

Energy Development in Africa: Technology and Innovation

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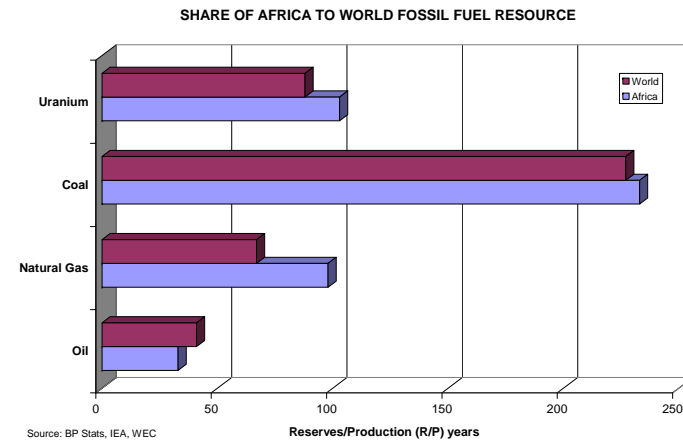
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- AEEP Goals for Energy Development
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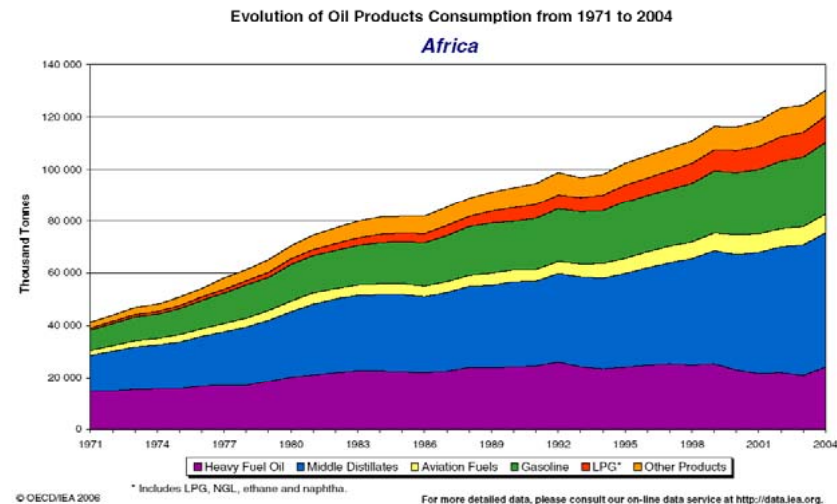
INTRODUCTION

- Africa is very rich in fossil and renewable energy resources
 - 9.6% of Oil, 9% of natural gas, 15% of coal, over 10% of uranium
 - Large solar, bio-energy and hydro resources
- Gains from energy exports need to be managed or affected countries will end up poorer than before exporting
- Good management, and committed political will yield positive results, Sugar in Mauritius and diamonds in Botswana are examples of good practise
- International interests on oil and gas are for exports are growing
- Africa's interests are reduction of poverty and inequalities and economic growth
- Combustion of coal, oil and gas were the major drivers from past and present economic boom
- Africa energy needs are huge and urgent.
- Concerns for global warming largely triggered by hydrocarbon combustion poses dilemma



IEA Energy Statistics

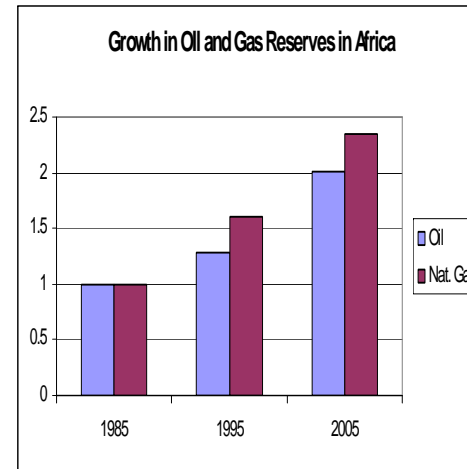
Statistics on the Web: <http://www.iea.org/statist/index.htm>



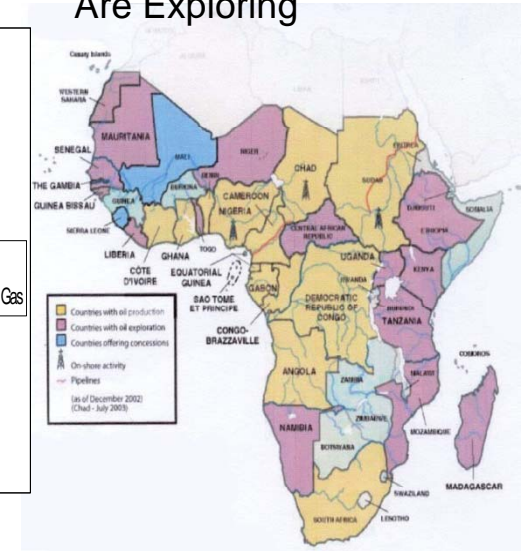
Oil and Gas in Africa

- Africa is becoming an important player in the global oil and gas industry.
- The rate of oil and gas discovery is fastest in the world for the last 20 years because the continent remains unexplored (oil - 100%, Gas - 163% between 1985 and 2000)
- 18 countries are oil-producers, 14 natural gas producers, and exploration are on-going in over 80% of countries
- African countries produce 9 m/day and consumes 3 m/day, hence two-thirds are exported

