GNESD
GLOBAL NETWORK ON ENERGY FOR SUSTAINABLE DEVELOPMENT
Facilitated by UNEP

UNEP

BIOENERGY STUDY THEME

Technical Synthesis Report

Prepared, in May 2011, by CENBIO/IEE, University of São Paulo (USP) and CentroClima/COPPE, FEDERAL University of Rio de Janeiro (UFRJ), Brazil (the Brazilian GNESD centers)

Authors: José Goldemberg[1], Emilio Lèbre La Rovere[2], Suani Teixeira Coelho[1], André Felipe Simões[2], Patricia Guardabassi[1], Renata Grisoli[1] and Manuel Moreno[1].

[1] Brazilian Reference Center on Biomass /University of São Paulo (Cenbio/USP).
[2] CentroClima/COPPE/UFRJ.

Table of Contents

I – Introduction

This is the Final Report on the Bioenergy Theme, a study developed by GNESD- the Global Network on Sustainable Development, created as a Type 2 Initiative in the World Summit of Johannesburg, in December 2002. The GNESD network (http://www.gnesd.org) includes Excellence Centres responsible for the production of several documents on energy access, renewable energy and energy efficiency, aiming to alleviate poverty in developing countries.

The Inception Reports, received in the First Phase of the study, highlighted that in most DCs only “traditional biomass” resources are available, wood and charcoal (often obtained through deforestation) are primarily used for basic energy needs such as inefficient cooking and heating. Modern bioenergy (such as liquid biofuels, solid biomass, and biogas for electricity production,) is forseen as a possible future energy supply and important step in alleviation of poverty. When produced sustainably, modern bioenergy has the potential to not only reduce oil import expenditures but also generate jobs in rural areas.

The previous Synthesis Report, based on the main findings of the GNESD centres, presented and discussed the current situation in *Argentina*, *Brazil*, *Chile*, *China*, *Colombia*, *Ghana*, *India*, *Indonesia*, *Kenya*, *Malawi*, *Mali*, *Paraguay*, *Senegal*, *South Africa*, Thailand and *Uruguay*. These initial reports, drafted by GNESD centres, were revised by CENBIO-CENTROCLIMA as well as external reviewers to produce a final version.

This Final Report presents a broader overview of the results obtained by the centres, including a table (Annex I) summarising the current situation in DCs, prospects for biomass and the policies proposed in each country.

II - The GNESD Bioenergy Study

It is widely known that the majority of developing countries' populations rely on 'traditional biomass' availability. The development of sustainably produced modern bioenergy resources is foreseen by most local governments to provide a more efficient energy supply as well as alleviation of poverty.

In this context, the GNESD Bioenergy Theme study analyses not only the current situation of bioenergy production and use, but also prospects for modern bioenergy in the previously mentioned countries.

III - Findings of the Centers in Asia

III.1 Asian Institute of Technology (AIT)

III.1.1 Indonesia

Production and use of bioenergy

There is vast potential to implement biomass power generation and cogeneration projects in Indonesia, particularly using currently untapped resources of agro-industrial residues. Considering the geographical context of isolated islands and regions, it is appropriate to pursue options for provision of basic energy needs through renewable energy.

The estimated potential for biomass energy generation is 50,000 MW, but present capacity of installed biomass projects is around 445 MW. Most biomass energy is used in households for rice milling, drying of agricultural produce and power generation in the wood and sugar industries. Traditional biomass fuels are used through direct burning, while modern biomass energy is obtained through process technologies such as pyrolisis and gasification.

The abundance raw material makes the development of biofuels an important alternative for Indonesia. As a well-established industry with potential for increased production, crude palm oil (CPO) is the main biodiesel feedstock. The production of biodiesel in 2008 was 1,238 million liters and the existing capacity of biodiesel production was only 0.01% of the estimated potential from palm oil (Food and Agricultural Organization, 2007). Other potential biodiesel feed stocks in Indonesia include coconut oil and *jatropha*. Currently, ethanol in Indonesia is mainly produced from sugarcane molasses and cassava. 144.5 million litres of bioethanol were produced in 2008, significantly below the installed capacity of 270.5 million litres/year (August 2009).

Existing policies

Biomass is one of renewable energy that has potential to substitute petroleum-based fuels. The government has issued policies to increase the utilization including mandatory targets and incentives to promote biomass energy projects. The government has set targets for achieving the share of new and renewable energy up to 17% by the year 2025. At the same time, the government also plans to reduce the share of oil in national primary energy mix to less than 20%. In order to achieve these goals, the Regulation No. 32/2008 of Ministry of Energy and Mineral Resources has mandate the minimum blending of biofuel for biodiesel and bioethanol for different sectors. In 2007, the government announced an interest rate subsidy for farmers growing biofuels crops including *jatropha*, oil palm, cassava and sugar cane. Loans at an interest rate of almost half of the market rate can be obtained for the farmers of cane, cassava, palm, rubber and coconut (APEC, 2009).

However, the implementation is still facing challenges such as its high production cost compared with the conventional and inefficient pricing policies. Clear price signals could also encourage the private sector participation in investing on bio-energy projects. The government needs to provide innovative financial mechanism to support biomass energy projects and to take actions for minimizing huge social and environmental impacts. Indonesia could introduce Renewable Portfolio Standard (RPS) to increase the share of renewable in the power generation sector.

Environmental and social impacts

Biofuel production in Indonesia, to date, has diverted minimum amounts of food commodities to fuel domestically due to low production levels. However, the government's biofuel regulations will result in escalating amounts of palm oil, sugar and cassava being diverted to biofuel production. These are all important crops for staple foods in Indonesia. Palm oil is used for cooking and in food processing. It can represent a major food expense also for households that grow their own food but must buy oil for cooking it. The average per-person domestic consumption of palm oil for food is approximately 16 kg per person per year. Despite being a net exporter of palm oil, Indonesian consumers are vulnerable to price rises and shortages. The government hopes that *jathorpha curcus* will be suitable for cultivation on marginal land that is unsuitable for food production. Sumba is one of the areas selected to expand *jatropha* cultivation.

There is evidence that forests in Indonesia have been, and continue to be, converted to palm oil plantations. A total of 0.22 million km^2 of forest land was allocated for conversion to oil-palm plantations until 2007 but only 0.02 million km^2 were actually planted with oil-palm. The remainder had been logged and abandoned (Dillon, et. al.,2008). It must be acknowledged that this is a controversial issue, and other views are also found in the scientific literature, such as, for example, Wicke et al, 2008, who claim that "for Indonesia, it was found that there are many, interrelated causes and underlying drivers that are responsible for this land use change – LUC - (…). Oil palm alone cannot explain the large loss in forest cover but that rather a web of interrelated direct causes (including oil palm production expansion) and underlying drivers are responsible. Important direct causes were (…) logging, oil palm expansion and other agricultural production and forest fires, while underlying drivers were found to be population growth, agriculture and forestry prices, economic growth and policy and institutional factors".

It must be acknowledged that this is a controversial issue, and other views are also found in the scientific literature, such as, for example, Wicke et al, 2008, who claim that "for Indonesia, it was found that there are many, interrelated causes and underlying drivers that are responsible for this land use change. Oil palm alone cannot explain the large loss in forest cover but that rather a web of interrelated direct causes (including oil palm production expansion) and underlying drivers are responsible. Important direct causes were logging, oil palm expansion and other agricultural production and forest fires, while underlying drivers were found to be population growth, agriculture and forestry prices, economic growth and policy and institutional factors."

III.1.2 Thailand

Production and use of bioenergy

Even though Thailand relies heavily on imported energy, the energy security of the country has been maintained through diverse sources and types of energy. Fossil fuels still play a major role, particularly petroleum based products and natural gas. Thailand's alternative energy sources include biomass from crop residues (taking advantage of their massive agricultural base) as well as municipal solid waste, etc.

Biomass, which has been mostly used as fuel in rural households and industries, is now playing a greater role as fuel in power generation and as an energy source for bio-liquid fuel production for vehicles. Most of the renewable energy types have proved to be environmentally friendly. Therefore, promotion of renewable energy technology research and development is considered to be of great importance and will continue to be supported by the government.

Thailand's Ministry of Energy estimates that the potential of biomass-based power generation from biomass residues, municipal solid wastes and biogas is 3,700 MW by 2011. Apart from bagasse, paddy husk and woodchips, other sources with good potential include municipal waste, biogas from pig farms and other agro-industry sources, corncobs and waste from palm oil factories. Thailand is committed to exploring a range of cost-effective alternative energy sources. The number of biomass-based power generation plants increased from 35 plants in 2006, with total capacity of about 574 MW, to 54 plants with total capacity of 1,129.75 MW in 2007. These plants use only 5% of the residue potential.

Existing policies

Policies allowing the trading of carbon credits through a Clean Development Mechanism (CDM) were approved in early 2007. This has given an enormous boost to a number of marginal projects, especially biogas and municipal wastes.

The Thai Government has established an objective to increase the renewable energy use from a level of 0.5% in 2002 to 8% of total primary energy mix, (approximately 6,600 ktoe), by the year 2011. In reaching this target for renewable energy, biomass-based energy is expected to provide a share of 60% surplus. In the second phase (2011-2022) of the renewable energy development plan, the Thai government's targets aim for increasing the 8% in 2011 up to a contribution of 20% of total primary energy supply to the total energy demand from all renewable energy in 2022. The key factors for the successful promotion of bio-energy programs of Thailand's economy are: prioritising renewable energy in the national energy policy, establishing authorised government institutions to promote and implement renewable energy policy and actions, and continuous and strong support from the government and other financing schemes- such as Board of Investment (BOI) incentives, Revolving Fund, Adder Cost, etc. as well as government provided infrastructure for the renewable energy expansion, regular policy review and long-term research, development, demonstration, dissemination and public relation activities.

Environmental and social impacts

The Thai government announced that new plantations for crop expansions will be created in disused rice fields, deserted public lands, flood-prone lands, acid and degraded lands in the South and the Eastern Seaboard. However, new palm crop replacement programs are already changing agricultural patterns. In most cases, forests have become victims of encroachers paving the way for palm plantations. The other major challenge could be the shortage of palm oil for cooking purposes. Palm oil is a popular cooking ingredient in Thailand. In the absence of policies for plantation planning to address palm oil requirements for cooking, it may drive up prices of the food commodity while reducing costly energy imports.

III.2 The Energy and Resources Institute (TERI)

III.2.1 India

Production and use of bioenergy

India's energy demand is expected to increase three to four times from the current level in the next 25 years. Non-commercial energy sources, predominantly fuel wood, chips and dung cakes, currently contribute around 30% of the total primary energy consumed in the country. With huge urban-rural disparities in terms of access to commercial energy forms such as grid electricity and LPG, bioenergy (energy from bio-resources) has an important role to play, not only contributing to meet the supply of future demand, but also to reduce the existing energy access inequity.

Since biomass is a resource more equitably distributed than other energy sources in India, it addresses energy security concerns for a country already dependent on energy imports, especially because it can be locally procured. Currently, bioenergy contributes to nearly 90% of energy used in rural households and around 40% of energy used in urban households..

The rural energy scenario in India is characterized by inadequate, poor and unreliable supply of energy services and large dependence on traditional biomass fuels. The traditional use of biomass as energy in India is characterized by low efficiency and environmental degradation. Currently, the new perspective considers biomass as a competitive energy resource, which can be pulled through energy markets. This change in perspective coincided with the development of several advanced biomass technologies. As a result, the policy of the Ministry of New and Renewable Energy (MNRE) shifted towards market based incentives and institutional support, leading to the introduction of modern biomass technologies such as bagasse-based cogeneration and large-scale gasification and combustion technologies for electricity generation using a variety of biomass.

Use of bioenergy for power generation, either through combustion or gasification, has been widely applied. However, the efficiency of these technologies has been relatively low and thus there is a need for dedicated research and development for creating more efficient technologies for power generation from bioenergy.

Life cycle analysis of modern bioenergy technologies (BETs) are reported to, in some cases, outperform, in economic terms, conventional fossil fuel based technologies for power generation. The existence of an economic advantage is based on the production costs of bioenergy production, which can vary widely depending feedstock, conversion process, scale of production and region. However, in most cases, the upfront cost of BETs is higher than for conventional technologies, thereby creating a practical barrier to their adoption. Suitable micro-finance mechanism would result in higher penetration of these technologies into economically under-privileged communities of rural areas in an economically sustainable manner.

Existing policies

In India, at policy level, a multi-pronged strategy for leveraging bioenergy for poverty alleviation and rural development was adopted: i) improving efficiency of the traditional biomass use (e.g. improved cook-stove programme), ii) improving the supply of biomass (e.g. social forestry, wasteland development), iii) technologies for improving the quality of biomass use (e.g. biogas, improved cook-stoves), iv) introduction of biomass based technologies for heat and electricity generation to deliver services provided by conventional energy sources, and v) establishing institutional support for programme formulation and implementation (formation of separate government wing to exclusively deal with non-conventional energy sources).

In September 2008, the Government of India adopted a National Biofuel Policy that aims to substitute 5% of transport diesel (fossil fuel) with biodiesel by 2012, 10% by 2017 and 20% beyond 2017, thereby establishing demand-side incentives in the form of an assured market for blending, apart from scrapping taxes and duties on biodiesel. The Renewable Energy Technology (RET) program received the required support with the establishment of the Department of Non-Conventional Energy Sources, which emphasised decentralised and direct use of RETs.

Renewable energy resources were viewed primarily as the solution to rural and remote area energy needs, in locations and applications where the conventional technology was unavailable or as stop gap supply options where commercial energy could not be supplied.

Direct subsidy to the user and supply orientation were the major elements of the RET program. Though the RET program achievements are noteworthy in India, two deficiencies from a policy perspectives contributed to the slow progress in the penetration of biomass technology. Firstly, biomass was viewed solely as a traditional fuel for meeting rural energy needs. Secondly, policies were primarily focused on the supply-side push with market instruments having small roles. Under these circumstances, modern plantation practices for augmenting biomass supply or the growing pool of advanced biomass energy conversion technologies could not penetrate the Indian energy market.

III.3. ERI

III.3.1. China

Production and use of bioenergy

China is an agricultural country, with a large part of the population living in rural areas. Bioenergy resources are scattered regionally, mainly located in rural areas. The country has an unbalanced development of the rural economy. On one hand, farmers from economically developed areas use cleaner energy, liquefied gas and other energy commodities, even allowing surplus straw to burn in fields, resulting in serious environmental pollution. On the other hand, in remote areas, even the basic livelihood of some farmers cannot be guaranteed; there are still seven million rural households without electricity supply. Straw, firewood and other types of bioenergy have always been their main source of fuel. Traditional use of biomass through direct combustion still accounts for about 98 per cent of total bioenergy in the rural areas, resulting in serious waste of resources and environmental pollution. In addition, 80% of large-scale livestock and poultry farms in rural areas lack the necessary pollution control facilities. The livestock and poultry manure are directly discharged without treatment, causes serious pollution of air and water, endangering the health of farmers.

Producing bioenergy through different biomass conversion technologies could provide various types of high-grade, high-quality and low-polluting energy products to meet the pressing demand of energy in rural areas, and also improve biomass thermal efficiency to 35~40%. Further benefits include saving resources, improving the living conditions of farmers and improving the standard of living.

China will develop bioenergy in a wide range of forms, hopefully focusing on biofuel for transport in the long term. Biopower in China will be locally-oriented in small-scale biopower facilities through Combined Heating and Power (CHP) cogeneration; biofuels will be ethanol and biodiesel from non-food feedstock, mainly cassava, sweet sorghum and *jatropha* in near term, but from cellulose from crops such as straw in the long term. Biogas, pellets and biomass gasification will play an important role in providing heating fuel.

Recent research shows that the total amount of straw biomass in China is more than 720 Mt per year, equal to 360 Mtoe (million tones of oil equivalent). Excluding uses such as returning straw to the field, livestock feed, and raw materials for papermaking and construction material, 300 Mt of crop straw are available for energy purposes. The annual production of firewood is 127 Mt (equalling 74 Mtoe), the annual production of livestock waste is 130 Mtoe and the annual production of municipal solid waste is 120 Mtoe, a figure that continues to increase by 8-10% per year. It is estimated that the total amount of exploitable biomass resources of China is about 700 Mtoe.

In overview, newly built biomass power generation projects are based mainly on the direct combustion of crop stalks, but also explore the construction of straw-pulverizing coal combustion power generation and thermoelectric cogeneration projects. China has also made notable progress in the development of biomass power generation equipment. In 2006, a straw-based direct combustion power generation project was put into operation in the city of Suqian, Jiangsu province, realising the first project to use domestic technology and equipment with full autonomy of property rights.

At present, biofuel technology using cassava, sweet sorghum, *jatropha curcas*, and other non-food crops/plants have reached the demonstration stage. In 2007, Guangxi constructed the first ethanol fuel plant using cassava as feedstock. Some companies have also been building and improving pilot power plants for cellulosic ethanol. Biodiesel is basically ready for industrialisation. According to rough estimates, only a small group of enterprises can continuously produce biodiesel, with a total annual output of hundreds of thousands of tonnes. Quite recently, the National Development and Reform Commission has organised and supported a few enterprises to build pilot biodiesel plants using *jatropha* oil.

Existing policies

From 2006, the implementation of “Renewable Energy Law” enhanced the confidence of corporate investors and significantly accelerated the pace of biopower development. With the “Renewable Energy Law”, related renewable energy price subsidy policies were promulgated and implemented. The new biomass power generation projects will enjoy price subsidies of 0.25 Yuan/kWh for 15 years. Inspired by this policy, investors’ enthusiasm is rising, and various types of agriculture, forestry and waste-based power generation projects have been constructed. According to statistics, 39 straw-based biopower projects were approved in 2006, with a total installed capacity of about 1.28 GW. By the end of 2008, the total capacity of biopower projects amounted to 3.15 GW, with biogas and waste incineration power generation accounting for 22.5% and the rest comprised of sugarcane bagasse and straw based power plants.

