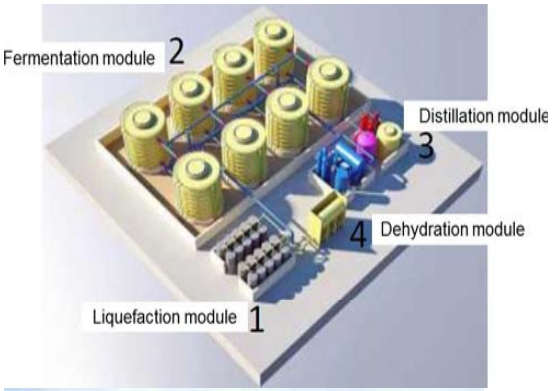
Existing International demand



FROM: Pinto M.S. 2011. "Global Biofuels Outlook 2010-2020". Africa World Biofuels Markets Conference, Rotterdam. March 23.

- **The global share of biofuels will only be 27% by 2050.**

Opportunities (Biogas)



- Biogas
- Bioethanol
- Electricity
- Heat
- Fertiliser

Opportunities

- Desire to keep urban centres clean and healthy;
- Available markets for biogas, bioethanol, electricity & fertiliser;
- Extra income for farmers;
- Rural and urban electrification.

United Nations
Economic Commission for Africa

Opportunities (Solid biofuels)

- **Improved charcoal production technologies;**
- **Pelletizing technologies;**
- **Abundant wood shavings from timber industry in some areas; and**
- **Availability of sustainable wood fuel practices.**

United Nations
Economic Commission for Africa

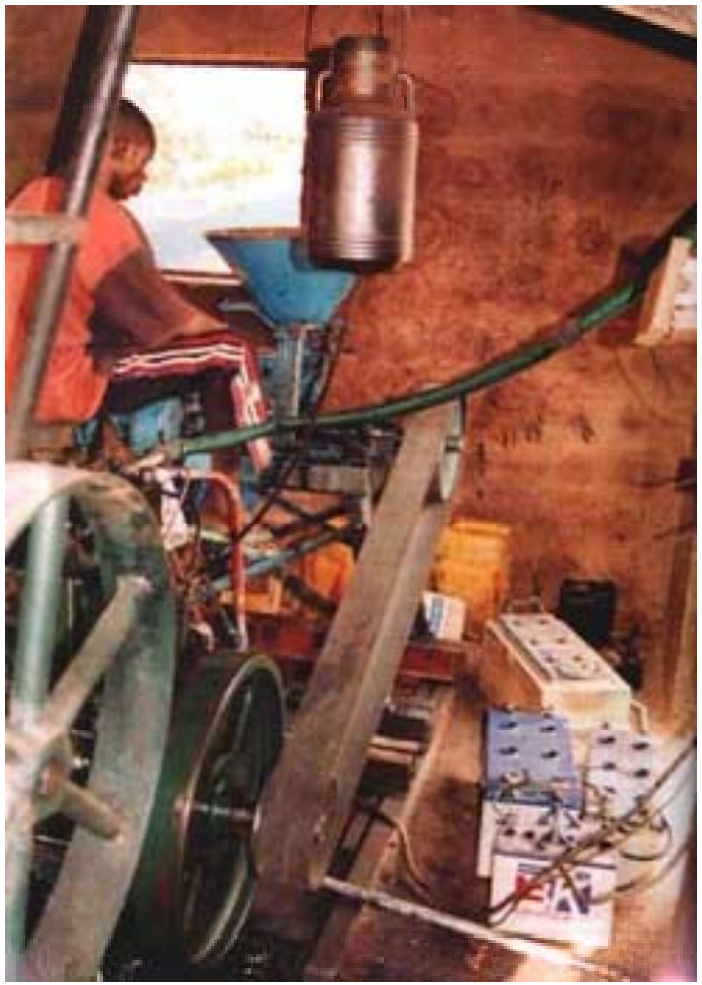
CHAMPION EXAMPLES

United Nations
Economic Commission for Africa

- **Bioethanol Production**
  - Ethiopia (E10), Malawi (E10), Mauritius (E10 ?), Kenya – Kisumu (E10) – Sugarcane based.
  - South Africa - Sugarbeet-based for bus fleet.
- **Co-generation**
  - Mauritius in sugar/ethanol production
- **Biogas-based electricity production**
  - South Africa at Ethekwini landfill project, South Africa.
  - Sisal-cum-cattle farm in Kilifi, Kenya.
  - West Africa (Ivory Coast?) from coconut waste
- **Small scale distributed power generation**
  - Mauritius
- **Well regulated wood/charcoal industry**
  - Sudan