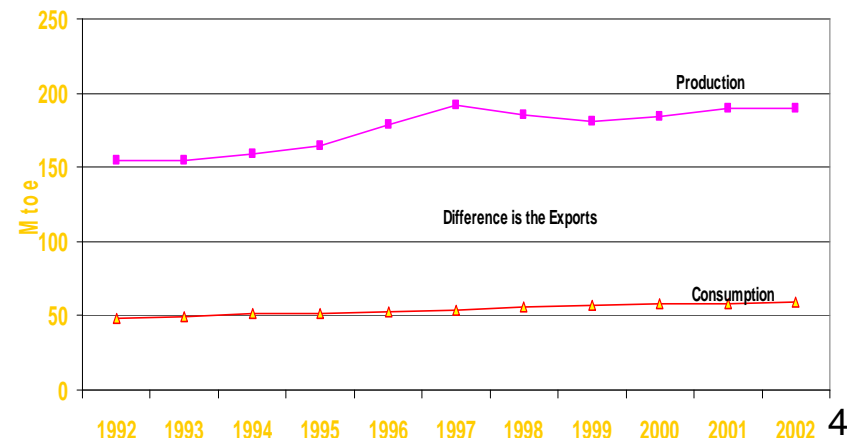
1985 = 1.0



Most Countries Are Exploring



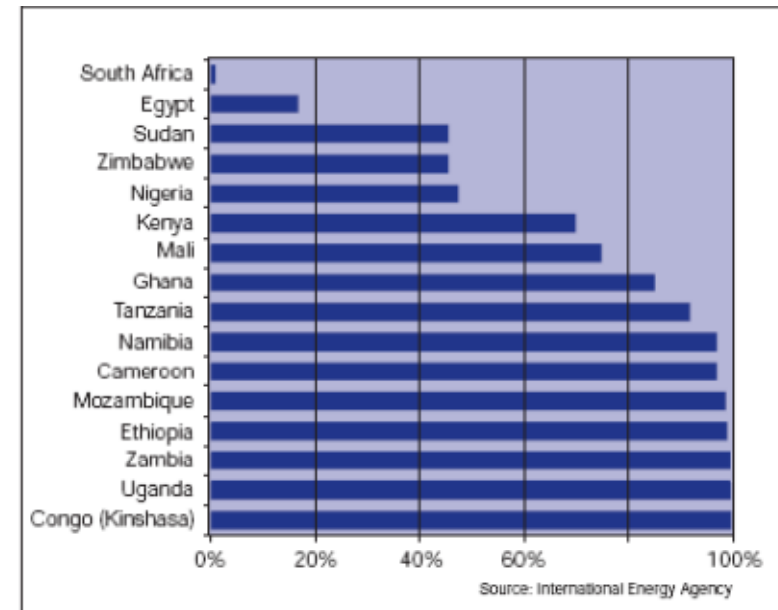
PRODUCTION AND CONSUMPTION OF CRUDE OIL IN WEST AFRICA



Source: BP Stats, 2003

HYDROPOWER IN AFRICA

- Only 24% of potential explored
- 17% is from hydropower (7% of continent's potential)
- Have potential of up to 200 GW for major plant and 2000 MW mini plants



Large Hydro



Kariba Dam

Mini-Hydro



Small-scale hydroelectric power scheme in Kenya.

Bio-Fuels in Africa

- African countries rich in bio-resources
- Very poor consumption patterns for energy
- Growing external interests in bio-energy
- Africa need to based work on agricultural and forestry wastes and few energy crops
- Many R&D issues
 - Land for food/energy
 - Land degradation
 - Local use/exports