China encourages well designed and operated biopower projects that meet local characteristics of biomass resources. Since July 2010 new grid-connected biopower projects in the countryside, using agricultural and forestry residues, have become eligible for the same fixed feed-in tariff (FIT) of 0.75 RMB/kWh for 15 years from the start of operations. However, co-fired generation plants using more than 20% of traditional fuels (such as coal) are deemed as traditional power plants rather than biopower plants, and thus ineligible for the FIT.

Policy recommendations

To develop bioenergy in China, the following policies are necessary:

- Firstly, to carry out assessments of resources. Resource evaluation is the basic condition for developing a biomass energy industry.

- Secondly, to establish adequate legislation and policies for biomass energy development. Based on the Renewable Energy Law, China can formulate relevant laws and policies to support the biomass energy development and implement economic encouragement. Furthermore, establishing a standard biomass energy system is very important.

- Thirdly, to accelerate the development, dissemination, and application of biomass conversion technologies. To increase support for the basic study and understanding of biomass technologies, independent intellectual property rights need to be established to accelerate the development of new energy technologies. Summarising the experiences and lessons learned, is also important in order to steadily promote a healthy development of the biomass energy industry.

In brief, the biofuel industry in China, in the future, should accomplish the following strategic tasks:

(1) Transform the mix of feedstock and consolidate a resource base. The resource base should be consolidated through a transition from reliance on edible food feedstock to a variety of agricultural raw materials such as non-food materials in order to avoid threats to food security and to expand feedstock input structure.

(2) Optimise the structure of product mix to improve economic efficiency by developing and integrating related technologies, expanding the industrial chain and improving a comprehensive use of resource, producing high added-value by products and new products according to the particular characteristics of the non-food feedstock.

(3) Restructure the industrial organisation chain to improve industrial efficiency.

(4) Reconsider the concept of industrial development to ensure sustainable development.

(5) Establish a sound industrial policy system to promote the healthy development of industry. It is urgent for the government to establish a sound policy system suitable to characteristics of non-grain liquid biofuel industry by formulating and implementing a series of incentive policies, clear regulations and effective mechanisms in line with the technological and industrialisation progress, feedstock and products mix, characteristic of industrial organisation and concept of sustainable biofuel, so as to ensure the construction of pilot projects and scale-up development of biofuels in China.

IV - Findings of the Centres in Africa

IV.1 Energy Environment and Development Network for Africa (AFREPREN/FWD)

IV.1.1 Kenya

Production and use of bioenergy

Kenya is relatively well endowed with biomass resources. In summary there are three main potential sources for modern bioenergy in Kenya, namely: use of natural occurring biomass such as wood from trees and other plants to produce modern energy, conversion of biomass waste from processes of agro-industries into modern energy and commercially grown crops solely grown for modern energy production.

Kenya has significant potential for bioenergy development for both liquid biofuel as well as for electricity generation. At the household level, there is a high potential for biogas production. The technical potential is estimated to be 1,259,000 units, but the number of installed biogas digesters is about 500 (Karekezi and Kithyoma, 2005). After recent world records of oil prices and crippling electricity generation shortfalls, Kenya joined many other Sub-Saharan African countries in encouraging bioenergy development. Most of the existing aforementioned biofuel initiatives are driven by non-Governmental Organizations. With about 80% of the country's land mass considered arid or semi-arid land, there is significant interest in the development of *jatropha curcas* – a plant that is said to do well in marginal land and can produce biodiesel as a cleaner substitute to crude oil-based diesel.

The most advanced modern bioenergy sub-sector in Kenya is the conversion of biomass waste from agro-industries into commercial energy. The aforementioned experience is, presently, mainly found in the sugar industry where sugar factories use bagasse through cogeneration, for internal use and sale of excess power to the national grid. Therefore, the best opportunities for Kenya in bioenergy area are related with cogeneration. In such context, it's opportune to highlight that the expansion of cogeneration in Kenya has important income generation implications, especially for smallholder sugarcane farmers. Also, minimising the negative impacts of cogeneration development on society is an important part of sustainable development. Cogeneration development has several positive impacts on rural communities where sugarcane is grown. For example, it does not impact existing settlements and therefore does not lead to the displacement of communities.

Only 18% of Kenya's population has access to grid electricity. In the rural areas, grid electricity access levels are a paltry 5% compared to 51% in urban areas. Cogeneration in rural-based agro-industries could potentially assist in widening rural access to electricity. The relatively high population growth rate of Kenya coupled with increasing demand from the industrial and commercial sectors has contributed to a narrowing reserve margin in electricity supply. Bioenergy-based power generation is seen to have an important role to play in filling the aforementioned supply gap. Already, cogeneration in the sugar industry is contributing around 26 MW (from one sugar factory) with 10 other proposals for developing biomass-based cogeneration submitted to the Ministry of Energy for the generation of about 270 MW - equivalent to over 20% of the current national installed capacity.

"Cogen for Africa" it is a project funded by UNEP (*United Nations Environment Programme*), GEF (Global Environment Facility) and AfDB (African Development Bank). The overall objective of the project is to help transform the cogeneration industry in Eastern and Southern Africa into a profitable cogeneration market, as well as to promote widespread implementation of more efficient cogeneration systems, by removing barriers to their application, including adequate capacity building. The Project now is under the phase of Mid Term Review by a team of consultants that evaluated the status and progress, as well as made proposals and recommendations for the remaining phase of the project.

Perhaps the most important economic consideration for cogeneration development is the fact that the sugar business on its own cannot sustain sugar factories in Kenya after 2012 when the sugar market in the Common Market for Eastern and Southern Africa region will be liberalised. The survival of sugar factories in Kenya post-2012 depends, to a large extent, on cogeneration development.

Existing policies

Kenya has not yet developed dedicated policies with important implications for bioenergy development or cogeneration. While a National Biofuels Committee was established in 2006 with the objective of coordinating stakeholders, the Committee has been focusing on developing a biodiesel strategy using *jatropha curcas*. The legal and regulatory framework of the existing policy supporting cogeneration development is embodied in the following documents:

- Sessional Paper No.4 of 2004 on Energy
- Energy Act of 2006
- Feed-in Tariff Policy for Renewable Energy

Existing barriers

Several barriers appear to be in the way of the country to fully realise its cogeneration potential. Flexible Feed in tariff, non-enforceable legal and regulatory instruments, lack of technical expertise, unavailable local financing, low confidence among small farmers and protracted sale of state – owned sugar factories are among the possible barriers to be mentioned. In order to realise the full potential of cogeneration in Kenya, the following policy recommendations are proposed: institution of pre-determined feed-in tariffs for bioenergy power plants, high-pressure technology and skills transfer (capacity building), innovative financing, innovative revenue-sharing mechanisms and sustainable bioenergy feedstock development

IV.2. ENDA - Energy, Environment, Development

The case studies analysed in this section have shown the abundant bioenergy resources that can be harnessed in West Africa to provide much needed modern energy services in rural areas in order to catalyse development. Unfortunately, this potential remains largely untapped while current uses of bioenergy resources endanger both the local and/or global environment as well as aggravating poverty in rural households.

Biomass accounts for the bulk of most West African countries total national energy supply. Reliance on traditional biomass energy is particularly high and accounts for 70-90% of the primary energy supply and up to 95% of total household consumption in some countries. Traditional biomass is considered to be free energy and represents the main energy source for the poor, especially in rural and peri-urban areas. Even oil producing countries in West Africa continue to rely on traditional biomass energy to meet the major proportion of their household energy requirements (cooking and heating). In Nigeria, it is estimated that traditional fuel use accounts for about 82.3% of total energy use.

The global energy balance of the eight countries comprising the West African Economic Monetary Union (*Union Economique et Monétaire Ouest Africaine* - UEMOA), Benin, Burkina Faso, Ivory Coast, Guinea Bissau, Mali, Niger, Senegal and Togo, provides eloquent evidence that traditional energy, biomass in particular, plays a critical role in the total energy consumption, around 80%. The average in the 15 ECOWAS countries totalled 82%, while the share of hydrocarbons and electricity remains quite low (15% and 5%, respectively). Given the low penetration of efficient and modern biomass use, there are questions as to whether the heavy reliance on biomass energy in West Africa could change in the near future.

Biomass is a key sector in West Africa with economic, environmental and social dimensions. However, a review of the Policy Framework leads to the conclusion that in most countries there is no specific policy outline for bioenergy. It is included as a sub-sector of the general Energy Policy/Strategy or in the Renewable Energy Policy/Strategies. Conventional sources of energy remain a priority.

Although the agriculture, forestry, environment and energy sectors are inter-related, their respective sector policies have been developed largely in isolation with little or no cross-sectorial collaboration. It is undeniable that these sectors need to be harmonised if modern bioenergy is to play an effective role as a tool for poverty reduction and rural development. Lack of consultations and coordination will compromise the ability of each of the sectors to achieve their respective policy objectives.

Since Africa seems to offer a good environment in terms of available land, cheap labour and favourable climate, private businesses (mainly foreign companies) are investing in the production of biofuels in many countries. Unfortunately, policy and regulation frameworks are not established to monitor these emerging private initiatives that appear to focus on exports.

Jatropha plantations for biodiesel production have recently attracted special interest in West Africa given that it is believed this plant does not require high quality land and rain. Thus, it does not seem to pose any competition for land and water uses, nor does it impinge on food security. Despite the observed craze for *jatropha*, commercial production of biodiesel from this tree has not started at a large scale. One of the private companies in Ghana has recently named themselves as the first company in Ghana and West Africa to commence the commercial production of biodiesel. It has declared 10 metric tons of biodiesel are produced from 650 hectares *jatropha* plantation.

The major barriers identified from the analysis of bioenergy development in the three selected countries can be summarised below:

- Absence of a comprehensive national bioenergy policy;
- Absence of coherence between sectoral policies that involve bioenergy;
- Lack of incentive mechanisms including appropriate financing schemes;
- Relatively high cost of bioenergy;
- Absence of high quality planting materials and feedstock;
- Feedstock availability;
- Lack of skilled work force and project management capacities at a local level.

For solid biomass, barriers are particularly related to:

- Difficulty for private companies to participate in structuring investments in forest resources assessment;
- Financial profitability and market penetration of improved cooking devices;
- Lack of technical knowledge of planting and cutting techniques

IV.2.1. Senegal

The major source of energy in Senegal is biomass, meeting almost 60% of the countries' final energy; a far greater percentage than other contributors such as petroleum products accounting for 37%, electricity being 5% and agricultural residues 1%.

The main forms of biomass are wood and charcoal used for cooking purposes. The minimum quantity used in the country is 50,000 tonnes of charcoal mainly in urban areas. In rural areas, firewood is the main source of energy. This consumption is difficult to estimate because of uncontrolled side-forest populations that according to the Forestry Code can benefit from the right of use. Contrary to charcoal, firewood is not submitted as a formal quota.

The case of solid biomass in Senegal shows the potential and challenges of a sustainable and improved production of forest based bioenergy. Community based and participative management of forest resources have been implemented with a market oriented approach to ensure community revenue generation, an efficient production of charcoal and improved cooking devices from sustainable collection of fuel wood.

Existing policies

The promotion of biofuels as a substitute for petroleum products is a major option that the Government has taken to reduce the country's energy dependence. The political will for the promotion of biofuels was emphasised in July 2006 when the President held a meeting of non-oil producing African countries that led to the creation of the Association of Non-Oil Producing African Countries (APANPP).

The action plan adopted by the APANPP envisages the development of biofuel use by the establishment of common strategies combining the setting up of a legislative and regulatory regime, the application of incentives and funding mechanisms.

In Senegal, a National *Jatropha* Plantation Programme (NJP) was launched in 2006 with the aim of planting 320,000 ha nationwide from 2007 to 2012. However, the responsibility for the institutional framework and management of agro-fuels moves between the Agriculture and Energy Department, and also the Ministry of “Pisciculture”, making it very hard for the NJP to keep on track and achieve objectives outlined in 2006. Privately, *jatropha* plantation initiatives are progressing on a decentralised basis without a proper national coordination. However, the biodiesel industry does not seem to emerge in the country. A mapping project has been initiated by ENDA’s energy programme to understand the location and purpose of these plantations.

Bioethanol production has also been addresed with the installation of a processing plant in the Senegalese Sugar Company (CSS). The company produces approximately 35,000 tonnes of molasses with strong sugar content. The ethanol plant can transform the molasses into 2,500 m^3 of industrial ethanol and 10,000 (metric) tones (12,500 m^3) of anhydrous ethanol as biofuels.

IV.2.2. Ghana

Production and use of bioenergy

Annual fuel wood production is estimated to be 18 million tonnes; wood can be converted into modern energy carriers using available technologies rather than their current use as fuel wood or charcoal. Ghana also has vast areas of degraded lands that can be reforested or used to produce short-rotation energy crops.

Despite the huge potential of agro-fuels and municipal waste as feedstock for the production of modern bioenergy, these resources remain untapped. For example, less than 2% of households in Ghana use crop residues for cooking with the majority of agricultural residues being left to decompose in the farms.

An estimated 2.7 million hectares of land are either alredy under cultivation or have been allocated for *jatropha* cultivation, representing 11% of total land area and 19% of total agriculture land.

In addition to bioenergy from *jatropha curcas*, other bioenergy forms have emerged in West Africa. These include other crop conversions, such as sunflower, cassava, cashew fruit, etc, and even waste-to-energy (biomethanisation).

The case studies analysed in this report cover *jatropha* plantations initiatives (in Mali and Ghana) and a Waste-to-Energy for power generation (in Ghana). The latter confirms the potential of biomethanisation (biogas) for community electrification. Effluents of agro-processing palm oil mills promises to be a viable and cost-effective option for waste-to-energy biomethanisation, providing rural energy, process fuel and organic fertiliser as well as contributing to GHGs emissions reduction. Feasibility studies conducted for the “Facilitating the Provision of Sustainable Energy and Environment for Development”, a 3.5 million Euro project soon to commence, has confirmed the benefits of the biomethanisation technology are enormous. This includes generation and provision of 126 kW of clean electricity to three rural communities, 1.95 million m3 of biogas per annum (equivalent of 1,000 metric tons of diesel) as process fuel to replace diesel, 2,000 metric tones of organic fertilizer for agricultural purposes and other value-added products and services.

Existing policies

In Ghana, a National *Jatropha* Plantation Initiative (NJPI) was introduced in 2006 with the ultimate target of developing up to one million hectares of *jatropha* plantations on available idle and degraded lands in the next five to six years. Private initiatives have also evolved recently and over 20 companies (mostly foreign owned) are cultivating large tracts of *jatropha* plantations all over Ghana. This rapid development is taking place without the creation of policy and regulation frameworks for a bioenergy industry and the existing forest and agricultural policies do not cover the bioenergy sector.

Environmental and social impacts

Evidence does not indicate that the bioenergy industry poses an immediate threat to food security in Ghana. This conclusion is based on two reasons: 1) that the industry is not at present focusing on feedstock from food crops, and 2) that only 51% of total land area suitable for agriculture is currently under cultivation. Even so, it is still possible that location-specific challenges to food security in Ghana exist and will develop. For example, in cases where individual subsistence farmers are deprived of their farmlands and sources of livelihood, there is a need to implement more stringent and well-regulated land acquisition processes.

Ghana currently has enough unused land as well as degraded lands that can be used to cultivate *jatropha* and other feedstock. However, the indiscriminate acquisition of land – usually through bilateral negotiations involving traditional rulers and/or individual farmers and foreign companies and their Ghana counterparts could create landlessness and food shortage in some rural areas. Land acquisition for large *jatropha* plantations and their ecological and environmental consequences must be investigated and dealt with.

IV.2.3. Mali

Production and use of bioenergy

Bio-energy is currently the major source of energy in Mali. The share of bioenergy in the country energy balance is around 70%; however, the traditional use of burning wood, charcoal, residues, etc. is not efficient. Furthermore, the potential of agricultural waste as an energy source is insufficiently exploited.

Jatropha plants, as naturally growing sources of bioenergy are widespread and well known among farmers in all of Mali**.** Interest in *jatropha* has been present for some decades. Recently, emphasis has been directed toward piloting rural electrification from *jatropha*-based oil. A unique *jatropha* oil project was implemented in the *Garalo* village to provide electricity to 250 subscribers with potential for more than 10 000 inhabitants, including social services and incomes and local businesses. Mali intends to replicate the Garalo experience to a wider scale to support its efforts towards rural electrification.

Existing policies

The National Strategy for the Development of Biofuels defines the regulatory framework for bioenergy in Mali. The National Agency for Bioenergy (BIOCARMALI) has recently been created and will operate these policies and strategies. The *National Energy Policy* of Mali adopted by the government in 2006 presents a framework for all programs in the field of energy. Other relevant policy fields are taken into consideration, i.e. economic reforms and industrialisation policies such as the National Strategy for Poverty Reduction (CSLP), environmental protection, decentralisation strategies, the Development and Education Program and Sanitation and Social Program. Its global objective consists of strengthening the sustainable development of the country by providing widely accessible energy services and simultaneously encouraging socio-economic investments.

In the Agriculture sector, the new agriculture legislation in Mali includes specific consideration for energy production from Agricultural crops. The "*Loi d'orientation agricole*" (Agricultural Orientation Law), recently adopted, focuses on biofuel production to meet rural energy needs.

The ethanol production from sugarcane plantations has led to employment among surrounding communities. When plans for expanding the plantations are undertaken it is important that smallholders are not locked out of the benefits and plantations do not encroach on their land. Smallholders and plantations are now growing *jatropha* trees as feedstock for biodiesel.

IV.2.4. Common findings from West Africa countries

Biomass is a key sector in West Africa with economic, environmental and social dimensions. However, the review of Policy Frameworks leads to the conclusion that in most countries, there is no specific policy outline for bioenergy, it is mostly included as a sub-sector in the general Energy or Renewable Energy Policy/Strategy. Conventional sources of energy remain the priority of energy policies.