- **Fund targeting the vulnerable groups**
  - Senegal (special fund for women)
- **Jatropha oil for basic needs (engines, lamp oil, soap, etc)**
  - Cameroon, Ghana, Mali, Senegal, Tanzania, Zambia, Etc.
- **Bioenergy powered multi-platforms**
  - Mali, Tanzania, Etc.

Multi-Functional Platform - MALI



Small agricultural processing business based on a multifunctional platform using jatropha oil as biofuel.

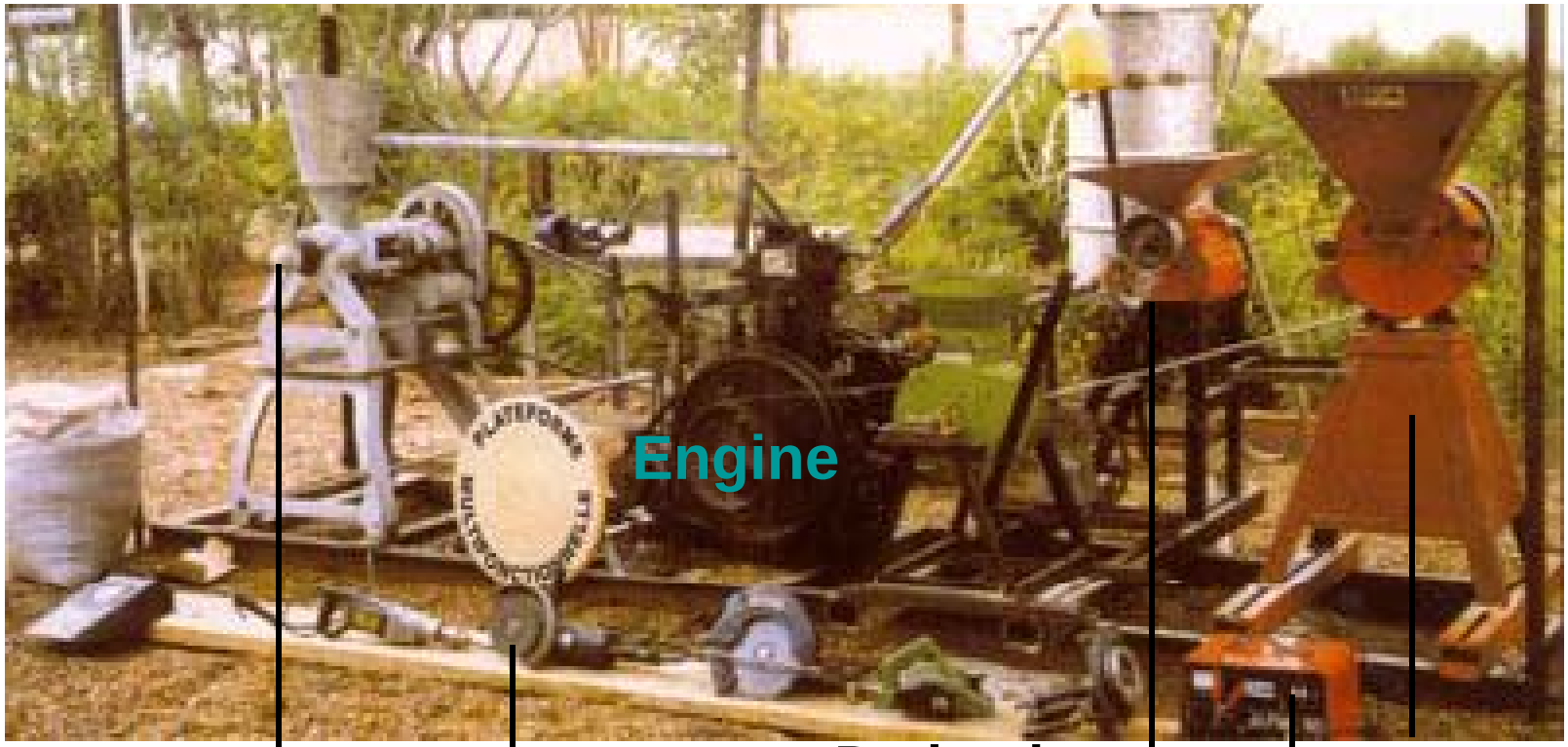
Installation provides milling and battery charging services to local people.