Feedstock vary

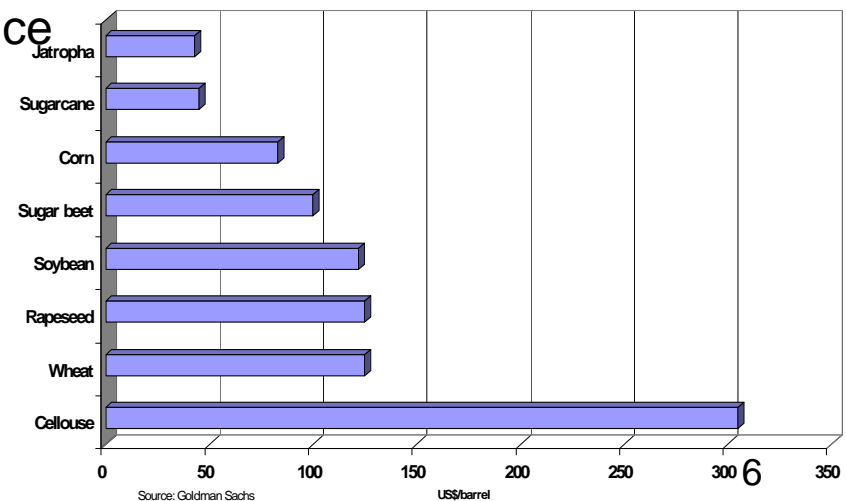


Bio-Refinery



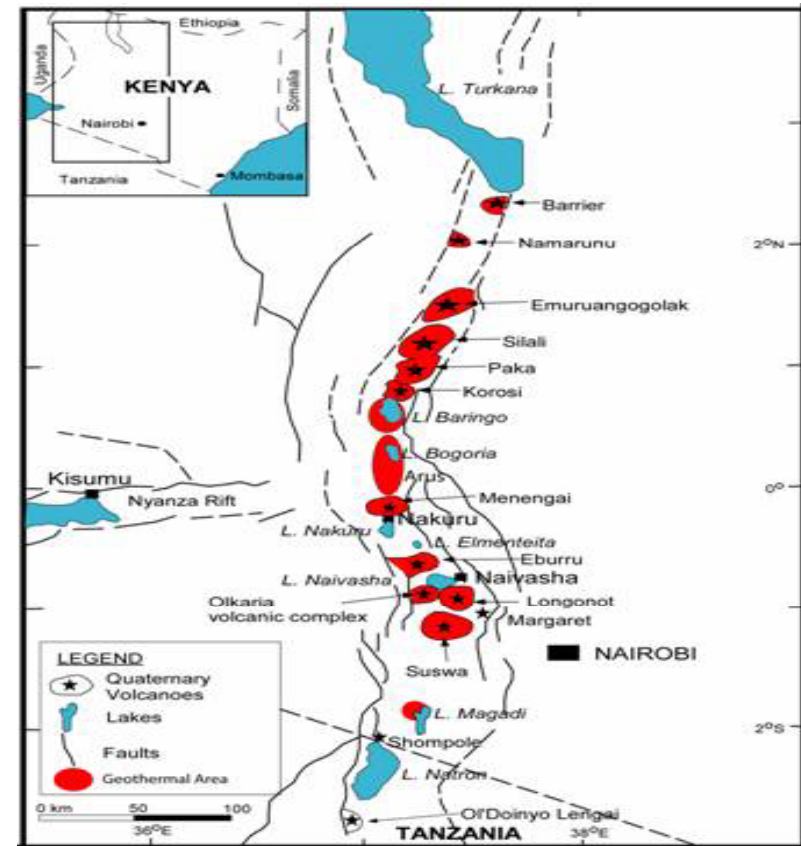
Cost per Barrel of Fuel by Biofuels feedstock

Fuel price do vary



Geothermal in Africa

- Significant potential, 9000MW along Rift Valley- countries
- Less than 10% of geothermal resources exploited – 127 MW in Kenya
- Iceland willing to develop up to 100MW in Africa