Although agriculture, forestry, environment and energy sectors are inter-related, respective sector policies have been developed largely in isolation with little or no cross-sectorial collaboration. It is undeniable that government involvement in these sectors should be harmonised if modern bioenergy is to play an effective role for poverty reduction and rural development. Lack of consultations and coordination will compromise the ability of each of the sectors to achieve their respective policy objectives.

Since Africa seems to offer a good environment in terms of available land, cheap labour and favourable climate, private businesses (mainly foreign companies) are investing in the production of biofuels in many countries. Unfortunately, policy and regulation frameworks are not established to monitor these emerging private initiatives that appear to focus on exports.

Sustainability and certification of bioenergy in West Africa

The international debate on bioenergy, in particular on biofuels, has attracted attention and discussion on several levels. The major concern has been around the negative effects of biofuel production and use, with a focus on food security, environmental preservation and labour rights.

Ensuring the sustainability of biofuel production is seen as a tool to prevent possible negative effects based on sustainability criteria, indicators and principles.

Several initiatives have been launched with respect to establishing sustainability standards and certification at national, regional and international levels.

Different sustainability initiatives are similar in how they refer to three main sectors: Social, Economic and Environmental. In addition, related sectors such as compliance with laws and agreements, indirect land use change, enhancement of the NGOs roles, traceability of biomass and the improvement of conditions at local level are also featured.

Sustainability is broadly mentioned in the national programs/initiatives in West Africa and concern is directed towards implementation of bioenergy plantations on idle and degraded lands (Ghana and Senegal). However, this condition does not seem to clearly apply for private bioenergy projects.

Although the present situation does not seem to pose any immediate threat to food security, it is likely that some subsistent farmers, have had their lands taken over and been deprived of their source of food and livelihoods. The situation is bound to worsen if the current indiscriminate and uncontrolled acquisition of land is not curtailed or moderated by the appropriate authorities in West Africa.

This study has attempted to analyse, based on selected case studies, sustainability of bioenergy according to Economic, Social and Environmental criteria, as set forth by sustainability initiatives.

At the macro-economic level, the *jatropha* programs in Ghana and Senegal are expected to lead to potentially significant revenues, contribute to energy security and the conservation of the foreign exchange. If Ghana were to cultivate 1 million hectares of *jatropha*, the benefit would be amount to US$ 4 billion annually. If 30% of gasoil is replaced with biodiesel and 30% of Kerosene is replaced with bio-oil, by 2010, the reduction in the import bill could reach 15 to 20%. In Senegal, if it were possible to achieve the National *Jatropha* Programme (320,000 ha of j*atropha* plantation), the country would replace 100% of gasoil with biodiesel, also reducing the energy bill.

The solid biomass industry in Senegal involves a controlled turnover of around 10 million Euro, of which 20% benefits local areas of production.

At the local level, indicators show some positive impacts in terms of job and revenue creation as well as improvement in community access to energy. However, environmental impacts have not been assessed at a local scale and concerns over land tenure and rural population displacement have been raised.

None of the West African countries has developed any specific criteria or certification schemes. Therefore, an opportunity exists for countries to examine existing sustainability schemes and adopt practices that are suitable to their context in order engage with international trade market of bioenergy. Clearly, to promote environmentally responsible markets, there is a need for additional costs and national capacity building.

IV.3. Energy Research Centre South Africa – South Africa, Mozambique and Malawi

In Southern Africa, traditional biomass is still the most common energy source and electrification rates are relatively low, ranging from 20 to 45%. The exception is South Africa, the most economically powerful country in the region, where electricity and fossil fuels are the major energy source and about 80% of households have access to electricity.

However, traditional fuel wood is still widely used and there is growing concern about the sustainable harvesting of trees and shrubs for fuel. Production of commercial biofuels for transport is still limited in the region.

Change is expected soon, as many Southern African countries are planning to grow feedstock and produce biofuels such as ethanol and biodiesel.

The three countries - South Africa, Mozambique and Malawi - were selected for this study because of their different approaches to bioenergy and biofuels.

South Africa has developed an industrial biofuel strategy including clear social objectives to address rural poverty and development; this is supported by policies with similar objectives in agriculture and land redistribution. In Southern Africa traditional biomass is still the most common energy source and electrification rates are relatively low and range from 20% to 45%. The exception is South Africa, the economically most powerful country in the region, where electricity and fossil fuels are the major energy sources and about 80% of households have access to electricity.

However, traditional fuel wood is still widely used and there is growing concern about the sustainable harvesting of trees and shrubs for fuel. Production of commercial biofuels for transport is still limited in the region.

This is about to change, as many Southern African countries are planning to grow feedstock and produce biofuels such as ethanol and biodiesel.

Mozambique has prepared a biofuel strategy, evaluating both plantation and smallholder farming as well as production activities.

In Malawi, bioethanol development is far ahead of other countries in the region and private companies have been producing bioethanol from sugar cane since 1982. Since then, about 10% of ethanol has been blended with gasoline. The country has considerable experience in ethanol production and is now investigating the feasibility of using 100% ethanol for vehicles.

The three countries are competitors in the domestic, regional and international biofuel markets.

Many countries in Southern Africa have large potential for growing biofuel feedstock. Angola, Mozambique, Zambia and Tanzania have low population densities and favourable soils and climate. So far, commercial biofuel production in the region is limited. This is set to change as many Southern African countries are planning and have already started to grow feedstock with intentions to producing ethanol, mainly from sugarcane and biodiesel from *Jatropha*. Coastal countries such as Mozambique will expand coconut plantations, which have been traditionally exported as vegetable oil.

There is some concern that African countries will produce and export raw oils, therefore it is important that more steps in biofuel production chain are localised to add value and to create more jobs.

IV.3.1. South Africa

Production and use of bioenergy

Traditional fuel wood is the one most widely used solid bioenergy resources available to the poor, particularly in rural areas and 20% of the population are still using it (Statistics South Africa, 2007). Sugar cane, maize, soya beans, sorghum, canola and sugar beet are the major biofuel crops expected to be grown for energy purposes. The Biofuels Industrial Strategy proposes sugar cane and sugar beet for ethanol production and sunflower, canola and soya beans for biodiesel. Due to food security concerns, maize, a staple food crop is excluded for ethanol production in the initial phase the Biofuels Industrial Strategy (DME 2007).

There have been plans to develop a soya biodiesel plant in South Africa but Sasol industry seems to have received insufficient government support and the plan has been shelved for now (Bridge, 2004). Biodiesel from used vegetable oil is also being produced and sold by a number of small plants in South Africa.

Although the national South African electricity company, Eskom, supplies most electricity municipalities, they are exploring ways to diversify their energy portfolio, increasingly looking at green energy. The City of Cape Town sees itself in the forefront of renewable energy and is exploring the use and application of bioenergy and biodiesel activities in South Africa (Wilson, et al., 2005).

Existing policies

The government has introduced policies and strategies to support renewable energy in the country, starting with the White Paper on the Energy Policy and the Renewable Energy Policy (DME, 2003) and recently the Renewable Energy Feed-in Tariff (REFIT) in 2009. Since the initial stages, policy support for renewable energy has steadily increased over the years. The REFIT supports a market mechanism to stimulate the renewable energy industry in South Africa to contribute toward the renewable energy target of 10,000GWh by 2013.

Of particular interest to the GNESD bioenergy study is the Biofuels Industrial Strategy of the Republic of South Africa (DME 2007). The strategy intends to achieve a 2% biofuel contribution to the national liquid fuel supply within five years. The proposed crops are sugar cane and sugar beet for bioethanol and sunflower, canola and soya beans for biodiesel. At this relatively low target, land availability is not of major concern because 5% of the national diesel demand could be generated from underutilised land in the former homelands. Food security concerns exclude the use of staple food such as maize. *Jatropha,* for being an alien species, is also excluded under the policy. This strategy appears to be overoptimistic in expecting emerging farmers to produce 400 million litres of biofuels within the next five years from a starting base of almost zero.

IV.3.2. Mozambique

Production and use of bioenergy

Mozambique, one of the poorest countries in the world, is potentially an energy-rich country and already exports hydroelectricity and natural gas to its neighbours. About 20% of the population has access to electricity. Forests cover over 51% of Mozambique. Fuel wood is the predominant fuel in rural areas and charcoal is more common in urban areas (SEI, 2001). About 80% of the population relies on charcoal. Due to fuel wood harvesting, forest degradation is occurring near major population centres.

The Mozambican Agricultural Research Institute (Econergy, 2008) estimates that 6.5 to 12.2 million ha - are available for expanding agricultural production. Local and foreign producers can get long-term renewable leases or concessions. Suitable agricultural land and sufficient water resources are found particularly in the Centre and North of the country where unemployment is high among the rural population. It will be important to integrate smallhold farmers into the emerging biofuel industry. Sugarcane and sweet sorghum are the proposed feedstock for bioethanol, while *jatropha curcas* and coconut will generate biodiesel (Republica de Mozambique, 2009).

Bioenergy policies in developing countries cannot be understood in isolation, they have to be compared to biofuel policies and targets in developed countries. It is expected that Mozambique and Malawi, with small internal markets, will look for export markets for biofuel production. Importantly, biofuel targets and mandates in other regions such as the EU and USA will influence the amount of land and resources allocated to biofuel production.

Existing policies

The Government of Mozambique commissioned a detailed assessment of biofuels in the country, focusing on technical, socio-economic and environmental feasibility (Econergy, 2008). The biofuels policy and strategy was published on the 21st May 2009 (Republica de Mozambique, 2009). The policy states that the biofuels sector is to contribute to energy security and socio-economic sustainable development. A new National Commission for Biofuels (CNB) will be responsible for the implementation of the biofuel strategy and a National Programme for Biofuel Development will provide financial support for biofuel activities and projects.

Environmental and social impacts

Unemployment in rural areas is 13%, compared to 31% in urban areas. The biofuel sector could contribute to alleviating rural unemployment (INE, 2006).

The land issue may become controversial in cases where smallholders will loose their land to plantations owned by international companies. Since only a very small minority of farmers have title deeds, traditional landownership has to be recognised by all to avoid land disputes.

IV.3.3. Malawi

Production and use of bioenergy

Malawi is one of the poorest countries in the world and unlike Mozambique there is very little unused land for biofuel expansion. Similar to other Southern African countries, Malawi has been growing and exporting sugar. However Malawi is the only country in he region producing bioethanol for blending with petrol (E10). Malawi has grown and processed bioethanol since 1982 and has blended petrol with 10% ethanol. There are also plans to grow sweet sorghum for ethanol feedstock. Malawi produces ethanol from sugar cane and two plants generate 18 million litres of ethanol per year. About 50% is blended with petrol in Malawi and the other 50% is exported to East and Southern Africa. The plants have a design capacity of 16 million litres of ethanol each, but produce well below the installed capacity because there are not enough molasses available. The country expects to expand sugarcane plantations so that the two plants can produce to capacity.

Biomass makes up 93% of energy use in Malawi and only 6% of households have access to electricity. Fuel wood and charcoal supply most of this demand. Forests cover about a third of Malawi but forests are declining at a rapid rate due to agricultural expansion, fuel wood use, commercial charcoal production, tobacco curing, brick making and other uses. Malawi's yearly fuel wood and charcoal demand is 7.5 million tonnes and the sustainable supply is only 3.8 million tonnes (Chimwala, 2008).

Charcoal production is illegal in Malawi but the government has turned a blind eye on the industry which provides 93,000 people depend with employment as producers, bicycle transporters and road side urban vendors (Government of Malawi, 2007). Due to unsustainable harvesting Malawi lost about 13% of its forest cover between 1990 and 2005.

Existing policies

Malawi is also encouraging private-sector jatropha projects to further diversify its overdependence on liquid fuel imports. There are a number of biodiesel projects based on jatropha in Malawi. The Government is expanding soya production and trying to attract investment for soya cultivation to produce soya milk, soya oil and other secondary products.

Environmental and social impacts

The ethanol production from sugarcane plantations has led to employment among the surrounding communities. When the plans for expanding the plantations are undertaken, it is important that smallholders are not locked out of benefits and that plantations do not encroach on their land. Smallholders and plantations are now growing jatropha trees as feedstock for biodiesel.

IV.4. Main findings from Africa

There is widespread energy poverty in sub-Saharan Africa and on average only 24 percent of the population has access to electricity, with some countries far below that. The vast majority depend on traditional biomass such as fuel wood, charcoal and agricultural residue for their energy needs. The development of biofuels in Africa should not only fill the cars in the industrialised world but should primarily alleviate energy poverty in the country where the feedstock is grown.

In sub-Saharan Africa the percentage of people living in absolute poverty has decreased from 53.7% in 1981 to 51.2% in 2005 but due to population growth the number of people in absolute poverty has risen from 214 million to 391 million in the same time period.

Some African nations have seen substantial developments in their agricultural sector. Government support (finances and policies), increased mechanization, irrigation, improved seed and fertilizer use are some of the reasons behind the success. The gains in agricultural production are outpaced by population growth with the effect that on average there is less food produced per person.

However, most farmers in Africa are smallholders and agricultural growth and poverty reduction will depend on more productive smallholder farming enterprise in the short and medium term. Over the years large globally integrated companies are entering African agriculture and these companies are advantaged because of greater technical expertise, market knowledge and access to cheaper capital. Smallholders are undercapitalised and are under increasing pressure to adopt new technologies and crops and learn to adapt to market requirements. Larger commercial farms are in a better position to manage risks associated with the adoption of new technologies and crops.

The challenge of the new biofuel industry is to strengthen support for smallholder farmers to be the engine of agricultural growth and poverty reduction in sub-Saharan Africa.

Most African farmers are subsistence farmers and low agricultural productivity is one of the major problems in poor rural areas. Biofuels are agricultural crops, which countries hope will stimulate agricultural productivity of smallholder farmers not only for the bioenergy crop but also for food production. In the past cash crops such as tobacco, tea, cotton, were thought to stimulate agricultural productivity and rural development but they generally failed to do so. The challenge is to make sure that a more suitable agricultural development model is adopted for growing and processing the new biofuel crops including both smallholder farms and plantations of agribusinesses.

In West Africa, the major barriers as identified from the analysis of bioenergy development in the three selected countries can be summarized as follow: absence of comprehensive national bioenergy policy; absence of coherence between sectorial policies that involves bioenergy; lack of incentive mechanisms including appropriate financing schemes; relatively high cost of bioenergy; absence of high quality planting materials and feedstock; feedstock availability; lack of skilled work force project management capacities at local level.

For solid biomass, barriers are particularly related to: difficulty for the private companies to participate in structuring investments in forest resources assessment; financial profitability and market penetration of improved cooking devices; lack of technical knowledge of planting and cutting techniques.

V - Findings of the Centers in Latin America

V.1 Fundación Bariloche

V.1.1 Argentina

Production and use of bioenergy

The most abundant biomass resources are located in the North East and North Central part of the country, mainly forest biomass. The Mesopotamia region also has abundant agro industrial residue resources, such as sawmill residues, rice husk and cotton residues. These residues are mostly used in the same agroindustry for processing.

The North-Central region presents some of the lowest rates in electricity coverage, in some departments the fraction of households connected to the grid is under 70%. Although the region eemains without grid supply, it lies between two high voltage transmission lines running South-North. Coincidentally, this is one of the regions of the country that also lacks access to natural gas supply and consequently presents one of the highest fractions of households using fuel wood and charcoal for cooking, again indicating the availability of traditional biomass resources.

Diesel and LPG are not feasible options for poor and deprived households due to cost barrier and supply problems. These barriers will not be eliminated unless a coherent plan is implemented at national level.

The provinces of Formosa, North-West of Chaco, East of Salta and North of Santiago del Estero present suitable conditions form the point of view of available resources and unsatisfied energy requirements for the implementation of biomass cogeneration units.

Existing policies

Argentina has enforced a National Biofuels Program (National Law N. 26093/2006 and Decree 109/2007), which includes biodiesel, bioethanol and biogas. However, the level of development and political commitment is relatively high for biodiesel, medium for ethanol and very low for biogas. The national law promotes biofuels, and sets mandatory targets (5% as of 2010) for ethanol and biodiesel blends (as mentioned, biodiesel targets were elevated to 7% in July 2010). Argentina is already one of the main vegetable oil exporters, having both the natural resources and installed capacity to produce more biodiesel than the amount needed to supply the percentage fixed by law, an amount that was meant to link small-scale regional producers of biodiesel with internal quotas. However, recent discussions are directing the biodiesel quota to big crushers (around 10 firms) instead of smaller regional providers.

V.1.2. Chile

Production and use of bioenergy

In the Northern region, Comunas with the highest poverty rates are in rural areas of General Lagos. Camina and Colchane, placed in the Región I, with poverty rates close to 35%. In turn the highest poverty rate of the Central region – close to 43% - is found in Temuco (Región IX). While in the Southern region the Comunas with highest rural poverty are San Juan de la Costa and Quinchao, 32.3% and 30.4% respectively.

Chile has one of the highest rural electrification rates in Latin America, reaching around 86% of rural households in year 2002[3]. Around 77,000 households remained unconnected as of 2009. The lowest rural electrification rates are located in regions XI (Aisén). XII (Magallanes) has coverage of around 74%, but low absolute population levels. Regions IX (Araucanía) and X (Los Lagos) present some of the highest fractions of rural population, in particular of indigenous people. This population also lacks access to natural gas and fuel wood is their main energy carrier for thermal uses. Forest biomass is generally very abundant in these four regions. Projects for rural electrification have a strong focus on grid extension.

Despite Chile's extensive agricultural and forestry resources, the use of biomass for generating electricity is still in its infancy[4] Current steam, biogas and electricity projects are related mainly to residues from forestry exploitation. The country has an installed capacity (thermal steam generation for the year 2007) of 73 MW (nominal) using black liquor as energy source and 118 MW from wood and forest residues. In that year, 744 GWh were generated, mainly from self-production of energy in industries.