FROM: http://www.malifolkecenter.org/

United Nations
Economic Commission for Africa

The Multifunctional Platform supports a **simple diesel engine** that can power different tools : cereal grinding mills, de-huskers, oil presses, joinery and carpentry tools …:

FROM: deafrica.net/workshops/**Tanzania**%201/Gordon-MDG%20impact.ppt



United Nations
Economic Commission for Africa

Co-generation from sugarcane industry - MAURITIUS

FROM: www.caricom.org/jsp/projects/Mauritius%20Presentation.ppt

Landfill Biogas/Electricity – EThekwini, South Africa

Mariannhill and La Mercy = 2 MW Potential

Production cost = 0.039 US$/kWh.

Made economically feasible through CDM funding.

Now there is a REFIT of US$0.117/kWh to develop other projects.

The Mariannhill landfill gas recovery unit

FROM: http://wbcarbonfinance.org/Router.cfm?Page=Projport&ProjID=9615

Cattle effluent biogas - KENYA



Feeding the biogas unit with cow manure.

FROM: http://bio-gas-plant.blogspot.com/2011/06/biogas-units-in-karatina-and-gatundu.html

United Nations
Economic Commission for Africa

Use of biogas for cooking from Jatropha Cake

FROM: Kakute in Arusha, Tanzania

Sisal – scam power generation – Kilifi, KENYA

750 m³ digester; Installed capacity: 150 kW, Actual maximum production 90 kW, Not connected to the grid; 4 ton substrate / day: Dung from 200 cattle (40%), sisal waste (60%); Feedstock available for extension up to 1 MW if excess electricity could be sold to the grid at a fair tariff; Electricity production cost: 0.16 €/kWh (for comparison: grid electricity 0.15-0.18 €/kWh).

Sisal waste

Cattle waste

Power generation room

FROM: http://www.biopower.co.ke/gallery.html

United Nations Economic Commission for Africa

Chardust and Typha Briquettes - SENEGAL

Chardust Briquettes

Typha for Briquettes

FROM: FAO – Small scale bioenergy initiatives

United Nations
Economic Commission for Africa

Wood/charcoal industry in Sudan

- Charcoal is recognized as a key source of energy.
- There is a specific institution, a government parastatal, to implement wood energy policies.
- Production of charcoal from plantations and natural woodlands is well planned.
- Resources are allocated on a yearly basis for plantation establishment.
- There is strong public and private sector participation.
- Charcoal is a formal and lucrative industry.
- There are clear marketing arrangements and rules.
- Traders are organized into a formal association recognized by the government.
- The government raises royalties and taxes, which are reinvested in establishing plantations.