Energy Growth Options

Renewable Energy

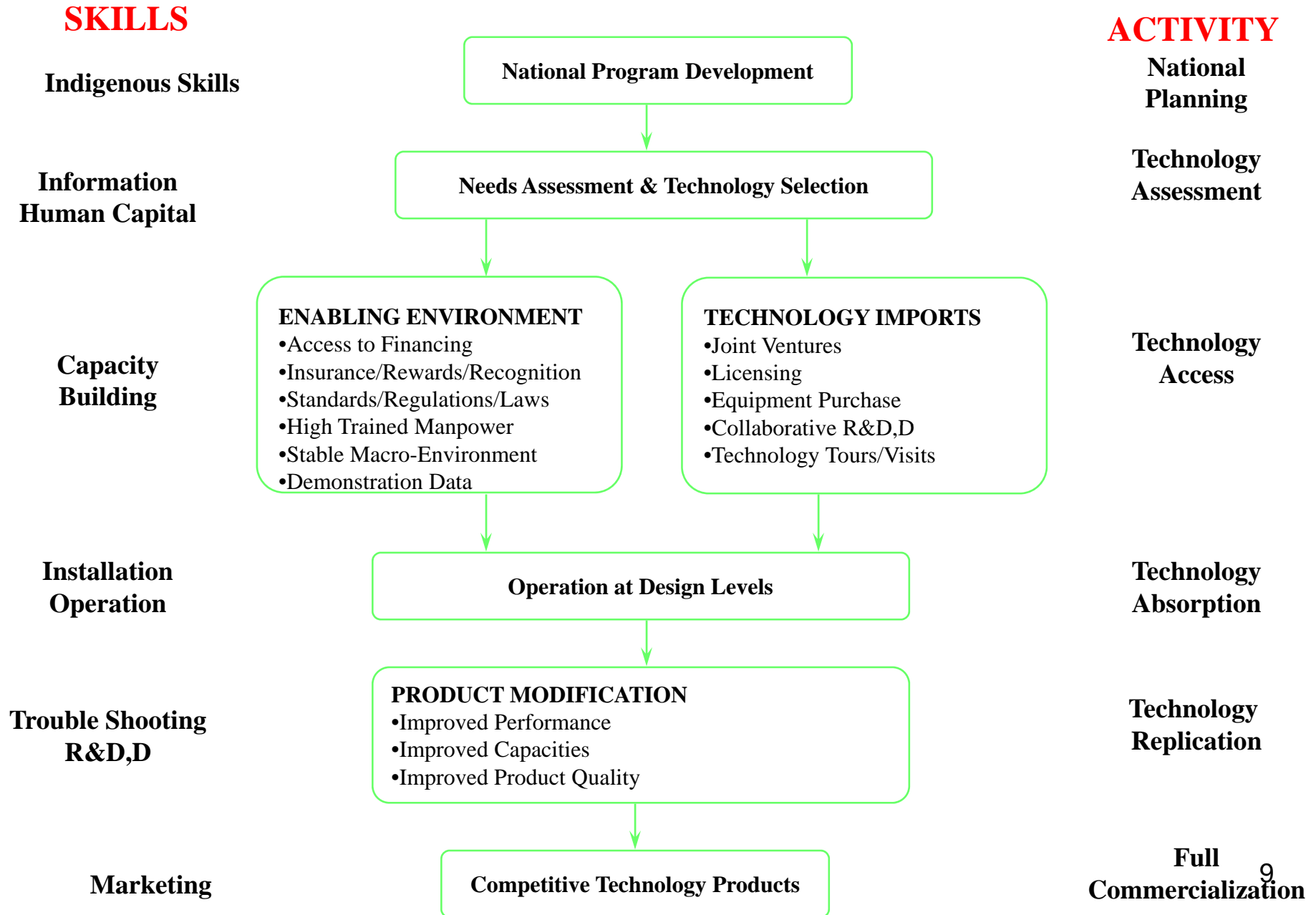
- Renewable energy systems can be used as stand alone or mini-grid based on
 - Needs assessment
 - Provision of wide technology choice
 - Facilitation of technical back-up
 - Provision of subsidised financial system
 - Support existing cooperatives or promote new ones



Courtesy of The National Renewable Energy Laboratory (NREL)