Existing policies

Based on the availability of forest resources, poverty levels and unelectrified populations, the main niche for bioenergy cogeneration in Chile is located in regions IX and X, and to a lesser extent in regions XI and XII. In Chile, biofuel commercialisation was authorised (by Decreto Supremo Nº11, of Ministerio de Economía, Fomento y Reconstrucción – January, 2008) in blends of 2% or 5% (volume basis) for both ethanol (with gasoline) and biodiesel (with diesel). In April 2008, National Law 20257 was enacted, mandating that 5% of the electricity provided would be generated from renewable sources, an obligation that binds commercialisation agents.

The country has a national support program implemented through CORFO for the development of advanced biofuels from forest biomass (and other renewables)[5]. Furthermore, in 2008 a national program for developing renewables (as a component of energy policy planning) was implemented and included the design and implementation of a "Renewable Energies Centre".

---

[3] Comisión Nacional de Energía, 2003.

[4] For example in each of Regions VII and VIII Energía Verde S.A., a subsidiary of the power producer AESGener, operates an 8.7-MW combined heat and power plant fired with waste wood. http://www.energiaverde.cl

[5] CORFO, 2008.

V.1.3. Paraguay

Production and use of bioenergy

Paraguay has very similar conditions to those prevailing in the Formosa province of Argentina, low electrification rates and lack of access to either LPG or natural gas. About 40% of rural households lack access to electricity. Rural electrification mainly aspires to grid extension when economically feasible and to a lesser extent off-grid/mini-grid solutions powered by stationary generators or small-scale renewables for remote rural areas[6]. The number of rural electrification projects carried out with renewable energies has been rather small, Puerto 14 de Mayo, Acaray Mi, Yacac Vash, Punta Diamante. In relation to biomass resources, the traditional use of fuel wood in Paraguay has been very intensive in the past few decades. This has lead to an important reduction and degradation of forest stands and an increasing pressure over the remaining forests.

In Paraguay, it is not considered suitable to propose energy supply niches based on the use of forest biomass. This does not imply that there are not specific situations where this could be recommended. It could then be preliminarily concluded that the most promising niches in Paraguay would lie in the production and use of vegetable oil, biogas and eventually biodiesel for self-consumption. This is reinforced by the fact that 67% of rural households have some kind of agricultural production[7].

On the other hand, if reforestation is considered, Paraguay presents very interesting precedents that may indicate the feasibility of establishing multi-purpose community reforested areas for biomass energy supply. Among other main biomass resources for Paraguay there are vegetable residues such as coconut, cotton and dung residues.[8] The use of fuel wood is very important in Paraguay, which is related not only to the high share of rural population, but also to the production of charcoal for residential and industrial use.

Existing policies

Paraguay has implemented a promotion system for ethanol and biodiesel, but the country still faces supply and quality problems.

[6] ESMAP, 2004.

[7] Ramírez, Julio y González, Cynthia. Crisis y pobreza rural en América Latina: el caso de Paraguay. Documento de trabajo Nº 48 Programa Dinámicas Productivas Rurales. RIMISP Centro Actividades Productivas Rurales. Santiago de Chile, 2009.

[8] Sub Secretary of Mines and Energy of Paraguay Mines http://www.ssme.gov.py/VMME/VMME.htm

V.1.4. Uruguay

Production and use of bioenergy

In Uruguay, where the departments with higher rural poverty incidence are located to the North of the country (Tacuarembó, Rivera, Artigas, Salto, Cerro Largo, and Paysandú), biomass accounts for 1.4% of electricity inputs. Following the National Decree 77/06 for biomass-based electricity promotion, three projects of about 10 MW each were recently selected (using wood residues, rice residues and sawdust as inputs). Another project of 140 MW of electricity generated from black liquor (40MW already dispatched from Botnia pulp and paper plant), completes the current framework[9]. In the country, "other biomass" consists mainly of sunflower, corn and rice residues and black liquor (residues from pulp and paper industry production).

Uruguay has an ethanol blending mandate of up to 5% by 2015 and a minimum of 5% from that year on. The blending mandate will be completed by 2010. For biodiesel, the blending mandate started at 2% in 2009 and will reach 5% by 2012. Uruguay aims to have a diversified feedstock supply for both biodiesel and ethanol production. The main target is local market supply. Also, Uruguay has a policy (the mentioned National Decree 77/06) for developing electricity generation from biomass, including its connection to the national grid.

Existing policies

Regarding biofuels, an agro-fuels law ("Ley de agrocombustibles", N. 18.195 of 14/11/07) indicates blending percentages of 5% of alcohol (bioethanol) in gasoline by 2015 and a progressive incorporation of 2 % biodiesel as of 2009 to 2011, and 5% as from 2012. In spite of lacking national biofuel technology production, Uruguay is developing a well-planned comprehensive strategy, including long-term contracts between the State Oil Company ANCAP and cooperative producers, affording higher cost of crop production in order to foster the local development of depressed rural areas, while guaranteeing locally provided biofuel crops. The sugar/alcohol project in Uruguay consists of sugar cane harvesting promotion in the North of the country, Bella Union, Artigas department. It is aimed at providing sugar to the domestic market and ethanol production for blending with gasoline.

[9] DNETN, Ministerio de Industria, Energía y Minería del Uruguay, 2008. This plant provides currently 40MW of capacity to the National Grid. By the en of 2009, 38MW will be bought by the UTE to renewable energy producers. ALUR (Alcohol from Uruguay) will provide 4 MW, while another 8MW will be used for self consumption; Fenirol (Tacuarembó) will provide 8.8 MW from rice husk and forest industry residues; Bioener (Rivera) will provide 12 MW and Weyerhaeuser another 2MW both from forestry industry residues; and Galofer (Treinta y tres) will contribute 14MW generated from rice husk. La República, Uruguay, 26/10/2009 and El País, Uruguay, 23/10/2009.

V.1.5 Findings common to Argentina, Chile, Paraguay and Uruguay

Although information regarding agricultural, cattle raising and forestry production is available for the chosen countries, the employment of biomass for energy purposes is not easily identifiable. Similarly, information regarding all sorts of biomass projects under development, but not already implemented, is not available, as it is very difficult to address the real situation of the implementation stage.

The introduction of some proposed technologies for the region (gasification; anaerobic digestion; small-scale biodiesel; pure plant oil and steam turbines) could only help poor rural people if they were integrated into a comprehensive development strategy.

This must include basic infrastructure to facilitate rural population mobility and wellbeing, such as the use of trains as an alternative means of transport, schools and health centres. Firms and institutions working on and benefiting from rural areas could be called in to contribute their commitment to this development.

Similarly, the probability of successful long-term implementation is rather low if the proposals are only conceived as rural renewable energy projects. The technologies involved generally require a very good organisational level, a minimum level of infrastructure, income and knowledge. This may mean that a significant portion of the poor rural population will not be a suitable target for the introduction of these technologies.

Current bionergy use is far from reaching its potential and, as case studies prove, more basic information is needed in order to employ geo-reference tools for comprehensive land planning. In particular, surveys on specific productive rural activities, as well as on energy needs and level of satisfaction of energy services, are needed.

V.2. CENBIO/CentroClima

V.2.1. Brazil

Production and use of bioenergy

Brazil has a huge experience on biofuels and bioenergy in general since its Alcohol Program is more than 30 years old. The lessons learned can be shared with other DCs, aiming to collaborate for local development of biofuel programs. Brazilian experience is not only for sugarcane ethanol but also for biodiesel and can be shared with other DCs.

The perspectives of the Brazilian bioethanol market are different from other countries because of the maturity of its biofuel program and the large expansion observed in bioethanol consumption and production capacity. Brazil produced 27.5 billion litters of sugarcane ethanol in 2008/2009, being the second largest producer in the world, using an area of 6.8 Mha (million hectares), corresponding to 1.5% of total arable land in the country (from this area around 50% is for alcohol production and the other 50% for sugar production) and 1.6 billion litres of biodiesel in 2009 (*www.anp.gov.br*).

For the 2012- 2013 season, a potential of 38 billion litters is forecasted, using an area of 10.3 Mha. It must be noted that this expansion (as well as the one for biodiesel) can be done in a sustainable way. Estimates for future scenarios are not an easy task because of the intense dynamics observed in the bioethanol agroindustry, where new projects are frequently implemented to meet the growing internal demand. However, some conservative production and consumption estimates are obtained for the period of interest.

Presently, there are no subsidies for anhydrous or hydrated ethanol production. Hydrated ethanol is sold for 60–70% of the price of gasohol at the pump station, due to significant reductions in production costs. These results show the economic competitiveness of ethanol when compared to gasoline. Recent increase in 2010-11 prices of ethanol in the pump stations were due to the high prices of sugar in international market, produced to the significant decrease on Indian sugar production. This interest of sugarcane industry for producing more sugar in fact occurred during the off-season (November 2010-April 2011), when the supply of ethanol in the country is generally reduced. However there was no significant impact for consumers since most of the current light vehicles fleet is based on the flex-fuel vehicles (engines running with any blend of ethanol-gasoline). During this period, consumers' choice was directed to gasoline consumption, returning to ethanol when ethanol prices decreased.

Existing policies

Among different programs for renewables in Brazil, together with Proalcool, the most important policy has been the National Program for Production and Use of Biodiesel (Programa Nacional de Produção e Uso do Biodiesel). The goal of this program is to introduce a new fuel in the Brazilian energy mix from self-sustained projects that combine good price, quality, supply guarantee and social inclusion policies. The addition of biodiesel to diesel, together with the ethanol program, is the main sustainability program for the transport sector.

From July 1st, 2008 onwards, all the diesel fuel sold in Brazil must contain 3% of biodiesel. Resolution N.2 of the Brazilian Energy Council (CNPE), published in March 2008, established the increase in the mandatory blend of biodiesel in diesel from 2 to 3%. However, due to the high production of biodiesel, the government anticipated the timetable and established the B5 blend to January 2010. In order to meet the B5 goal, studies show that around 2.3 billion litres of vegetable oil will be necessary. Therefore, it is unrealistic to consider a single species of oleaginous plant to supply raw material to fulfil such goals (CAMARA, 2006).

The Federal Government is making efforts to stimulate more renewable sources of energy. With respect to electricity generation, Brazil has invested in projects of renewable energy, distributed by the Program of Incentive to Alternative Sources of Electric Energy (*Programa de Incentivo às Fontes Alternativas de Energia Elétrica - Proinfa*) in 63 small hydroelectric power plants, 54 wind parks and 20 thermal units (for investments in energy through biomass).

Environmental and social impacts

Brazil has currently quite strong legislation in both the social and environmental sectors. In the social sector it is important to note recent initiatives from the government of São Paulo to avoid unemployment due to the introduction of the mechanical harvesting of green sugarcane. Several initiatives were implemented, including special capacity building not only to operate the sophisticated computerised machines but also to create opportunities for jobs in other sectors such as construction and industry.

Considering environmental issues, significant improvements were made in several government levels (Federal, State and Municipal ones) with the introduction, in September 2009, of the Federal zoning of sugarcane in the country, aiming to protect fragile ecosystems (*Amazonian rain forest*, *Pantanal wetlands*, *Brazilian savannah – "cerrado"*, *Atlantic Rain Forest*) and biodiversity. [10] Previously, State initiatives dominated, the most important one being from Sao Paulo State. [11]

The creation of such zones by the Federal Government and by the states of São Paulo, Minas Gerais and Mato Grosso do Sul aim to define which areas are adequate for sugarcane crop without pressure against fragile biomes. Also, a recent study from ICONE (NASSAR et al, 2010) shows that LUC (Land Use Change) and ILUC (Indirect Land Use Change) are not considered a problem in Brazil. Also, more strict limits for vehicles emissions were introduced, not only for gasoline and diesel engines, but also for alcohol and flex fuel ones. [12]

V.2.2. Colombia

Production and use of bioenergy

Colombia is starting a biofuel program and local perspectives are quite positive. Considering the production of biofuels, 327.2 million litters of ethanol were produced in 2009, 26% more than in 2008 and 350 million litters of biodiesel in 2008, mainly from palm oil, in an area of 337,000 hectares (FEDEPALMA, 2008).

Existing policies

Colombia started in 2004 a National Program of Biofuels, with a mandatory blend of sugarcane ethanol in gasoline in 2005 and, in 2007, its Biodiesel Program, aiming to produce and use biodiesel from palm oil (with a mandatory blend of 5 % biodiesel in diesel oil in 2008).

After launching the ethanol program with the goal of achieving 10% blend of bioethanol in gasoline, Colombian ethanol output grew steadily, as shown in Table 5. All five plants dedicated to

[10] EMBRAPA - Brazilian Agricultural Research Corporation (www.embrapa.br)

[11] São Paulo State Environment Secretariat (www.ambiente.sp.gov.br)

[12] CETESB - Environmental Agency of São Paulo State http://www.cetesb.sp.gov.br/Ar/emissoes/proconve2.asp

anhydrous ethanol concentrate 90% of the national output, fully dedicated to the domestic market (RIEGELHAUPT et al, 2009). Nowadays in Colombia most gasoline is blended with 10% of ethanol (83% of Colombian territory). There are excellent conditions to grow sugarcane in Colombia and since 2001 there is legislation regarding the production and blending of bioethanol (CIEMAT, 2008, and ASOCAÑA, 2009).

Environmental and social impacts

The negative aspects of these crops are mainly due to concerns related to water use in crop and when its cultivation occurs in areas of native forests. Sources show that Colombia has a large territory for the cultivation of palm oil, but currently these areas are focused on raising cattle extensively. Through an adequate organization of the region, making cattle raising more intensive, it is possible the sustainable production of palm oil in Colombia.

New legislation is being introduced in the country to incentivate biofuels, as well as to guarantee their sustainable production, without having to cut down native forest areas and are built in regions which were once used for farming, adopting a range of good practices which allow them to maintain a competitive edge and promote sustainability, while complying with international standards.

Policy recommendations

The main reason for Colombian investment on biofuels (as, in an ample vision, for other Latin American countries) is the Brazilian experience.

Programs such the Brazilian Proálcool in the 1970s for bioethanol and the ‘National Program for the Production and Use of Biodiesel’ require an official commitment from the government in addition to a comprehensive system of obligations, subsidies, incentives, and big investments in infrastructure and development. If similar programs are intended to be launched in Colombia, many challenges would have to be faced. Primarily, political stability to guarantee long-term governmental support is fundamental.

VI – Conclusions - Common Key Recommendations

An effective way of alleviating poverty is through the energisation of productive activities in order to improve life quality and income. The studies driven by the GNESD centers show that the technologies focused in expanding the use of bioenergy require high organisational efforts, a minimum level of infrastructure, income and knowledge, elements that must be developed in most of the rural sector. Additionally, lack of small-scale electricity generation is found in all the countries analyzed. Finally and most importantly, the introduction of these technologies could only help poor rural people if they were integrated into a comprehensive development strategy.

The table presented in Annex I presents a summary of the main findings on the reports from the centers of excellence, not only showing current production/consumption of bioenergy in each country but also existing and proposed policies in favor of bioenergy, as discussed above in details.

The main barrier to the use of biomass as fuel in commercial or industrial sector, as well as for power generation is its high investment cost, low conversion efficiency, difficulties in transportation, seasonal dependency, and moisture content. To mitigate the above barriers, countries need to consider not only technologies development of biomass utilization by increasing conversion efficiency, but on technologies know-how and transfer to the operators. Moreover, policy/measures, raw material supply, demand side management and users' awareness, and financial support are to be well thought-out.

Based on the findings from the reports from GNESD centers, the following policy recommendations are proposed for consideration:

- To develop and implement national bioenergy policies; such policies should set clear and realistic targets for bioenergy in the national energy mix and develop strategies, including proper incentive mechanisms to help achieve set targets.
- To set up supporting regulatory frameworks to insure sustainable production and use of bioenergy at the environmental, economic and social levels.
- To institute sustainability approaches to help insure a sustainable production and use of bioenergy. This will safeguard the livelihood systems of the vulnerable and poor people.
- To implement sustainability approaches that should primarily target in-country productions, processing and uses of bioenergy and insure the improvement of local populations' livelihood, energy and food security.
- To insure transparency in bioenergy financial resources allocation. To put in place supporting measures to enhance capacities to implement the sustainability of bioenergy and promote environmentally and socially friend bioenergy markets

On the other hand, for the biofuel industry to be consolidated as an energy commodity in the international market and, therefore, have their production and marketing increased, some barriers must be overcome:

- It is necessary to have several countries as suppliers and consumers. However, currently the high costs of raw materials hinder the production diversification, because only the biofuel production from sugarcane is considered economically viable without subsidies, and it is unlikely that this situation can be changed in the 5 or 10 years, unless in the ethanol from cellulose will be obtained in large scale and competitive prices, what seems to be no so possible.
- End of subsidies and protectionism (ie, the shares imports) that produces distortions on international trade, preventing the free flow of products and limiting the market to occasional transactions, when there are deficiencies in supply.
- It is also necessary that the ethanol has quoted prices in a transparent world market. Therefore, it is important to develop a futures market, and that "hedgings" are applied (a good start was the launching of ethanol contracts on the New York Board of Trade in 2004 and contracts of corn ethanol on the Chicago Board of Trade in 2005).
- Bioethanol is sometimes considered impractical because of low demand and the large-scale investment needed to produce it, the costs involved in converting filling stations and vehicles. However, gasoline engines can be adjusted to ethanol and its blends. Besides, flex-fuel vehicle technology has become available with no extra costs to consumers.