Jatropha to Green the Desert – LUXOR, EGYPT

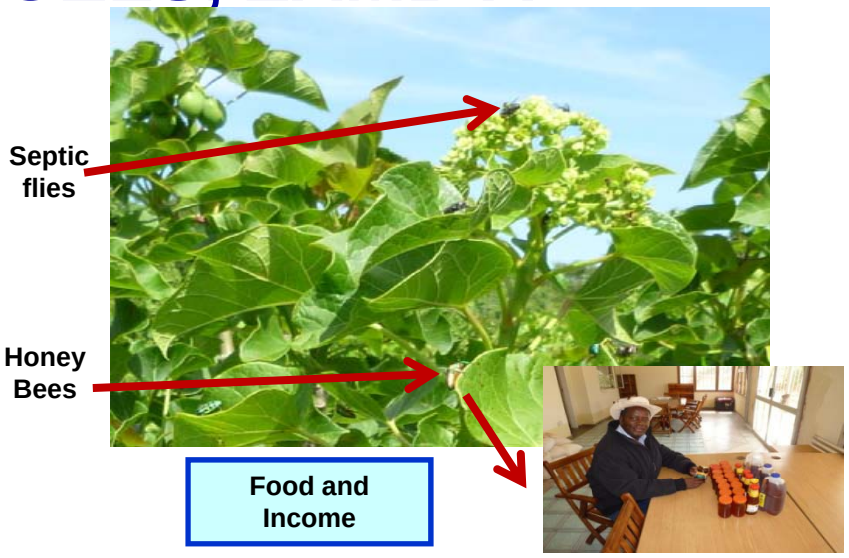
Municipal treated water for irrigation

United Nations
Economic Commission for Africa

Win – Win Jatropha Plantation Management

THOMRO BIOFUELS, ZAMBIA

Livestock for weeding



Promoting bees for pollination

Tephrosia for pests and diseases

Domestic birds for termites

United Nations Economic Commission for Africa

Small Independent Power Producers - MAURITIUS

- **Grid Code is restricted to generating plant up to a maximum capacity of 50 kW.**
- **A maximum of 200 installations or a total installed capacity of 2 MW island-wide.**
- **Valid for 15 years, and so the FIT validity period as well.**
- **Dependent on annual production ratio**
  - **Ratio less than 3:** Rs 10 to Rs 25 (0.36 to 0.89 US$)
  - **Ratio more than 3:** Rs 8.50 to Rs 21.25 (0.30 to 0.75 US$)

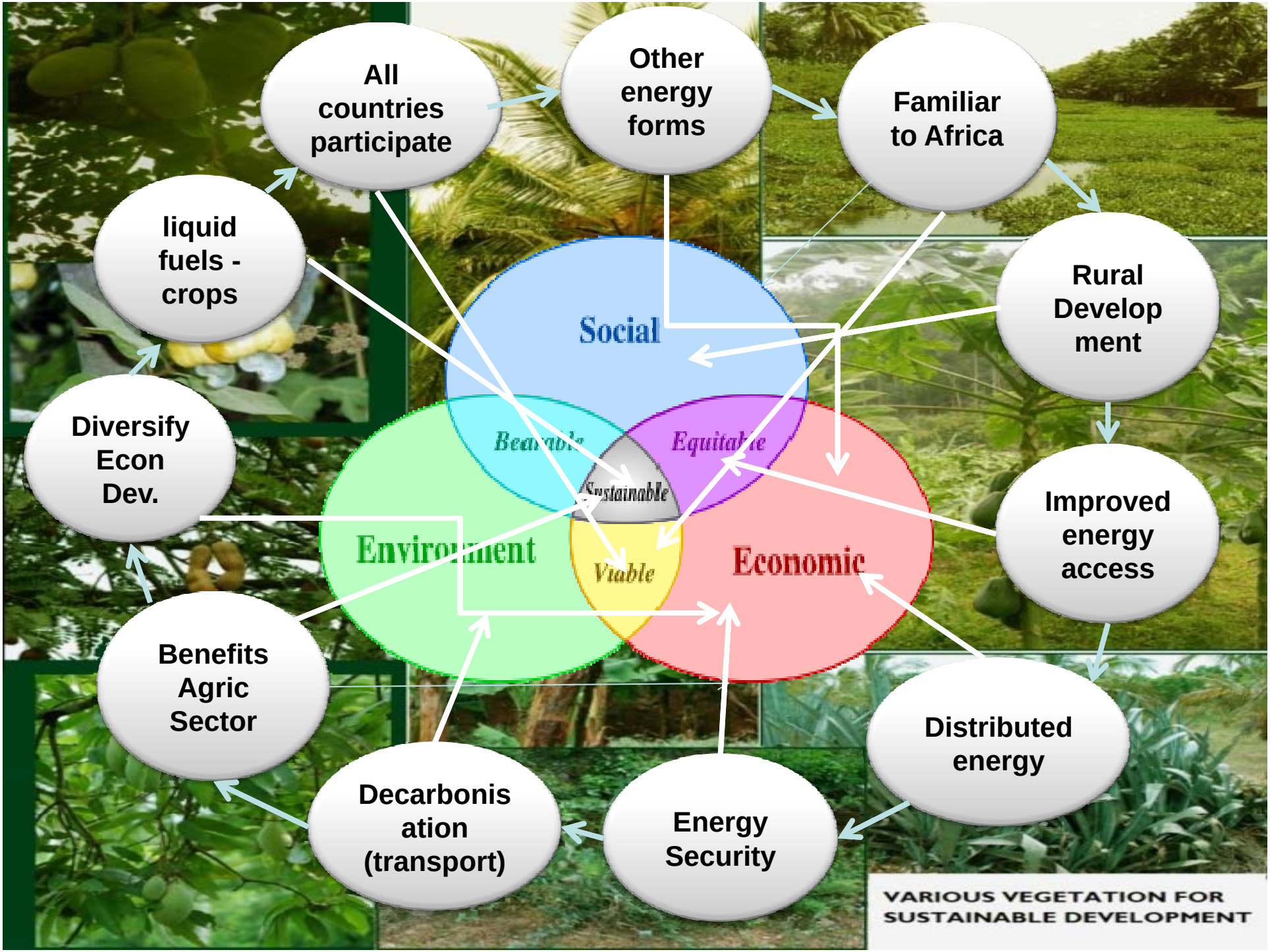
Sub-Regional Promotion of Biofuels Production