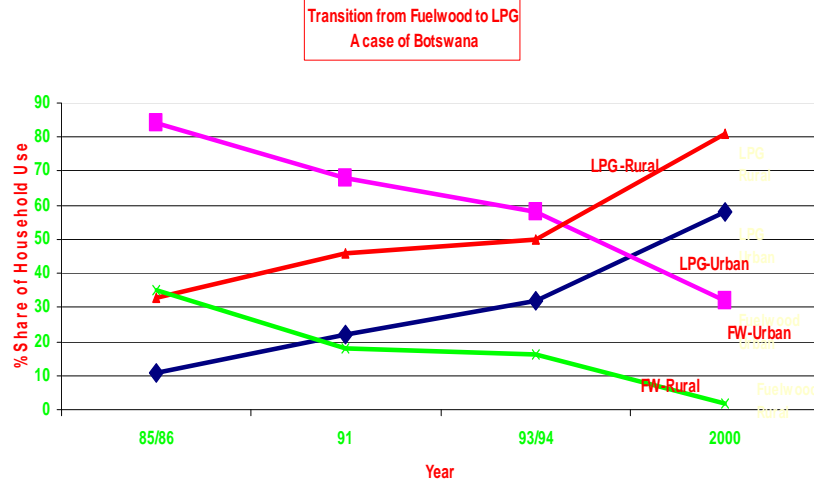
FRAMEWORK FOR TECHNOLOGY COOPERATION



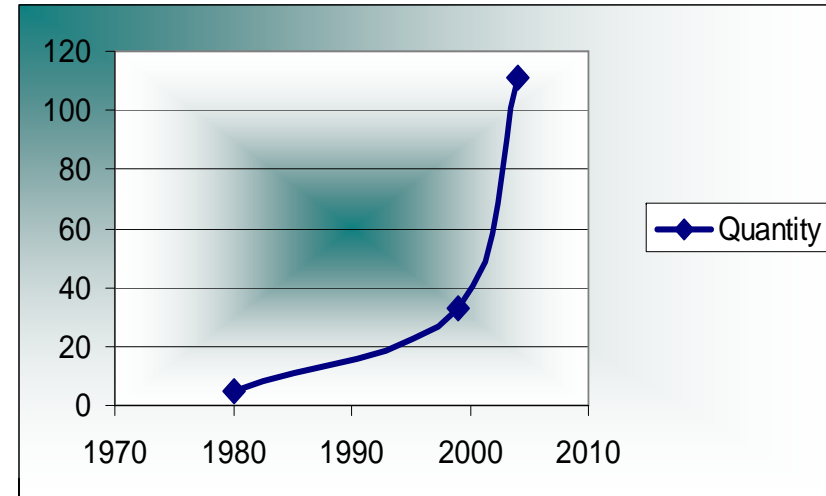
Energy Growth Options

Wider use of LPG

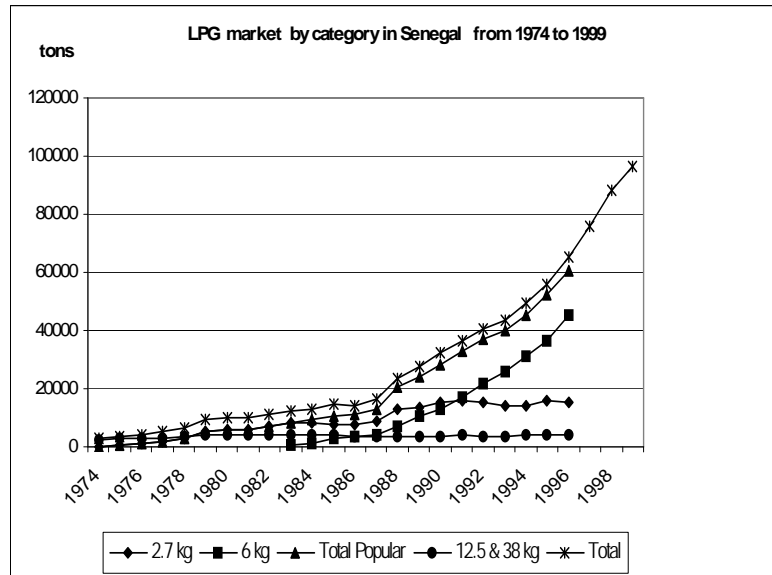
LPG in displaces firewood in urban and rural Botswana



Exponential growth use of LPG in Sudan



Growth of LPG in Senegal



LPG Cylinder manufacture & distribution in Ghana



Policy & Price Regime are needed

5 STAGES IN TECHNOLOGY TRANSFER PROCESS

Assessment

Choice of technology, local technology needs

Agreement

Contracting, financing

Implementation

Skills, participation

**Evaluation/
Adjustment**

Learning, adaptive research

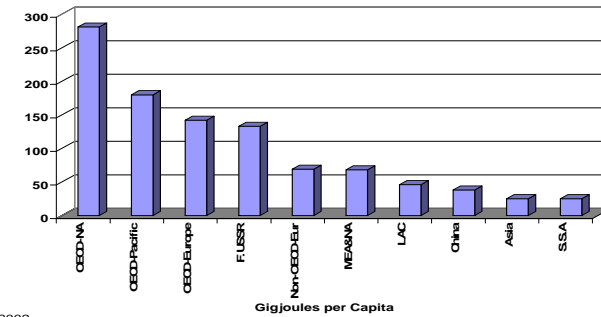
Repetition

Institutional capacity, financing, dissemination

African Energy Sector: Challenges

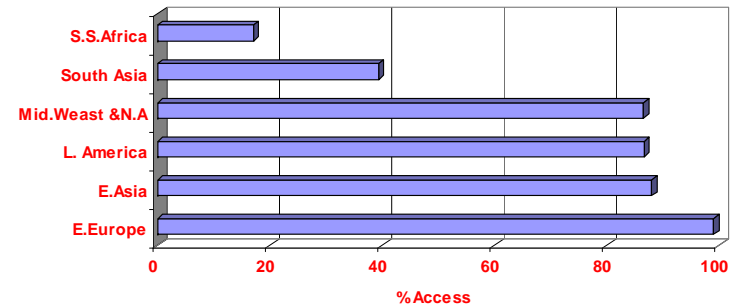
- Substantial increase needs to improve energy access
 - Abundant proven economic reserves
 - Search for technologies appropriate to local conditions
 - Search for financial investments
- Energy Infrastructure for viable energy sector
 - Weak national and regional institutional capacity
 - Inadequate human resource
 - Poor information and institutional base
- Energy RD&D
 - Poor integration between energy R&D agenda and development objectives
 - Inadequate interests in fossil fuels
- Linking global and local environmental issues
 - Search for trade-offs
 - Search for win-win solutions
 - Climate change related problems
- Energy security
 - Control outside interests
 - Inadequate regional systems
 - Linking to environmental security