- The strategic nature of bioethanol implies the existence of some degree of protectionism in almost any producing country. Protectionism is especially acute where energy security is equated with self-suficiency or where biofuels are promoted to help domestic farmers in high-cost producing countries (DUFEY et al., 2007).
- Subsidies are a key concern. In industrialised countries, government support for the domestic production of energy crops, the processing or commercialisation of biofuels seems to be the rule (DUFEY, 2006). Amounts involved are enormous. In the United States, Koplow (2006) estimated that subsidies to the biofuels industry to be between US$ 5.5 billion and US$ 7.3 billion a year.
- The use of tariffs to protect domestic biofuel industries is a common practice and, as the impacts these policies have on developing countries competitiveness and potential for poverty reduction needs to be understood as domestic support in these countries is likely to be very limited. Moreover, subsidies impacts on environmental sustainability are also questionable as they promote bioethanol industries based on the less efficient energy crops and with the least greenhouse gases reductions such as maize and wheat (DUFEY, 2006).
- In addition to tariff barriers, non-tariff barriers also exist, considering: Technical and sanitary requirements; Quality standards; Public Health policies; Labor regulation; Rules on competion; Consumer's protection; Corporative politicies; Social and environmental policies.
- Biofuels must have specifications (standardisation) and possibly also be required for production certification, but adapted to the real conditions of each region. Adequate capacity building and funding are fundamental issues to collaborate to biofuels programs in Least Developing Countries (LDC's).
- Certification issues, despite the fact that they are important to guarantee the sustainability of biofuels production and use, can also be a non-tariff barrier. For Least Developing Countries (LDC), where the lack of funding and adequate capacity building is a matter of fact, this is a huge barrier against biofuels exports to industrialized countries (UNCTAD, 2008). In these cases a waiver related to certification schemes could be a significant collaboration for the economic development of such countries, not only considering the local supply but also the export of biofuels. Considering that in many cases local demand is quite low due to economic conditions, export of biofuels could allow a higher production, in a scale which allows economic competitiveness of biofuels with fossil fuels.
- Such waiver could include more time for capacity building in these developing countries to allow adequate adaptation, as well as for the introduction of modern technologies such as mechanical harvesting of green cane.

Considering all these issues, further discussions are needed about the environmental and social concerns, with a wider dissemination of the current results obtained with the use of biofuels, making a consistency of reporting and not considering uncertain issues, that make a barrier for the market of producer countries.

VII - References

VII.1. Asian Institute of Technology (AIT)

Amatayakul, W., Berndes, G., 2007, Fuel ethanol program in Thailand: energy, agricultural, and environmental trade-offs and prospects for CO2 abatement, Energy for Sustainable Development, Volume XI No. 3, September 2007.

Amranand, P., 2007, Renewable energy policy in Thailand, Keynote address- Entech Pollutec Asia 2007 and Renewable Energy Asia 2007, 6 June 2007, BITEC Bangkok.

Amranand, P., 2008, Alternative Energy, Cogeneration and Distributed Generation : Crucial Strategy for Sustainability of Thailand's Energy Sector, Energy Policy and Planning Office, Ministry of Energy, Thailand, Available at http://www.eppo.go.th/doc/Piya-RE-in-Thailand.pdf, Retrieved on 05 February 2010.

Ariati, R., 2009, National energy policy and biomass development program in Indonesia, 6th Asia Biomass Seminar, Nikko Hotel, Jakarta, March 16-20, 2009.

Asia Biomass Office, 2009, Power Generation Potential by EFB and Rice Husk in Indonesia, Available at http://www.asiabiomass.jp/english/topics/0907_05.html.

Asia Pacific Economic Corporation (APEC), 2009, Indonesia biofuel activities, APEC Biofuels, Available at http://www.biofuels.apec.org/me_indonesia.html.

Biofuels Digest, 2010, Thailamd biofuels: feedstocks and market opportunities, 17 May 2010, Available at: http://www.biofuelsdigest.com/bdigest/2010/05/17/thailand-biofuels-feedstocks-and-market-opportunities/, Retrieved on 28 July 2010.

Center of Energy and Mineral Resources, Hand book of Energy and Economic Statistic of Indonesia 2007, Center of Energy and Mineral Resources, Jakarta.

Department of Alternative Energy Development and Efficiency (DEDE), 2005. Palm biodiesel development strategies. Ministry of Energy, Thailand.

Department of Alternative Energy Development and Efficiency (DEDE), 2007. Annual Report of Electricity Power in Thailand 2007. Ministry of Energy, Thailand.

Department of Alternative Energy Development and Efficiency (DEDE), 2008a, Thai Energy Situation-2008, Ministry of Energy, Thailand.

Department of Alternative Energy Development and Efficiency (DEDE), 2008b, Alternative Energy Development Plan 2008-2022, Ministry of Energy, Thailand, Available it: http://www.dede.go.th/dede/index.php?id=996.

Department of Alternative Energy Development and Efficiency (DEDE), 2009. Ethanol factories in Thailand, Available at http://www.dede.go.th.

Department of Alternative Energy Development and Efficiency (DEDE), 2010a, Latest Information of E85 and Balance of Cassava & Molasses for Food and Ethanol, Available at: http://www.dede.go.th/dede/fileadmin/upload/pictures_eng/pdffile/e85-17-june.pdf, Retrieved on 28 July 2010.

Department of Alternative Energy Development and Efficiency (DEDE), 2010b, List of B100 Biodiesel Plants in June 2010, Available at: http://www.dede.go.th/dede/fileadmin/upload/pictures_eng/pdffile/Bio_Plants_june_10.pdf, Retrieved on 28 July 2010.

Dillon, H. S., Laan, T., Dillon, H. S., 2008, Biofuels at what cost? Government support for ethanol and biodiesel in Indonesia, The Global Subsidies Initiative of the International Institute for Sustainable Development, Switzerland.

Dutta, A., Shrestha, R. M., Kumar, 2006. ProBIOS: Promotion of Biofuels for Sustainable Development in Thailand. Asian Institute of Technology (AIT), Thailand.

Energy Policy and Planning Office (EPPO), 2008. Thai biogas promotion programme. Available at: http://www.thaibiogas.net/en/home.

Energy for Environment Foundation, 2009. Biogas based electricity generation capacity in Thailand. Available at http://www.efe.or.th/home.php?ds=content&mid=cMS7s93gtBdrFxPI&docmenu=YstuBk4NUpWmdGLO.

Energy for Environment Foundation, 2009. Potential of Biogas production from different industries in Thailand. Available at http://www.efe.or.th/home.php?ds=content&mid=cMS7s93gtBdrFxPI&docmenu=fzBk3mhUyRZ8t4Jv.

Energy for Environment Foundation, 2009. Status of biomass power generation capacity of SPPs and VSPPs (Oct 2007). Available at: http://www.efe.or.th/home.php?ds=content&mid=hGtTu8zx7jWvD4by&docmenu=3hP7p6a8KInbwvG5.

Food and Agriculture Organization, 2007. FAO Statistics data by country. Available at http://faostat.fao.org/.

Global Agriculture Information Network (GAIN), 2008, Thailand biofuels- annual 2008, Global Agriculture Information Network, USDA Foreign Agricultural Service.

Global Agriculture Information Network (GAIN), 2009, Indonesia biofuels- annual 2009, Global Agriculture Information Network, USDA Foreign Agricultural Service.

Global Agriculture Information Network (GAIN), 2010, Thailand biofuels- annual 2010, Global Agriculture Information Network, USDA Foreign Agricultural Service.

Garivait S., Chaiyo U., Patumsawad S. and Deakhuntod J., 2006. Physical and Chemical Properties of Thai Biomass Fuels from Agricultural Residues. The 2nd Joint International Conference on “Sustainable Energy and Environment (SEE 2006)”1-23 November 2006, Bangkok, Thailand.

Hadiwidjoyo, S., 2009, Indonesia’s biofuels policies and programs, Biomass-Asia Workshop, Japan, 18 November 2009, Available at http://www.biomass-asia-workshop.jp/biomassws/06workshop/presentation/09_saryono.pdf.

Hermawan, Hadi, S. P., 2006, Existing sustainable (Renewable) energy system in Indonesia, The 2nd Joint International Conference on “Sustainable Energy and Environment (SEE 2006)”, Bangkok, Thailand, 1-23 November 2006, Available at http://www.jgsee.kmutt.ac.th/see1/cd/file/F-045.pdf.

Indrawa, C., 2009, Biofuel based energy self sufficient village, 6th Asia Biomass Seminar, Nikko Hotel, Jakarta, March 16-20, 2009

Institute for Global Environmental Strategies (IGES), 2008, Second IGES White Paper
Climate Change Policies in the Asia-Pacific: Re-uniting Climate Change and Sustainable Development, Chapter 5: Prospects and Challenges of Biofuels in Asia: Policy Implications, IGES, Hayama, Japan.

International Energy Agency (IEA), 2008, Energy policy review of Indonesia, International Energy Agency, Paris, France.

Ishizuka K, Shigeru Hisajima, Darryl R.J. Macer, 1995. Utilization of Agricultural Wastes for Biogas Production in Indonesia Traditional Technology for Environmental Conservation and Sustainable Development in the Asian-Pacific Region pp. 134-138 Proceedings of the UNESCO - University of Tsukuba International Seminar on Traditional Technology for Environmental Conservation and Sustainable Development in the Asian-Pacific Region, held in Tsukuba Science City, Japan, 11-14 December, 1995.

Legowo, E. H., Kussuryani, Y., Reksowardojo, I. K., 2007, Biofuel development in Indonesia, USDA Global Conference on Agricultural Biofuels: Research and Economic, Minnesota, August 20th - 22th, 2007.

Masyarakat Energi Terbarukan Indonesia (METI), 2009. Indonesia renewable energy policy 2006-2025. Accessed from http://www.meti.or.id/

National Energy Policy Council (NEPC), 2006, Thailand's Energy Policy and Development Plan, Available at http://www.eppo.go.th/admin/cab/gov-policy/pol_56-energy-policy-E.html, Retrieved on 03 February 2010

Netherlands Development Organisation (SNV), 2010, Domestic biogas newsletter, Issue 2, January 2010, http://www.michaelyon-online.com/images/pdf/20100127snvdomestic-biogas-newsletter-issue-2january-2010.pdf, Retrieved on 29 July 2010.

Ngaemngam, S., Tezuka, T., 2006, Effect of Energy Policy on Biomass-based Power Generation in Thailand, The 2nd Joint International Conference on Sustainable Energy and Environment (SEE 2006, 21-23 November 2006, Bangkok, Thailand, Available at: http://www.jgsee.kmutt.ac.th/see1/cd/file/F-022.pdf , Retrieved on 28 July 2010.

Nunt-Jaruwong, S., Thailand Renewable Energy Policy - The Potential for Electricity from Dendro-power (Summary), Available at http://www.nri.org/projects/biomass/conference_papers/thailand_renewable_energy_policy_summary.pdf, Retrieved on 03 February 2010.

Panaka, P., Yudiarto, M. A., 2007, New Development of Ethanol Industry in Indonesia, Asian Science & Technology, Jakarta, March 7 2007.

Pienpucta, N., Pongtepupathum, W., 2009, Small hydropower development at existing irrigation dams for clean and renewable energy in Thailand, RIO 9 - World Climate & Energy Event, 17-19 March 2009, Rio de Janeiro, Brazil, Available at: http://www.rio9.com/programme/Book_of_Proceedings/40_SH_Pongtepupathum.pdf , retrieved on 29 July 2010.

Praptiningsih G. Adinurani, Anggi Nindita, Roy Hendroko, 2009. Challenges of Biofuel Industry in Indonesia. Workshop on Renewable Energy & Sustainable Development in Indonesia, Past Experience – Future Challenges, 19-20 January 2009.

Royal Danish Embassy- Thailand, 2007, Sector overview- Energy in Thailand, April 2007; Available at http://www.ambbangkok.um.dk/NR/rdonlyres/2295E8D4-C11C-4012-8898-8636D0BBEBAD/0/SectorOverviewEnergyinThailand26april2007.pdf , Retrieved on 03 February 2010.

Sovacool, B. K., 2010, A comparative analysis of renewable electricity support mechanisms for Southeast Asia, Energy (2010), doi:10.1016/j.energy.2009.12.030 in press.

Sajjakulnukit, B., Yingyuada, R., Maneekhao, V., Pongnarintasut, V., Bhattacharya, S.C., Salam P.A. (2005), Assessment of sustainable energy potential of non-plantation biomass resources in Thailand, Biomass and Bioenergy, 29 (2005), 214-224.

Sarochawikasit, R., 2009, Alternative Energy Development Plan (2008 – 2022), medium - and long – term investment plan and the role of the private sector, Presented to Climate Financing: Clean Technology Fund (CTF) and the Role of the Private Sector Workshop, 15 July 2009, Available at http://siteresources.worldbank.org/INTTHAILAND/Resources/333200-1089943634036/475256-1232532308749/5753865-1248058855014/dr.rangsan-dede.ppt, Retrieved on 03 February 2010.

SenterNovem, 2009, Bilateral energy coorporation Indonesia Netherland- biogas, Available at: http://www.senternovem.nl/becin/projects/biogas.asp, Retrieved on 29 July 2010.

Siemers, W., 2009, Sustainable Utilization of Biomass Resources for Power and Biofuels in Thailand, ORBIT 2009 CHINA, Beijing, 19 -21 Nov 2009.

Srisovanna, P., 2004, Thailand's biomass energy, Electricity Supply Industry in Transition: Issues and Prospect for Asia, 14-16 January 200, Available at http://www.cogen3.net/doc/countryinfo/thailand/ThailandBiomassEnergy_report.pdf, Retrieved on 3 February 2010.

Tjakrawan, P., 2009, Experience in biofuel industry development, 6th Asia Biomass Seminar, Nikko Hotel, Jakarta, March 16-20, 2009.

Wiraphorn, N., Nuchprayoon, S., 2008, Financial impact of renewable Portfolio Standard policy on electricity generation cost, Section 3: Industrial cleaner technology in practices- International Symposium on Environmental Management : Hazardous-Environmental Management Toward Sustainability, Royal Hill Resort & Spa Nakorn Nayok, Thailand, 22-23 September 2008.

Wattimena, B., 2009, Prospect of Bio Fuels Development in Indonesia and It It's Implication on Sustainable Development, 6th Asia Biomass Seminar, Nikko Hotel, Jakarta, March 16-20, 2009.

Wirawan, S. S., Tambunan, A. H., 2006, The Current Status and Prospects of Biodiesel Development in Indonesia : a review, the Third Asia Biomass Workshop, Tsukuba, Japan, November 16, 2006.

VII.2. The Energy and Resources Institute (TERI)

Demirbas, 2009, Political, economic and environmental impacts of bio-fuels: A review. Applied Energy 86, 5108-5117

Desai, 2004, The World Health Organization, Indoor smoke from solid fuels Environmental Burden of Disease Series, No. 4 Assessing the environmental burden of disease at national and local levels http://www.who.int/entity/quantifying_ehimpacts/publications/en/Indoorsmoke.pdf

ESMAP 2004, Clean Household energy for India: Reducing the Risks to Health 2004, UNDP Energy Sector Management Assistance Programme

FAO, 2007, A review of the current state of bioenergy development in G8 +5 countries, Food and Agriculture Organization of the United Nations (FAO), 2007

FAO, 2007, A review of the current state of bioenergy development in G8 +5 countries, Food and Agriculture Organization of the United Nations (FAO), 2007

Hitofumi 2005, Summary of Biomass Power Generation in India, Abe Hitofumi, Japan International Cooperation Agency

IEA, 2009, World/India Energy Balanc, http://www.iea.org/stats/balancetable.asp?COUNTRY_CODE=29 Accessed on 17 February, 2010

MNRE, 2004, Annual report 2003/04, Ministry of New and Renewable Energy, Government of India

MNRE, 2009, Annual report 2008/09, Ministry of New and Renewable Energy, Government of India

MNRE, 2009, Annual Report 2008/09, Ministry of New and Renewable Energy, Government of India

Nouni,Mullick, Kandpal, 2008, Providing electricity access to remote areas in India: An approach towards identifying potential areas for decentralized electricity supply, Science Direct, M.R. Nouni, S.C. Mullick , T.C. Kandpal, Renewable and Sustainable Energy Reviews, 12 (2008) pg 1187–1220

NSSO, 2008, National Sample Survey Organisation, 2008. NSS 63rd Round Household Consumer Expenditure in India, 2006-07. Report No. 527 (63/1.0/1); Ministry of Statistics and Programme Implementation, Government of India, New Delhi.

Palit Mande, 2007, Biomass Gasifier Systems for Thermal Applications in Rural Areas, Debajit Palit and Sanjay Mande, The Energy and Resources Institute

Palit, Mande 2007, Biomass Gasifi er Systems for Thermal Applications in Rural Areas, Debajit Palit and Sanjay Mande; Boiling Point No 53 2007 Pg 17-19

Patricia Thornley,John Rogers, Ye Huang, Science Direct, Renewable Energy 33 (2008) Pg 1922–1927

Planning Commission, 2006, *Integrated Energy Policy*. Report of the Expert Committee. Government of India. *Planning Commission*. New Delhi. August 2006

Ravindranath and Balachandra, 2009, Ravindranath, N.H., Balachandra, P., 2009, Sustainable bioenergy for India: Technical, economic and policy analysis. Energy 34, 1003–1013

Ravindranath and Balachandra, 2009, Ravindranath, N.H., Balachandra, P., 2009. Sustainable bioenergy for India: Technical, economic and policy analysis. Energy 34, 1003–1013

Ravindranath, Balachandra 2009, Sustainable bioenergy for India: Technical, economic and policy analysis, N.H. Ravindranath, P. Balachandra, Energy Policy 34 (2009) pg 1003–1013

Singh K D. 2008a, Forests, farms and trees: recent trends and future prospects, International Forestry Review Vol 10 (2) : 103-115

Singh K D. 2008b, Balancing fuelwood production and consumption in India, International Forestry Review Vol 10 (2) : 190-200

Sinha, 2002, Bhaskar Sinha, The Indian stove programme: an insider's view – the role of society, politics, economics and education, Boiling Point 48, pg 23.

TEDDY, 2009, The Energy Data Directory Yearbook, 2008/09, The Energy and Resources Institute, New Delhi, India.