- **West African Economic and Monetary Union (UEMOA)**
  - An inventory of bioenergy projects in the region;
  - Connecting producers and farmers;
  - Investment in pilot programs; and
  - Organising funds/projects for the industry.

- **Southern Africa Development Community (SADC)**
  - Regional survey of needs and status; and
  - Formulation of regional strategy.

WAY FORWARD TO INCREASE SHARE OF BIOFUELS IN AFRICA

United Nations
Economic Commission for Africa


All countries participate
Other energy forms
Familiar to Africa
liquid fuels - crops
Rural Develop ment
Diversify Econ Dev.
Improved energy access
Benefits Agric Sector
Distributed energy
Decarbonis ation (transport)
Energy Security
Social
Equitable
Sustainable
Viable
Economic
VARIOUS VEGETATION FOR SUSTAINABLE DEVELOPMENT

Known Barriers to Biofuels Development in Africa

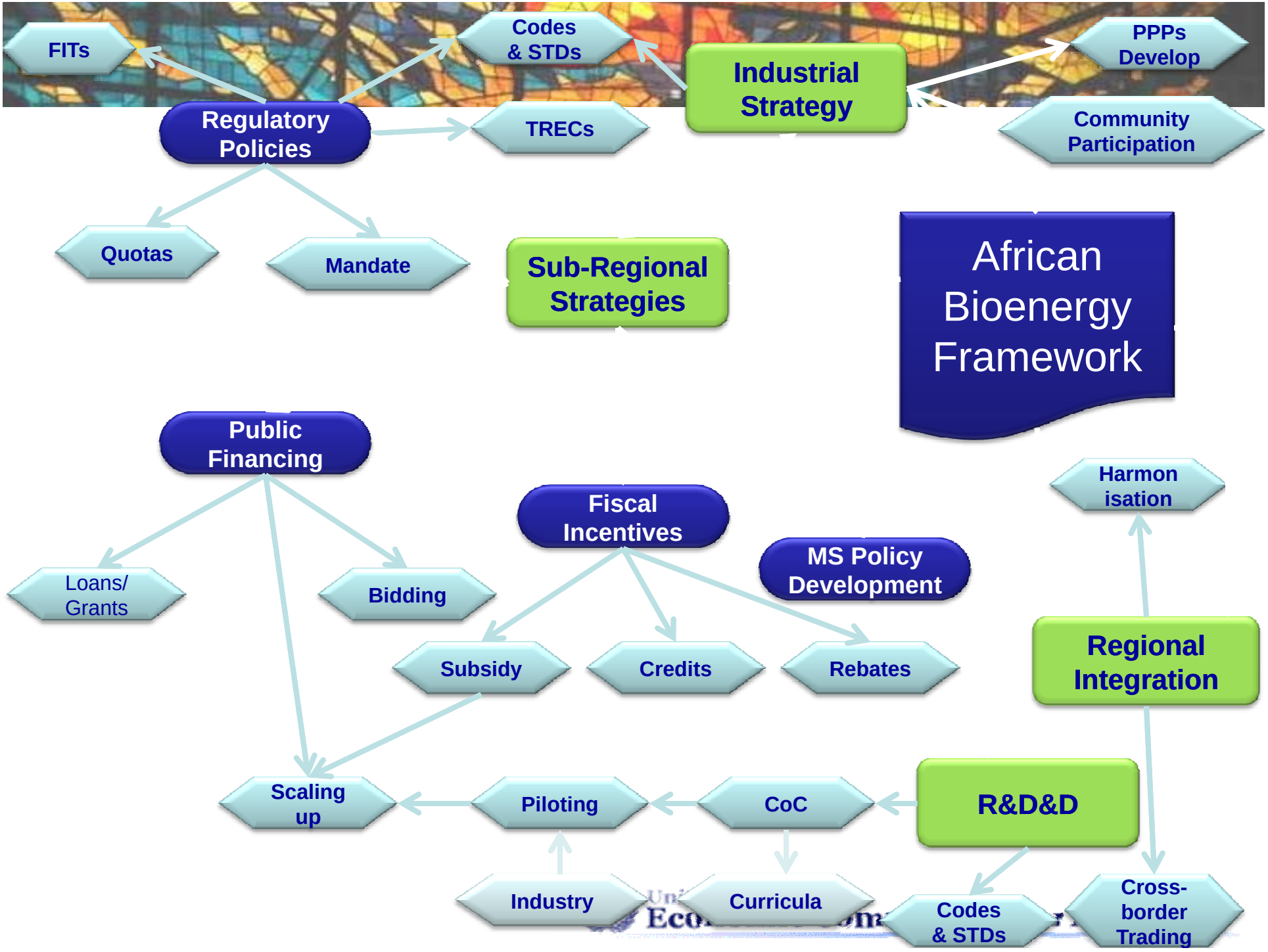
All Biofuels	Liquid Biofuels	Solid Biofuels	Waste
Lack of appropriate funding	Expensive start-up		Tedious access to finance & high capital costs
Consumer awareness	Lack of infrastructure	Weak policy coherence with conflicting responsibilities	
Biased energy policies	Inadequate policy support	Wood/Charcoal ignored by policy makers	
Inadequate capacity	Lack of info on appropriate feedstock	Absence of gender in many policies	Toxicity of waste including capacity to separate waste
Poor market development	Land ownership hurdles	Lack of baseline information for policy formulation	
	Misinformation on food security vs. biofuel development	Limited policy will to reorganize the charcoal production sector	