Per Capita Energy use (commercial and Non-Commercial) by World Regions, 2000

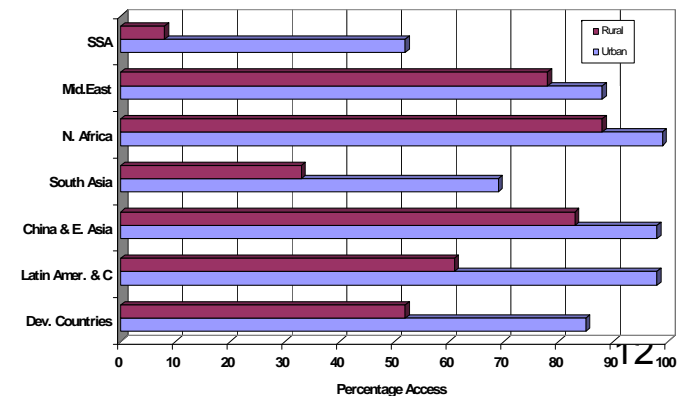


Source: IEA, 2002

Population with Access to Electricity in Developing Regions, 2000



Rural and Urban Access to Electricity in Developing Countries, 2002



AEEP TARGETS

- Providing energy access to additional 100 million Africans
- Doubling the capacity of cross border electricity interconnections
- Doubling of use of natural gas in Africa, as well as doubling African gas exports to Europe
- Building 10,000 MW of new Hydropower
- Building at least 5 000MW of wind power
- Building 500 MW of all forms of solar energy
- Tripling the capacity of other renewable energy
- Improving energy efficiency in Africa in all sectors

National System of Innovation (NIS)

- Almost none NIS in Africa
- Integration of capacity building, access to information and creating enabling environment
- Stimulate partnerships between all relevant private and public stakeholders, both domestically as well as internationally
- Provide focus for activities of MDB's and other international organisations
- Include wide variety of activities, such as training, strengthening educational institutions, assessment of information, identification of solutions for removing barriers, innovative financing mechanisms

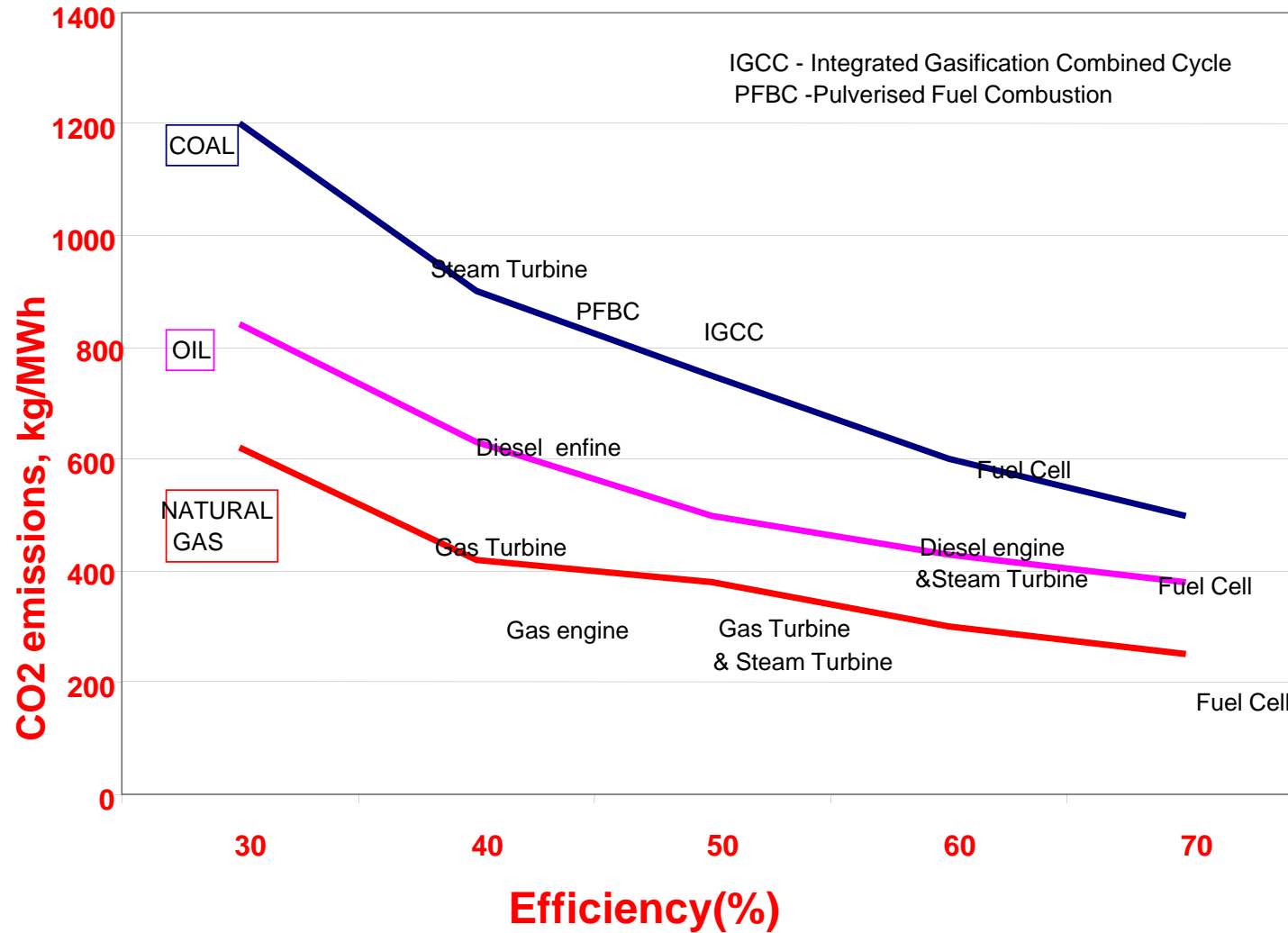
What areas should be the focus of capacity building and how should it be undertaken