Thornley, Rogers and Huang, 2008, Quantification of employment from biomass power plants.

UN, 2007, Sustainable Bioenergy: A framework for decision makers. United Nations Energy. 2007.

Verma M. 2008, Framework for forest resource accounting: factoring in the intangibles, International Forestry Review Vol 10 (2) : 362-375

WHO, 2002, The World Health Report 2002: Reducing Risks, Promoting Healthy Life World Health Organization, Geneva

WWF, 2007, Sustainability Standards for Bioenergy, World Wildlife Fund for Nature, Germany, 2006

VII.3. ERI

BTG.sustainable criteria & certification systems for biomass production. 2008

Center for Renewable Energy Development, Energy Research Institute, NDRC . THE RENEWABLE ENERGY INDUSTRIAL DEVLEOPMENT REPORT (2008). GOC/WB/GEF China Renewable Energy Scale-up Program.2009

National Development and Reform Commission, P.R. China. The Mid- and Long-term Plan for Renewable Energy. 2007

National Energy Administration, P.R. China. Chinese Energy Industry in Sixty Years.2009

U.S. Department of Energy, U.S. Department of Agriculture. Sustainability of Biofuels: Future Research Opportunities. Report from the October 2008 Workshop, Workshop Dates: October 28–29, 2008,Report Publication Date: April 2009, http://genomicsgtl.energy.gov/biofuels/sustainability/

VII.4. Energy Environment and Development Network for Africa (AFREPREN/FWD)

AFREPREN/FWD (2006), ‘Cogen for Africa FSP (Full Size Project) Brief Final Report’, AFREPREN/FWD, Nairobi.

AFREPREN/FWD (2008), ‘Large Scale Hydropower, Renewable Energy Adaptation and Climate Change: Climate Change and Energy Security in East and Horn of Africa’, Occasional Paper N0. 33, AFREPREN/FWD, Nairobi.

Central Electricity Board (CEB). 2009. 2008 Annual Report. Curepipe: Central Electricity Board

Daily Nation. 2010. Mumias secures Sh1.6bn loan. http://www.nation.co.ke/magazines/smartcompany/Mumias%20secures%20Sh1bn%20loan%20/-/1226/999666/-/e2l2yfz/-/index.html. Accessed 5th September 2010.

Deepchand K. (2001) ‘Bagasse-Based Cogeneration in Mauritius – A Model , for Eastern and Southern Africa’. Occasional Paper No. 2, African Energy Policy Research Network (AFREPREN/FWD), Nairobi, Kenya.

Deepchand, K. 2002. ‘Promoting Equity in Large-scale Renewable Energy Development: The Case of Mauritius’. Energy Policy Journal, Volume 30, Issues 11-12, September 2002, Pages 1129-1142. Elsevier Science, Oxford. UK.

ESDA (undated), ‘Biomass Conversion Technologies’, http://www.esda.energyprojects.net/links/biomass.htm, Nairobi, Kenya: Energy for Sustainable Development Africa (ESDA).

Export Processing Zone Authority (EPZA), 2005. Kenya’s Sugar Industry 2005. Nairobi: EPZA.

Food and Agriculture Organization (FAO). 2004. FAO Fertilizer and Plant Nutrition Bulletin - 15. http://www.fao.org/docrep/008/y5749e/y5749e0e.htm

http://www.pisces.or.ke/pubs/pdfs/Jatropha%20Feasibility%20Study%20Final.pdf

Imitira, J.K. 2009. Power Situation in Kenya: Reforms to Guarantee Security of Supply. Presentation made at the Experts Roundtable on the Current Crisis in Kenya on 27th August 2009, Nairobi.

Karekezi, S. and Kithyoma, K. 2006. Bioenergy and the Poor. In: Hazell, P.B.R., and Pachauri, R. K. (Eds). Focus 14: Bioenergy and Agriculture: Promises and Challenges for Food, Agriculture, and the Environment, Brief 11 of 12, December 2006. International Food Policy Research Institute: Washington, DC.

Karekezi, S. and Kithyoma, W. 2005. Sustainable Energy in Africa: Cogeneration and Geothermal in The east and Horn Africa – Status and Potential. Nairobi: AFREPREN/FWD.

Karekezi, S., Kimani, J., Kamoche, M. and Ajuoga, V. 2009. Successfully Implementing Cogeneration Development in Africa. Paper presented at the Cogeneration World Africa 2009, 16th – 17th September, 2009, Johannesburg.

Karekezi, S., Kithyoma, W. and Kamoche, M. 2009. Evaluating Biomass Energy Cogeneration Opportunities and Barriers in Africa: The Case of Bagasse Cogeneration in the Sugar Industry. In: Kelly, R. (Ed.) Biocarbon in Eastern & Southern Africa: Harnessing Carbon Finance to Promote Forestry, Agro-Forestry and Sustainable Energy. UNDP: New York.

KenGen. 2010. Kenya Electricity Generating Company. http://www.kengen.co.ke/

Kenya National Bureau of Statistics (KNBS). 2009. Economic Survey 2009. Nairobi: Kenya National Bureau of Statistics.

Kenya Sugar Board (KSB). 2009. Year Book of Statistics 2008. Nairobi: Kenya Sugar Board.

Kenya Sugar Board (KSB). 2010. Kenya Sugar Board Website. http://www.kenyasugar.co.ke

Kiva, I. 2009. GoK Responses to the Energy Crisis. Presentation made at the Experts Roundtable on the Current Crisis in Kenya on 27th August 2009, Nairobi.

Legros, G., Havet, I., Bruce, N. and Bonjour, S. 2009. The Energy Access Situation in Developing Countries: A Review Focusing on the Least Developed Countries and Sub-Saharan Africa. New York: UNDP and World Health Organization.

Mauritius Sugar Industry Research Institute (MSIRI). 2006 Mauritius Sugar Industry Research Institute Annual Report 2005. MSIRI: Réduit

Mbendi. 2010. Sugarcane Farming in Kenya. http://www.mbendi.com/indy/agff/sugr/af/ke/p0005.htm

Mbuthi, P. 2006. Cogen for Africa: Kenya Country Report, Unpublished Report. Nairobi: AFREPREN/FWD.

Menya, W. 2008. Sugar Board, Millers Want Law Amended. 14th December 2008, Saturday Nation. http://www.nation.co.ke/business/news/-/1006/501780/-/j3op6az/-/index.html

Ministry of Energy (MoE). 2004. Draft National Energy Policy. Nairobi: MoE.

Ministry of Energy (MoE). 2010. Feed-in Tariffs Policy on Wind, Biomass, Small-Hydro, Geothermal, Biogas and Solar Resource Generated Electricity. http://www.energy.go.ke/index.php?option=com_content&task=view&id=39&Itemid=35

MoE, 2008. Feed-in Tariffs Policy on Wind, Biomass, and Small Hydro Resource Generated Electricity. Ministry of Energy, Nairobi, Kenya.

Mugambi, K. 2010. Mumias Clean Energy Project Roars Into Life. Business Daily. 22nd Feb 2010. http://www.nation.co.ke/business/news/-/1006/604632/-/ijjwduz/-/

Mumias Sugar Company (MSC). 2009. Annual Report & Financial Statements. Mumias: Mumias Sugar Company Ltd.

Mumias Sugar Company (MSC). 2010. Overview of Mumias Sugar Company. http://www.mumias-sugar.com/index.php?page=Overview

Muok, B. and Kallback, L. 2008. Feasibility Study of Jatropha Curcas as a Biofuel Feedstock in Kenya.

Murungi, K. 2009. Kenya's Energy Sector Bubbling with Opportunities. Business Daily, 10 April 2009.

Nguyen, T.L.T and Gheewala, S.H.. 2008. Case Study: Life Cycle Assessment of Fuel Ethanol from Cane Molasses in Thailand. http://www.thaiscience.info/Article%20for%20ThaiScience/Article/3/Ts-3%20life%20cycle%20assessment%20of%20fuel%20ethanol%20from%20cane%20molasses%20in%20thailand.pdf

Odhiambo, A. 2010. KPLC to Pay More for Mumias Power Supply. Business Daily 2 February 2010.

Veragoo, D. 2003. "Cogeneration: The Promotion of Renewable Energy and Efficiency in Mauritius". Paper presented at the Eastern Africa Renewable Energy and Energy Efficiency Partnership (REEEP) Regional Consultation Workshop, 9-10th June 2003. Nairobi: AFREPREN/FWD and REEEP.

World Alliance for Decentralized Energy (WADE). 2004. World Survey of Decentralized Energy.

VII.5. ENDA - Energy, Environment, Development

African Economic Outlook, available at: http://www.africaneconomicoutlook.org/en/countries/west-Africa/mali/ (09.10.2009)

Agalssou, Alassane/ AMADER, 2008: Atelier International de COMPETE 25 Nov 2008: Bioenergie et Electrification Rurale. Cas de Garalo, 2.

Ampofo K. 1996: National Biogas Resource Assessment. Ministry of Energy, Ghana

Bioenergy and Biofuels: Opportunities and Constraints by International Assessment of Agricultural Knowledge, Science and Technology for Development.

Central Intelligence Agency. (2009). The World Factbook: Ghana. Updated October 28, 2009. Retrieved from https://www.cia.gov/library/publications

CIESIN: Center for International Earth Science Information Network, available at: http://www.ciesin.org/decentralization/English/CaseStudies/mali.html (09.10.2009).

Commission of the European Communites, COM(2008) yyy final: Directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources. Version 15.4

COMPETE International Workshop: Bioenergy Policies for Sustainable Development in Africa. 25-27 Nov 2008, Bamako, Mali. Proceedings, December 2008, p. 10. Disponible sur: http://www.compete-bioafrica.net/events/events2/mali/COMPETE-Workshop-25Nov-Mali-Proceedings-090331.pdf (21.09.2009) - Short citation: COMPETE Bioenergy Policies 2008 .

DEFCCS, document du projet de réhabilitation des forêts et espaces ruraux, 2007, 132p MEF, Document de stratégie pour la croissance et la réduction de la pauvreté au Sénégal (2006-2010), 2006, 103p

DEFCCS, Nouvelle politique forestière du Sénégal, 2005 DEFCCS, 143 pages.

DIARRA, A. : Etudes des retombées économiques et financières liées à l'exploitation du bois énergie pour les populations locales dans le cadre d'un aménagement participatif au Sénégal : cas du massif de Thiéwal dans la Région de Kolda, 2006, memoire ISFAR, 46 pages,

Diawara, Sinalou, 2008: Bioenergy Policies in Mali - Issues of Energy Supply and Energy Security.Presentation at the COMPETE International Workshop: Bioenergy Policies for Sustainable Development in Africa. Nov 2008, Bamako, Mali, 2. Available at: http://www.compete-bioafrica.net/events/events2/mali/Session1-1-Diawara-COMPETE-WS- Mali-2008.pdf

Dogbevi, E. K. 2009. "Biofuel Africa Produces First 50 Barrels of Biodiesel from Jatropha". Retrieved from https://www.ghanabusinessnews.com

Encyclopedia of the Nations, available at: http://www.nationsencyclopedia.com/Africa/Mali- ECONOMIC-DEVELOPMENT.html (09.10.2009)

Enda Energy, Environment, Development: Bio energy for rural Development and Poverty alleviation in West Africa. Draft Inception Report. April 2009, 12-13.

Energy Commission, 2003. "Indigenous Energy Resources Catalogue", A background assessment report prepared as part of the Strategic National Energy Plan

Energy Commission. (2005) Strategic Energy Plan and Policy: 2005-2020, Vol. 1

FAO Final Report 2009: Small-Scale Bioenergy Initiatives: Brief description and preliminary lessons on livelihood impacts from case studies in Asia, Latin America and Africa. Final Report, January 2009, 51-55. Available at: <ftp://ftp.fao.org/docrep/fao/011/aj991e/aj991e.pdf>

FAO, situation des forêts dans le monde, 2002,181 pages.

Garalo Bagani Yelen – un nouveau paradigme énergétique pour le développement durable en Afrique. L'électrification des 10 000 habitants de Garalo à partir de l'huile de pourghère, MFC Nyetaa (Mali-Folkecenter) 2007. Available at : bionecho.org/bamako/docs/MFC_Garalo07_fr.pdf (25.09.2009).

Ghana National Petroleum Corporation (GNPC). 2008. Status Report on the Jubilee Field Oil and Gas Development

Ghana Statistical Service (GSS). (2002). 2000 Population and Housing Census Report. Accra, Ghana

Ghana Statistical Service. (2008). Ghana Living Standards Survey; Report of the Fifth Round (GLSS 5), Accra, Ghana

Indigenous Energy Resource Catalogue, School of Engineering, KNUST, April 2003.

Johnston M & Holloway T. 2007. A Global Comparison of National Biodiesel Production Potential, Environmental Science and Technology, Vol. 41(23) pp: 7967-7992

Jumbe, Charles; Frederick Msiska; Lewis Mhango: COMPETE First Periodic Activity Report, January 2008. Annex 6-I Report on National Policies and Strategies, 6.

KITE, (2007). “Review of Jatropha Initiatives in Ghana”. Report submitted to the UNDP Agenda for Growth Project

KITE, (2008). “Feasibility Study of Domestic Biogas in Ghana”. Report submitted to the Shell Foundation.

KITE. (2009). “Biomass Energy for Sustainable Development: An Assessment of the Feasibility of Using Agricultural Residues and Municipal Waste to Produce Modern Energy Services in Selected Communities in the Eastern Region of Ghana”. Final Report Submitted to the American Physical Society

Koopmans, A. and J. Koppejan, 1997. “Agricultural and Forest Residue – Generation, Utilization and Availability”, Paper presented at the Regional Consultation on Modern Applications of Biomass Energy, 6-10 January, Kuala Lumpur, Malaysia

Lucien NDECKY, Vérification et réactualisation éventuelle des cœfficients de conversion de la meule Casamance sous zones aménagées : cas du massif aménagé de Missirah/Kothary, région de Tambacounda. Mémoire ISFAR, 61p

Maiga, A.S., G.M. Chen, Q. Wang, J. Y. Xu, 2006: Renewable Energy Options for a Sahel country: Mali, in: Renewable and Sustainable Energy Reviews 12 (2008), 564-574.

Mame Cor S., Etude de la filière du charbon de bois au Sénégal, 2008, 61p, Banque mondiale

MANGA, D. Etude de l’apport des produits forestiers non ligneux dans un programme d’aménagement forestier participatif et intégré : cas du massif forestier communautaire de Thiéwal dans la zone d’intervention de PROGEDE/KOLDA. 2003, Mémoire de fin d’étude, ENCR Bambey,42 pages.

Massing, Andreas, 2007: The household energy market in urban Mali, available at: http://www.hedon.info/TheHouseholdEnergyMarketInUrbanMali , last edited: 04.12.2008.

Mensah, A. and E. Larbi. 2005. “Solid Waste Management Disposal in Ghana”, WELL Factsheet – Regional Annexes in Developing Countries, November

Ministre des Mines, de l’Energie et de l’Eau, Secrétariat Général, 2006: La Politique Energétique du Mali.

Ministry of Energy, 2002. “Draft National Woodfuel Policy”

Ministry of Energy, 2005. “Draft National Biofuel Policy”

Ministry of Food and Agriculture (MOFA), 2007. Food and Agriculture Sector Development Policy (FASDEP II)

Ministry of Lands and Forestry, 1994. Forest and Wildlife Policy of Ghana

National Development Planning Commission (NDPC). (2009). 2008 Annual Progress Report, Accra, Ghana

National Policies and Strategies on Bioenergy in Africa, Ghana case study, COMPETE, January 2008.

NGOM A. Analyse de la filière du charbon de bois pour une implication des populations rurales et une gestion durable des ressources forestières. 1994 Mémoire de fin d'étude, ENSA ;106 pages.

NGOM, A et al, Eude de la filière du bois d'œuvre pour la réforme du régime fiscal forestier au sénégal, 2006, 56p

NGOM, A., Analyse de la viabilité financière et institutionnelle du projet de production de charbon de bois par les populations rurales dans les régions de Tamba et de Kolda. Mémoire IFACE(UCAD) 20003, 67p

NIANG, M. Production de bois d'œuvre et opportunités d'exploitation et de commercialisation au profit des populations locales dans le cadre de l'aménagement participatif et intégré du massif forestier communautaire de Saré gardi(Département de Kolda) dans la zone d'intervention du PROGEDE. 2005 Mémoire de fin d'étude, ENCR Bambey, 64 pages.

Onua Amoah, 2006. "Jatropha: A Catalyst for Economic Growth". Paper Presented at a Regional Workshop on Financing Biofuels and Jatropha Plantations, La Palm Royal Beach, Accra, Ghana, 13-14 November. Retrieved from http://www.unctad.org/sections/wcmu/docs/ditc_comb_jatropha001

Oteng-Adjei, J. (2009). "Energy for Growth – Vision and Agenda". Statement presented by the Minister of Energy at a Press Conference, May 5

Outtara, Ousmane, 2008: Jatropha Network Activities in Mali. Presentation at the COMPETE International Workshop: Bioenergy Policies for Sustainable Development in Africa. Nov 2008, Bamako, Mali, 2. Available at: http://www.compete-bioafrica.net/events/events2/mali/Session2-2-Ouattara-COMPETE-WS-Mali-2008.pdf

PROGEDE, 1998, diagnostic économique des villages riverains de la forêt communautaire de Thiéwal, compilation des rapports MARP.

Rijssenbeek, Winfried, Ibrahim Togola, FACT Foundation, 2006: Jatropha Village Power in Garalo, Mali. A new Dimension for People, Planet and Profit Actions, available at: http://www.fact-foundation.com/en/Projects/Mali/Documentation

Rijssenbeek, Winfried/ FACT Foundation, 2008: Jatropha for Rural Development Applications and Revenue Sources, Presentation for the COMPETE Workshop, Bamako 25 Nov 2008, 8.