Biofuels Incentives in Selected African Countries

COUNTRY	POLICY / STRATEGY ON LIQUID BIOFUELS	REGULATORY POLICIES					FISCAL INCENTIVES				PUBLIC FINANCING	
		Feed-in tariff (incl. premium payment)	Electric utility quota obligation/ Renewable portfolio standard	Biofuels obligation/ mandate	Heat obligation / mandate	Tradable renewable energy certificate (REC)	Capital subsidy, grant, or rebate	Investment or production tax credits	Reductions in sales, energy, CO_2, VAT, or other taxes	Energy production payment	Public investment, loans, or grants	Public competitive bidding
Algeria		X										
Botswana	X	March 2012		B20; Biogas 3%					X			
Egypt							X		X		X	X
Ethiopia				E10					X		X	
Gambia									X			
Ghana				**Draft:** B10, 10%PPO		X			X			
Kenya	Draft P	X		E10 in Kisumu					X			
Malawi				E10								
Mali									X			
Mauritius	X	X		E10, B100[a]			X				X	X
Mozambique	X			Approved							X	
Nigeria	X			E10, Minimum B20								
Rwanda									X		X	
Senegal	X			Jatro PPO 1190 mln L/yr; Bioethanol 12 mln L/yr							X	
South Africa	X	X		Proposed E2,B5		X	X					X
Uganda		X					X		X			
Tanzania		X					X		X			
Tunisia							X		X		X	
Zambia	X			B5,E10					X			

Africa needs an integrated approach to biofuels development to take advantage of regional diversity, cross border biofuels trade & knowledge transfer between countries

AUC-ECA proposes that Africa needs to have a Bioenergy Framework that will spur R&D (i.e. creation of African Centres of Competence), address the funding gap, develop complementary policies and regulatory mechanism & stimulate markets


FITs
Codes & STDs
Industrial Strategy
PPPs Develop
Regulatory Policies
TRECs
Community Participation
Quotas
Mandate
Sub-Regional Strategies
African Bioenergy Framework
Public Financing
Harmon isation
Fiscal Incentives
MS Policy Development
Loans/ Grants
Bidding
Subsidy
Credits
Rebates
Regional Integration
Scaling up
Piloting
CoC
R&D&D
Industry
Curricula
Codes & STDs
Cross-border Trading

Thank You

United Nations
Economic Commission for Africa