- ***Human capacity***
 - technical, business, regulatory skills
 - include broad range of training in capacity building projects and ensure integration
- ***Organisational capacity***
 - strengthen networks of organisations, particularly assessment, management, financial, legal services
 - provide adequate communication infrastructure
 - promote private firms covering essential organisational services
 - encourage associations of professionals, private firms and consumers
 - use participatory approaches in policy making and project formulation and decentralise decision making where appropriate

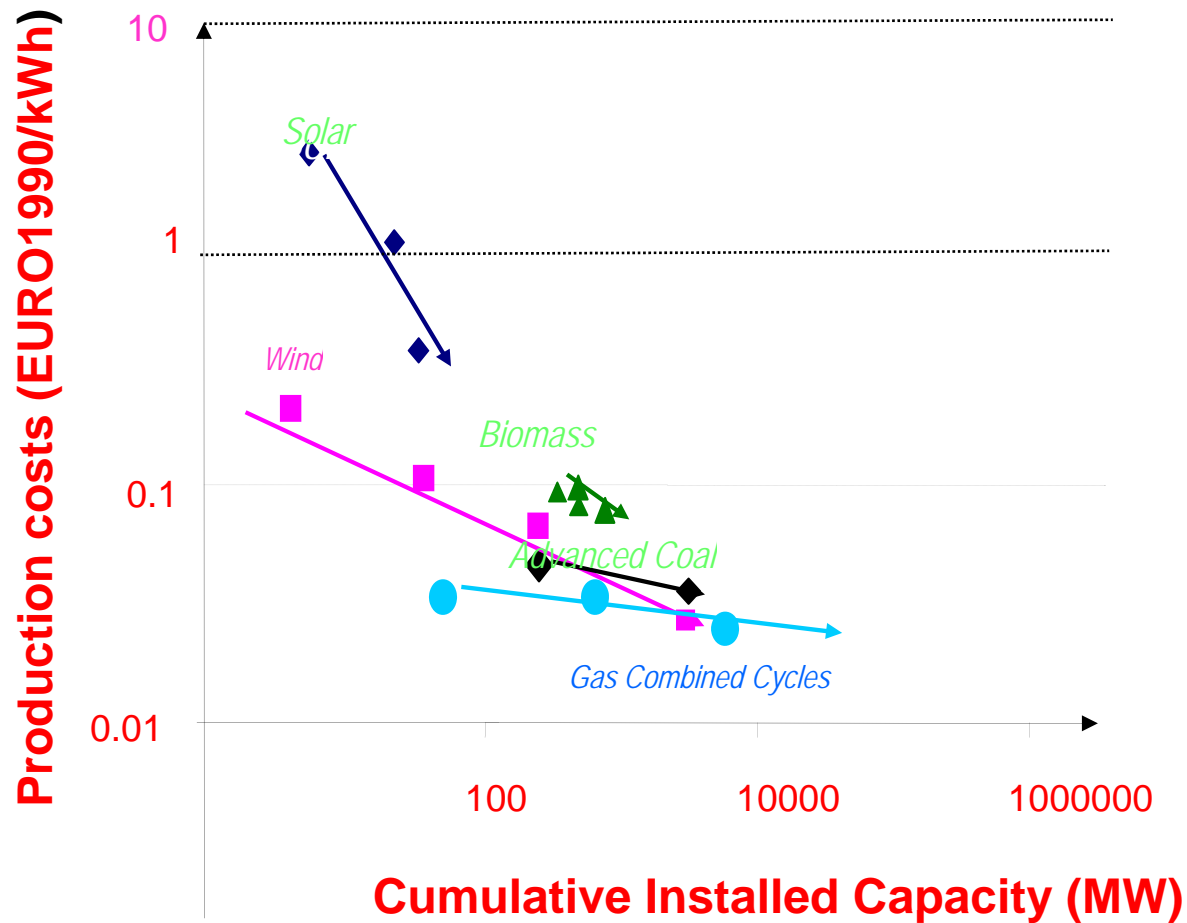
POSSIBLE NEW INITIATIVES

- Collaborative mechanisms for multilateral institutions
- Specific and targeted training
- Collection, organization and screening of information
- Technology assessment and demonstration
- Building technology partnerships
- Direct support for project preparation
- Support for market intermediaries
- Innovative financial mechanisms

Technology Opportunity II - Efficiency and CO2 Emissions Power Plants



Cost of electricity technologies are declining for both conventional and Renewable energy technologies



Electric technologies, EU 1980-1995, Source: IEA

Growing Interest in African Energy Resources

- **China**
 - China intends to rely on African countries for 30% of its imports
 - Operate in most countries but largest operation is Angola and Nigeria
 - Invest in both upstream and downstream projects (refineries, railways, industries)
- **India**
 - Started with investments in Sudan
 - Desire to expand operations
 - Interested in industrial and South-South relationships
- **Malaysia**
 - Operating in a few countries
 - Interested in several other industries (telecommunications/agriculture)
- **Russia**
 - Started discussions on nuclear development
 - Started linkages with natural gas development

Growing Interests in African oil and Gas

- Over 30-40 companies in the major oil and gas producing countries, all with diverse interest and geo-political positions
- One example is Mauritania off-shore oil and gas facility: production of 75,000 barrels per day and started in February 2006 by an Australian led consortium. A UK company is planning to export its gas as LNG
- Another example: Exxon Mobil invested \$12 billion in Central and West Africa since 2000 - Angola, Cameroon, Chad, Equatorial Guinea and Nigeria. Chevron plans to invest \$20 billion in Africa over the next 5 years.