Sanogo, Cheik Ahmed, 2005: Energie et écodéveloppement au Mali, in : Helio International : Observatoire de la viabilité énergétique 2005/2006, 6. Available at : http://www.helio-international.org/reports/pdfs/Mali-FR.pdf

Sentinel Security Assessment - West Africa, 25.03.2008, available at: http://www.janes.com/articles/Janes-Sentinel-Security-Assessment-West-Africa/INFRASTRUCTURE-Mali.html (consulted 09.10.2009)

Sow, Hamed, Energy Minister of Mali: La politique energétique au Mali. Mettre nos resources au service du développement, in : Croissance Actualité (2007) Vol. 37, 11. Available at: http://www.ffa-int.org/files/p.11EURSOWEURCA37.pdf

Togola, Ibrahim, 2009: MFC Jatropha activities and case studies. Barriers and opportunities for financing. COMPETE Financing Conference Dakar, 29 Sept – 1 Oct 2009, 2.

Touria Dafrallah, Secou Sarr, Etude RETs II, ENDA-GNESD ‘Policies and Measures for Large Scale Dissemination of Improved Stove in Africa: the Case of Senegal’, 2006

UN Energy, 2007. Sustainable Bioenergy: A Framework for Decision Makers

UNCTAD (2008) – Making Certification Work for Sustainable Development: The Case of Biofuels, New York and Geneva

United Nations Conference for Trade and Development, 2008: Making Certification work for Sustainable Development: The Case of Biofuels.

Van der Putten, Eric 2009: Jatropha Handbook, 2nd edition – June 2009. Available at: http://www.fact-foundation.com/en/Home

WHO/UNICEF. (2008). Coverage Estimates for Improved Drinking Water and Sanitation. Joint Monitoring Programme Report.

Wijgerse, Inge, 2008: The electricity system for a rural village in Mali, Master Thesis Sustainable Energy Technology. TU/e

Wijnker, Mara, FACT Team Member, 2008: Report on visit to Bamako and Garalo, Mali, January 2008.

World Bank, Africa Technical Department, Review of Policies, Strategies and Programs in the Traditional Energy Sector. In: Proceedings of Workshop 1, Bamako, Mali, May 10–12, 1993 (Working-level translation from French, 1993). p. 23.

World Bank. (2009). Country Brief: Ghana. Updated September 2009. Retrieved from https://www.go.worldbank.org/OAKWTY7640

Yeoh, B. G. 2004. “A Technical and Economic Analysis of Heat and Power Generation from Biomethanation of Palm Oil Mill Effluent”. Paper Presented at an International Conference on Electricity Supply Industry: Issues and Prospects for Asia, AIT, Thailand, 14-16 January

VII.6. Energy Research Centre South Africa – South Africa, Mozambique and Malawi

ActionAid. 2008. Food, Farmers and Fuel: Balancing Global Grain and Energy policies with Sustainable Land Use. Johannesburg : ActionAid International, 2008.

Battle, D. 2009. Working for Energy programme. Energy Management News. September, 2009, Vol. 15, 3.

Bridge, S. 2004. Sasol ponders soya biodiesel plant. http://www.businessreport.o.za. [Online] 12 March 2004.

Chimwala, M. 2008. Malawi looks to diversify energy mix with ethanol stove plan. Engineering News. 25 January , 2008.

—. 2008. Malawi moves to scale-up jatropha-based biodiesel industry. Engineering News. 06 June, 2008.

Dewees, PA. 1995. Trees on farms in Malawi: Private Investment, Public Policy and Farmer Coice. World Development. 1995, Vol. 23, 7.

DME. 2007. Biofuels Industrial Strategy of the Republic of South Africa. Pretoria : Department of Minerals and Energy (DME), 2007.

—. 2004. Capacity Building in Energy Efficiency and Renewable Energy: Economic and Financial Calculations and Modelling for the Renewable Energy Strategy Formulation. Pretoria : Department of Minerals and Energy, 2004.

—. 1998. White Paper on the Energy Policy of the Rebublic of South Africa. Pretoria : Department of Minerals and Energy, 1998.

—. 2002. White Paper on the Promotion of Renewable Energy and Clean Energy Development. Pretoria : Department of Minerals and Energy, 2002.

—. 2003. White Paper on the Renewable Energy Policy of the Republic of South Africa. Pretoria : Department of Minerals and Energy (DME), 2003.

DWAF. 2005. A Woodland Strategy Framework for the Department of Water Affairs and Forestry. Pretoria : Department of Water Affairs and Forestry, 2005.

—. 1997. National Forestry Programme. Pretoria : Department of Water Affairs and Forestry, 1997.

—. 1996. White Paper on Sustainable Forest Development in South Africa. Pretoria : Department of Water Affairs and Forestry, 1996.

Econergy. 2008. Mozambique Biofuels Assessment. Washington, D.C. : Ecoenergy, 2008.

European Bioethanol Fuel Association. 2009. EU biofuels policy. http://www.ebio.org/policy.php. [Online] 2009. [Cited: 20 01 2010.]

European Environmental Bureau (EEB). 2009. EEB Analysis of EU's revised biofuels and bioenergy policy. www.eeb.org. [Online] 18 03 2009. [Cited: 20 01 2010.]

FAO. 2009. How to feed the world 2050 - A special challenge for sub-saharan Africa. Rome : Food and Agricultural Organisation, 2009.

Government of Malawi. 2007. Charcoal - the reality: A study of charcoal consumption, trade and production in Malawi. Lilongwe : Government of Malawi, 2007.

INE. 2006. Statistical yearbook. Maputo : National Statistical Institute, 2006.

IPPC, UNEP and WMO. 2007. Climate Change 2007: the physical science basis. New York : Cambridge University Press, 2007.

Janssen, R, Rutz,D, Woods, J, Diaz-Chavez, R. 2009. Bioenergy for sustainable development in Africa - Environmental and social aspects. http://www.compete-bioafrica.net/sustainability/OD_9-2_paper_COMPETE_Janssen_090730.pdf. [Online] 2009. [Cited: 28 01 2010.]

Mataveia, M. 2009. Biofuel policy and strategy for Mozambique. Presentation. New York : s.n., 2009.

Meyer, F, Strauss, PG and Funke, T. 2008. Modelling the impact of macro-economic variables on the South African biofuels industry. s.l. : Agrekon, 2008. Vol. 47, 3.

Ministry of Agriculture; Ministry of Energy. 2008. Mozambique Biofuels Assessment. Maputo : Ministry of Agriculture and Ministry of Energy, 2008.

National Biofuels Task Team (NBTT). 2006. National Biofuels Study: An Investigation into the Feasibility of Establishing a Biofuels Industry in the Republic of South Africa. s.l. : Department of Minerals and Energy http://www.dme.gov.za/energy/documents.stm, 2006.

NERSA. 2009b. Renewabble Energy Feed-In Tariffs Phase II. Pretoria : National Energy Regulator of South Africa (NERSA), 2009b.

—. 2009a. South Africa Renewable Energy Feed-in Tariff (REFIT) Pase 1, Regulatory guidelines. Pretoria : National Energy Regulator of South Africa (NERSA), 2009a.

OECD. 2006. OECD review of agricultural policies - South Africa. s.l. : OECD, 2006.

Pegels, A. 2009. Prospects for renewable energy in South Africa - Mobilizing the private sector. Bonn : German Development Institute, 2009.

Republica de Mozambique. 2009. Approva a Politica e estsategia de biocombustiveis. Maputo : Boletim da Republica, Publicacao Oficial de Mozambique 3. Suplemento, 21 May, 2009.

SADC. 2005. Feasibility study for the production and use of biofuels in the SADC region. Gaborone, Botswana : Southern African Development Community, 2005.

Scholes, RJ,. 2004. Woodlands of South Africa. [book auth.] MJ, Eeeley, HAC, Shackleton, CM, Geach, BGS Lawes. Indigenous Forsts and Woodlands in South Africa - Policy, Peo;e and Practice. s.l. : University of Kwa-Zulu natal Press, 2004.

SEI. 2001. Charcoal Potential in Southern Africa, CHAPOSA: Final Report for Mozambique. Stockholm : Stockholm Environment Institute, 2001.

Shackleton, CM, et al. 2004a. Fuelwood and Poverty Alleviation in South Africa: Opportunities and Constraints. s.l. : Report for DWAF, 2004a.

Shackleton, CM, Grundy,IM, Williams,A. 2004b. Use of South Africa's woodlands for energy and construction. [book auth.] MJ, Eeley, HAC, Shackleton, CM, Geach, BGS Lawes. Indigenous Forests and Woodlands in Southern Africa. s.l. : University of Kwa-Zulu-Natal Press, 2004b.

Statistics South Africa. 2007. Community survey 2007. Pretoria : Statistics South Africa, 2007.

Thompson, MW. 1999. South Africa's National Land-Cover Database Project. Data Users Manual. Final Report. Pretoria : CSIR, 1999. Vol. Report No. ENV/P/C 98136.

Tilman, D, Socolow, R, Foley, JA, Hill, J, Larson, E, Lynd, L, Pacala, S, Reilly, J, Searchinger, T, Somerville, C, Williams, R. 2009. Beneficial biofuels - The food, energy and environment trilemma. Science. 2009, Vol. 325, 5938:270-271.

Von Maltitz, G, Willis, CB, Geldenhuys, CJ. 1999. Natural forests. [book auth.] FJ Kruger. State of the Forests. Pretoria : CSIR, 1999.

Von Maltitz, GP and Brent, A. 2008. Assessing the Biofuel Options for Southern Africa. Pretoria : CSIR Natural Resources and Environment, 2008.

Wiggins, S. 2009. Can the smallholder model deliver poverty reduction and food security for a rapidly growing population in Africa. Future Agricultures Consortium. FAC Working Paper, 2009, Vol. 8, 2.

Wilson, SC, et al. 2005. Review of the Status of Biodiesel related Activities in South Africa. Cape Town : Report for the City of Cape Town, South Africa, 2005.

—. 2005. Review of the Status of Biodiesel Related Activities in South Africa. s.l. : Report for the City of Cape Town, 2005.

World Bank. 2009a. Africa - Regional Brief. [Online] 2009a. [Cited: 02 12 2009.] http://go.worldbank.org/3lGKDWFTG1.

—. 2008. Malawi Country Brief. Washington : World Bank, 2008.

VII.7. Fundación Bariloche

AAPRESID Manual de Buenas Prácticas Agrícolas, AAPRESID, http://www.aapresid.org.ar/agricultura.asp, October 2008b.

AAPRESID Protocolo de Agricultura Certificada, AAPRESID, http://www.aapresid.org.ar/agricultura.asp, October 2008a.

Agostini, C. et al, Spatial distribution of poverty in Chile, Estudios de Economía. Vol. 35 - N° 1, Junio 2008. Págs. 79-110.

Ajila, Víctor Hugo and Chiliquinga, Byron, “Analysis of Biofuels Legislation in Latin America” Analisis de Legislación sobre Biocombustibles en América Latina, OLADE, April 2007.

Barril G., A. y Almada, F. (ed.) La Agricultura Familiar en los países del Cono Sur. Asunción, IICA, 2007.

Bravo, V. Requerimientos básicos y mínimos de energía de los pobladores urbanos y rurales pobres e indigentes de Argentina, IDEE/Fundación Bariloche, 2004.

CNE (National Energy comisión Chile) Política Energética, Nuevos Lineamientos, 2008. http://www.cne.cl/archivos_bajar/Politica_Energetica_Nuevos_Lineamientos_08.pdf

Comisión Nacional de Energía, Chile, La electrificación rural en Chile – Logros de un plan social del gobierno 1992-2002, 2003.

CORFO Chile, Renewables in Chile Investment opportunities and project financing Project's Directory, 2008.

DNETN, Ministerio de Industria, Energía y Minería del Uruguay, Evaluación Económico – Financiera Proyecto de 10 MW Generación de Electricidad a partir de Residuos y/o Subproductos de Biomasa, Noviembre, 2008.

Donato, L. B., Estimación del consumo potencial de gasoil para las tareas agrícolas, transporte y secado de granos en el sector agropecuario, Instituto de Ingeniería Rural, INTA, 2007.

ECLAC Statistical Yearbook for Latin America and the Caribbean, 2007; Panorama Social de América Latina, CEPAL 2008.

ESMAP, Technical Paper 082, Desafíos de la electrificación rural en Chile, October 2005.

ESMAP. Paraguay. Power Sector Strategy, May 2004.

Fundacion Bariloche, RETs II Final Report, FB-GNESD, March 2007

Fundacion Bariloche, RETs Inicial Assessment and Policy Outlines, 2005.

Hilbert, J.A. et al., Rendimiento comparativo de biodiesel y gasoil en tractores agrícolas INTA, 2002.

Honty, G. and Gudynas, E. CLAES, Observatorio del desarrollo Mayo 2007.

Hoogwijk. M. and Graus. W. 2008. Global Potential of Renewable Energy Sources: A Literature Assessment. ECOFYS. 2008. http://www.ren21.net/pdf/REN21_RE_Potentials_and_Cost_Background_document.pdf

Iglesias Casanueva, Rebeca. Biomasa, agroenergía, bioenergía, eficiencia energética, ahorro energético. ODEPA, Santiago, Chile. Septiembre de 2008.

IICA (Instituto Interamericano de Cooperación para la Agricultura), Atlas de la agroenergía y los biocombustibles en las Américas: 1 etanol. San José, Costa Rica, 2007.a

IICA, Enfoques y Estrategias para Enfrentar la Pobreza Rural en Uruguay, June 2005

IICA, Informe anual 2008: la contribución del IICA a la agricultura y al desarrollo de las comunidades rurales en Paraguay. IICA, Asunción, 2009.

IICA, Instituto Interamericano de Cooperación para la Agricultura, Desarrollo Rural Sostenible Políticas para la Prosperidad Rural, La contribución de la agricultura y de los territorios rurales a la creación de empleo y la reducción de la pobreza". San José, Costa Rica, 2006.

Jahns, Ricardo. Energía Renovable para la Electrificación Rural Descentralizada Proyecto PAR/00/G41 Documento de Proyecto. Gabinete del Viceministro de Minas y Energía, Paraguay 2002, GVME/PNUD.http://www.ssme.gov.py/VMME/archivos%20varios/publicaciones/Project_Brief.pdf

Kozulj, R. Contribución de los servicios energéticos a los Objetivos de Desarrollo del Milenio y a la mitigación de la pobreza en América Latina y el Caribe. ECLAC, Club de Madrid, GTZ, PNUD, 2009

Lorenzatti, S. Factibilidad de implementación de un certificado de agricultura sustentable como herramienta de diferenciación del proceso productivo de siembra directa, MSc.Thesis, Agronomy School, University of Buenos Aires, September 2006.

Obschatko, E, del Pilar Foti, M. and Román, M. Los pequeños productores en la República Argentina. Importancia en la producción agropecuaria y en el empleo en base al Censo Nacional Agropecuario 2002. 1a ed. - Buenos Aires: Secretaría de Agricultura, Ganadería, Pesca y Alimentos: Instituto Interamericano de Cooperación para la Agricultura I.I.C.A., 2006.

OLADE, Diagnóstico del Sector energético en el área rural de Paraguay, November 2005

Pistonesi, H. Nadal, G., Bravo, V. and Bouille, D. Aporte de los biocombustibles a la sustentabilidad del desarrollo en América Latina y el Caribe. OLADE/GTZ, Santiago de Chile, 2008.http://www.eclac.cl/cgi-Bin/getProd.asp?xml=/publicaciones/xml/6/32836/P32836.xml&xsl=/drni/tpl/p9f.xsl&base=/drni/tpl/top-bottom.xslt

Quijano, João Carlos. Asunción, 22 May 2007. REDIEX, Paraguay. Net of investments and exportations http://www.rediex.gov.py/carlos-quijano-BID.pdf

Regúnaga, M. (Coordinator) Agrocombustibles y Desarrollo Sostenible en América Latina y el Caribe, 2008.

Sergio Von Horoch – Consultores, Development Of Decentralised Rural ElectrificatIon - "APPLIMAR" Project Country Study: Paraguay. Asunción, Paraguay, April 1998.

Slutzky, D. PROINDER Situaciones Problemáticas de Tenencia de la Tierra en Argentina, July 2006.

Trejo García, Elma del Carmen, Estudio de Derecho Comparado y Marco Jurídico Internacional sobre Biocombustibles/Bioenergéticos. Centro de Documentación, Información y Análisis, Dirección de Servicios de Investigación y Análisis, Subdirección de Política Exterior, México, Abril, 2007

Wasielke, Angelika (Ed) Energy-policy Framework Conditions for Electricity Markets and Renewable Energies, 23 Country Analyses, Chapter Chile, Eschborn, GTZ, September 2007.

Yapura, P.Madera controlada: otra contribución del FSC al uso responsable de los recursos forestales, Fundación Vida Silvestre Argentina, Feria Internacional del mueble y la madera, Formosa, Argentina, October 2006.

VII.8. CENBIO/CentroClima

AMAYA AVILA, A. A. Analysis of Potencial and Barriers for the Developing and Implementation of Palm Oil Biodiesel in Colombia (in Portuguese). 2009. 165 p. Master Thesis. Graduation Program on Energy. University of Sao Paulo..

ANEEL (Agência Nacional de Energia Elétrica – National Electric Energy Agency). “Informações técnicas”, 2007. Available at: http://www.aneel.gov.br

ANEEL (AGÊNCIA NACIONAL DE ENERGIA ELÉTRICA - National Electric Energy Agency) “Banco de Informações de Geração”, 2008. Available at: http://www.aneel.gov.br.

ASOCAÑA. Asociación de Cultivadores de Caña de Azúcar de Colombia, 2008. Available at: http://www.asocana.org/

BALLESTEROS, M. MANZANARES, P. BioTop Biofuels Overview of Existing Biomass Conversion Technologies in Latin America. BIOTOP - Assessment
on Technical Opportunities and Research Needs for Latin America., 2009

BALSADI, O. V. “Mercado de trabalho assalariado na cultura da cana-de-açúcar no Brasil no período 1992-2004”. Informações Econômicas, São Paulo, v. 37, n. 2, 2007.