- Another example is Sudan started with Petronas from Malaysia, then the Oil and Gas National Company (OGNC) from India, followed by China National Petroleum Corporation (CNPC). – interests is not only upstream but downstream as well. Asian companies are interested in both infrastructure and downstream development
- Another example In North Africa, Libya is the most attractive mainly due to the political improvements between Libya and western countries. BP of UK, Agip of Italy, Occidental Petroleum from USA and Nippon Petroleum and Mitibushi and other three firms from Japan. Asian companies have licenses for exploration.
- Managing the energy security interests of the more powerful nations and regions of the world is a major challenge. This poses a threat to African energy security.
- Balancing the interests between western European countries, India and China and USA may prove difficult.
- The case of Darfur in Sudan (USA-China) illustrates how energy can be at the centre of conflicts.

POSSIBLE GOVERNMENT ACTIONS

- Build human and institutional capacities
- Build Research and Development, and Demonstration centres
- Create enabling environment for private sector and community development
- Information provision to enhance access to ESTs.
- Technology transfer mechanisms and enhance financial mechanisms

Threats to Energy Security

- Environmental problems
 - Climate Change demands
 - Climate variability
- Conflicts and political instability
 - Darfur
 - Chad
- Management of resources from energy exports
 - Nigeria - poverty
 - Angola -inequalities

Droughts in Africa



Oil producing areas need development



Conclusions

- The interest in the energy resources are growing from most parts of the world, especially in oil and gas
- However, the sector has changed, largely triggered by recent activities of China and India.
- The challenge for African countries is to exploit these changes to develop their upstream and downstream ends of the oil and gas sector
- Energy cannot be developed without major state involvement.
- Cooperative arrangements in many areas will be needed, especially in human and institutional development. Optimal use should be made of existing national, regional and international networks
- Government should accelerate the development of the enabling environment for private sector effective participation
- Technology cooperation should be the cornerstone of the relationship with EU regarding energy development in Africa