BERNDES, G. 'Bioenergy and water. The implications of large-scale bioenergy production for water use and supply', Global Environmental Change 12 (4), 253-271, 2002

BNDES - Banco Nacional de Desenvolvimento Econômico e Social, 2009. Access to the website http://www.bndes.gov.br/SiteBNDES/bndes/bndes_pt

BNDES. “Sugarcane-based Bioethanol – Energy for Sustainable Development”. Rio de Janeiro, 2008. Available at: www.bioetanolcana.org

BRAUNBECK O. Personal Communicatyion in van den Wall Bake, 6-12-2005, Fac. Engenharia Agrícola, UNICAMP, Campinas, Brazil, 2005

BRAUNBECK, O. et al. Prospects for green harvesting and cane residue use in Brazil, Biomass and Bioenergy 17, p. 495-506, 1999.

CÂMARA, G. M. S. BIODIESEL BRASIL - ESTADO ATUAL DA ARTE. Piracicaba, 2006

CASPARY, G."Gauging the future competitiveness of renewable energy in Colombia," Energy Economics, Elsevier, vol. 31(3), pages 443-449, 2009

CENICAÑA. Centro de Investigación de la Caña de Azúcar de Colombia, 2008. Available at: http://www.cenicana.org/

CENTRAIS ELÉTRICAS BRASILEIRAS S. A. – Eletrobrás, 2009. Available at: http://www.eletrobras.com/elb/main.asp?View=%7B293E16C4-A8C9-49C8-AF77-DD1B488978EC%7D&langid=en

CERRI, C.E.P et al., 2007. “Predicted soil organic carbon stocks and changes in the Brazilian Amazon between 2000 and 2030.” Agriculture, Ecosystems and Environment 122, 58–72.

COELHO, S. et al. Implementation of a 200 kW Thermal Power Plant using Wood Residues from a Sawmill Industry in Brazil’s North Region. 14th European Biomass Conference and Exhibition. Paris, França, 2005a

COELHO, S. et al. Palm Oil as Fuel to Conventional Diesel Engines in the Amazon Region Isolated Communities. 14th European Biomass Conference and Exhibition. Paris, França, 2005b

COELHO, S. et al. Uso de Óleo de Palma “In Natura” como Combustível em Comunidades Isoladas da Amazônia. III Workshop Brasil-Japão em Energia, Meio Ambiente e Desenvolvimento Sustentável, Campinas, SP, Brasil, 2005c

CORPODIB - CORPORACIÓN PARA EL DESARROLLO INDUSTRIAL DE LA BIOTECNOLOGÍA Y PRODUCCIÓN LIMPIA. Estrategia de Insercion del Biodiesel en el Mercado de los Combustibles en Colombia. Colombia: Bogotá, 2003

COSTA, R. C.; SANTOS, A. M. Biodiesel production in Brazil: barriers and opportunities to produce biofuels in degraded lands. In: SANCHEZ, Ilya B; ALONSO, Carl L. (org.). Deforestation research progress. Nova York: Nova Publishers, v. 1, 2008, p. 110-150.

CTC - CENTRO DE TECNOLOGIA CANAVIEIRA. Simposio de Avaliacao da Agroindustria da Cana-de-Açucar no Estado de Alagoas, 1988

DAMEN, K. Future Prospects for Biofuel Production in Brazil, Master Thesis, Utrecht University. NWSE - 2001-31, p. 68., 2000

DIAZ, J. C.V. El programa de biocombustibles en Colombia. Ministério de Minas y Energia, 2007

DUFEY, A. Biofuels production, trade and sustainable development: emerging issues. Sustainable Markets Discussion Paper 2. International Institute for Environment and Development, London, UK, 2006. Available at: http://www.iied.org/pubs/pdf/full/15504IIED.pdf

DUFEY, A., S. VERMEULEN AND W. VORLEY. Biofuels: Strategic Choices for Commodity Dependent Developing Countries. Common Fund for Commodities, 2007

ECOFYS. Global potential of renewable energy sources: a literature assessment (Working Report). March, 2008. Available at Http://www.ecofys.com/com/publications/reports_books.asp

EMBASSY OF COLOMBIA, 2009. Available at: www.colombiaemb.org

EIA - Energy Information Administration. Country Analysis Briefs: Colombia, 2009. Available at: http://www.eia.doe.gov/cabs/Colombia/pdf.pdf

FARGIONE, J.; Hill, J.; Tilman, D.; Polasky, S.; and Hawthorne, P., 2008. “Land clearing and the biofuel carbondebt.” Science 319, 1235–1238.

FEDEPALMA. Federación Nacional de Cultivadores de Palma de Aceite. Colombia, 2008. Available at: http://www.fedepalma.org/

GOMES, L. M., REIS, R. B.; CRUZ, C.B.M. “Análise da cobertura florestal da Mata Atlântica por município no Estado do Rio de Janeiro”. Anais XIV Simpósio Brasileiro de Sensoriamento Remoto, Natal, Brasil, INPE, p. 3849-3857, 2009

GLOBAL TRADE ATLAS. Official data obtained from the exports-imports database, 2008.

GOLDEMBERG, J. et al., Ethanol learning curve- the Brazilian experience. Biomass and Bioenergy, vol. 26/3 pp. 301-304, 2003.

GOLDEMBERG, J. Sugarcane ethanol: strategies to a successful program. University of São Paulo, São Paulo, Brazil, 2010, Springer (to be published)

GOLDEMBERG, J. Sustainability of sugarcane ethanol in the state of Sao Paulo, Brazil. Personal written communication to K. Kwant, SenterNovem, 2006.

GOLDEMBERG, J.; “The challenge of biofuels”. Energy & Environmental Science Vol. 1, pp. 523-525. doi: 10.1039/b814178a, 2008

GOLDEMBERG, J.; NIGRO F. E. B. N.;COELHO S. T.; "Bioenergia no Estado de São Paulo: Situação Atual, Perspectivas, Barreiras e Propostas", Imprensa Oficial do Estado de São Paulo. São Paulo, 2008

GOLDEMBERG, J.; GUARDABASSI, P. Ethanol: can the success of Brazil be replicated? Future Science. Biofuels (2010) 1(5), under publication, 2010

GUILHOTO, J. J. M. “Geração de emprego nos setores produtores de cana-de-açúcar, açúcar e álcool no Brasil e suas macro-regiões”. Cenários para o setor de Açúcar e Álcool Report. São Paulo: MB Associados e Fipe, 2001.

HOLANDA, A. Biodiesel e inclusão social. Brasília: Câmara dos Deputados, Coordenação de Publicações, p.13-60. (Série Cadernos de Altos Estudos; n.1), 2004

HORTA NOGUEIRA, L. A. Biocombustíveis na América Latina: situação atual e perspectivas. São Paulo: Cadernos do Memorial da América Latina, 2007.

IEA - International Energy Agency, 2008. Available at: http://www.eia.org

IEA - International Energy Agency. IEA Energy Statistics, 2009. Available at: http://www.iea.org/textbase/stats/pdf_graphs/COTPESPI.pdf

IEA - International Energy Agency. IEA Energy Statistics, 2009a. Available at: http://www.iea.org/Textbase/stats/renewdata.asp?COUNTRY_CODE=CO (September, 21th, 2009).

IBGE - Instituto Brasileiro de Geografia e Estatística ; Resolução No. 05, de 10 de Outubro de 2002, Área Territorial: UF – São Paulo – SP - 35 Pdf-file from ftp-archive. Areas of municipalities in São Paulo state. Retrieved on 2008-10-14., 2002a

IBGE- Instituto Brasileiro de Geografia e Estatística. Sistema Sidra IBGE de Recuparação Automática (2002). Available at: http://www.sidra.ibge.gov.br/bda/tabela/listabl.asp?z=cd&o=7&i=P&c=2094. Retried on 2009-9-14, 2002b

IBGE- Instituto Brasileiro de Geografia e Estatística. Pesquisa Nacional por Amostragem de Domicílios (PNAD), 2009a.

IBGE - Instituto Brasileiro de Geografia e Estatística. Sistema de Recuperação Automática – SIDRA, 2009b. Available at: www.sidra.ibge.gov.br/bda/pecua/default.asp?t=2&z=t&o=22&u1=1&u2=1&u3=1&u4=1&u5=1&u

KLINE, K. L. et al. Biofuel Feedstock Assessment for Selected Countries. ORNL Biofuel Feedstock Assessment, 2008

KOPLOW, D. Biofuels: At What Cost? Government Support for Ethanol and Biodiesel. In: the United States report prepared by Earth Track, Inc for !e Global Subsidies Initiative (GSI) of the International Institute for Sustainable Development (IISD), Geneva, Switzerland, 2006

LORA, B.A., Monteiro, M.B., Assunc-a˜o, V., Frigerio R., 2006. "Levantamento Georreferenciado da Expansão da Cultura de Cana-de-Açúcar no Estado de São Paulo" (Georeferenced Assessment of Sugarcane Culture Expansion in Sao Paulo state), Sao Paulo, December 2006.

LUCAS, L. P. Da campanha "O Petróleo é Nosso" aos desafios do pré-sal. Instituto Teotônio Vilela, 2009

MACEDO, I. C. "Greenhouse gas emissions and energy balances in bio-ethanol production and utilization in Brazil (1996)". Biomass and Bioenergy, v. 14 (1), 1998

MACEDO, I. C. "The sugarcane agro-industry and its contribution to reducing CO2 emissions in Brazil". Biomass and Bioenergy, v. 3 (2), 1992.

MACEDO, I. C. et al. "Greenhouse gases emissions in the production and use of ethanol from sugarcane in Brazil: The 2005/2006 averages and a prediction for 2020". Biomass and Bioenergy, v. 32 (4), 2008.

MACEDO, I. C. et al. Balanço das emissões de gases do efeito estufa na produção e no uso do etanol no Brasil. São Paulo: Secretaria do Meio Ambiente, Governo de São Paulo, 2004.

MACEDO, I. C. et al. Sugarcane's energy. Twelve studies on Brazilian sugarcane agribusiness and its sustainability, UNICA, pp. 237, 2005

MACEDO, I. C.; HORTA NOGUEIRA, L. A. "Balanço de energia na produção de açúcar e álcool nas usinas cooperadas". Boletim Técnico Copersucar, v. 31/85, 1985.

MACEDO, I.; CORTEZ, L.A.B., Sugar-cane industrial processing in Brazil, reader UNICAMP, São Paulo, Brazil, 1999

MAPA - MINISTÉRIO DA AGRICULTURA, PECUÁRIA E ABASTECIMENTO. Grupo de Trabalho Interministerial – Biodiesel. Relatório Final Anexo III. Subgrupo Aspectos Tecnológicos, 2003

MEIRELLES, F. S. Biodiesel. Brasília, 2003.

MENDES, A. P. A; COSTA, R.C. Mercado brasileiro de biodiesel e perspectivas futuras. BNDES Setorial 31, p. 253-280, 2009

MILANEZ, A. Y. et al. Perspectivas para o etanol brasileiro. Rio de Janeiro: Departamento de Biocombustíveis/BNDES, 2008.MME BOLETIIM MENSAL DOS COMBUSTIVEIS RENOVAVEIS, MAIO/2010.

MOREIRA, J. R., & GOLDEMBERG, J. The alcohol program. Energy Policy , 27, pp. 229-245, 1999

NACIONAL DIESEL BOARD, USA. Biodiesel Production and Quality, 2007. Available at: http://www.biodiesel.org/

NASSAR A. et al., 2009. Impacts on Land Use and GHG Emissions from a Shock on Brazilian Sugarcane Ethanol Exports to the United States using the Brazilian Land Use Model (BLUM). Report to the U.S. Environmental Protection Agency regarding the Proposed Changes to the Renewable Fuel Standard Program. Institute for International Trade Negotiations Report (ICONE).

NASSSAR, A. et al. ,2010. An allocation methodology to assess GHG emissions associated with land use change. Final Report. Institute for International Trade Negotiations Report (ICONE).

NASTARI, P. O mercado de etanol. Presented at the “I Simpósio Internacional de Combustíveis, Biocombustíveis e Emissões” (1st International Symposium of Fuels, Biofuels and Emissions), Datagro, Associação Brasileira de Engenharia Automotiva, São Paulo, 2008.

PASQUIS, R. – Etude Préliminaire en Vue de l’Evolution des Projets de Reforme Agraire en Amazonie Legal – Relatório de Pesquisa – CIRAD-UnB-CenDoTec, 2004

PIACENTE, A.E. Perspectivas do Brasil no Mercado Internacional de Etanol. (Dissertação de Mestrado). Campinas: Universidade Estadual de Campinas, Faculdade de Engenharia Mecânica, 2006

PNAD - Pesquisa Nacional por Amostra de Domicílios. Pesquisa Nacional por Amostra de Domicílios (National Household Sample Survey). Instituto Brasileiro de Geografia e Estatística (IBGE), 2009. Available at http://www.ibge.gov.br/home/estatistica/populacao/trabalhoerendimento/pnad2004/default.shtm

RAMOS, L. P. Conversão de óleos vegetais em biocombustível alternativo ao diesel convencional. In: CONGRESSO BRASILEIRO DE SOJA, Londrina, 1999. Anais. Londrina: Embrapa-Soja, p.233-236, 1999

RAMOS, L.P.; DOMINGOS, A.K.; KUCEK, K.T.; WILHELM, H.M. Biodiesel: um projeto de sustentabilidade econômica e sócio-ambiental para o Brasil. Biotecnologia: Ciência e Desenvolvimento, v.31, p.28-37, 2003

RIEGELHAUPT, E. et al.Overview of biofuel markets and biofuel applications in Latin America. BIOTOP - Assessment on Technical Opportunities and Research Needs for Latin America, 2009

ROJAS, M. Assessing the Engine Performance of Palm Oil Biodiesel. Biodiesel Magazine. Available at: http://www.biodieselmagazine.com/article.jsp?article_id=1755, 2007

SEARCHINGER T.; HEIMLICH R.; HOUGHTON R.H.; DONG F.; ELOBEID A.; FABIOSA J.; TOGKOZ S.; HAYES D.; AND T YU.; 2008.“Use of U.S. croplands for biofuels increases greenhouse gases through emissions from land use change.” Science 319, 1238–1240.

SEVERINGHAUS, J. Why we import Brazilian bioethanol. Iowa Farm Bureau, 2005

SMA -SAO PAULO STATE SECRETARY FOR THE ENVIRONMENT, 2010. Projeto Etanol Verde. Available at: http://www.ambiente.sp.gov.br/etanolverde/index.php#

SMEETS, E., M. JUNGINGER, A. FAAIJ, A. WALTER AND P. DOLZAN. Sustainability of Brazilian bio-ethanol. Copernicus Institute - Department of Science, Technology and Society for SenterNovem, The Netherlands Agency for Sustainable Development and Innovation, The Netherlands, Utrecht, 2006

THE COLOMBIA INFRASTRUCTURE REPORT, 2008. Business Monitor International. ISSN 1752-5314. January, 2008, 45pp.

TOASA, J. Colombia: A New Ethanol Producer on the Rise? WRS-0901 Economic Research Service/USDA, 2009

UNCTAD - United Nation Conference on Trade and Development. Making Certification Work for Sustainable Development: The Case of Biofuels 2008.

UNICA – UNIÃO DA INDÚSTRIA DE CANA-DE-AÇÚCAR. Estatísticas. União da Indústria de Cana-de-Açúcar, 2008. Available at: http://www.portalunica.com.br.

UNITED NATIONS. United Nations Database 2009. Available at http://data.un.org/CountryProfile.aspx?crName=Brazil

UNITED NATIONS. United Nations Database, 2009a. Available at http://data.un.org/CountryProfile.aspx?crName=Colombia

UPME - Unidad de Planeación Minero Energética. Biocombustibles en Colombia, 2009. Available at: http://www.upme.gov.co/Index2.htm

WEHRMANN, M. E. S. F.; VIANNA, J. N. S; LAURA M. G. DUARTE, L. M.G.D. Biodiesel de Soja: Política Energética, Contribuição das Oleaginosas e Sustentabilidade. Associaço Nacional de Pós-Graduação e Pesquisa em Ambiente e Sociedade – ANPPAS, 2006. Available at: http://www.anppas.org.br/encontro_anual/encontro3/arquivos/TA457-28032006-162404.DOC.

WORLD BANK, 2008. Double jeopardy: Responding to high food and fuel prices. Available at: http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:21827681~pagePK:64257043~piPK:437376~theSitePK:4607,00.html.

YUSOFF, S. Renewable energy from palm oil e innovation on effective utilization of waste. Journal of Cleaner Production, 87 - 93, 2004

ZUURBIER, P; VOOREN, J.V. Sugarcane ethanol- Contributions to climate change mitigation and the environment. Wageningen Academic Publishers: The Netherlands, 2008

ANNEX I – Results from Reports

<table>
<tr><th colspan="6">Main findings of the Bioenergy countries reports - Africa</th></tr>
<tr><th>Block of countries studied</th><th>Existing biomass</th><th>Country</th><th>Proposed case studies</th><th>Production data</th><th>Main specific characteristics</th></tr>
<tr><td rowspan="5">Ethiopia, Kenya, Sudan, Tanzania and Uganda</td><td rowspan="5">Wood fuel, ethanol, biodiesel, biogas</td><td>Block of countries</td><td></td><td></td><td>Most African farmers are subsistence farmers; and low agricultural productivity is one of the major problems in poor rural areas. Biofuels are agricultural crops, which countries hope will stimulate agricultural productivity of smallholder farmers not only for bioenergy crops but also for food production. In the past cash crops such as tobacco, tea, cotton, were thought to stimulate agricultural productivity and rural development but they generally failed to do so. The challenge is to make sure that a more suitable agricultural development model is adopted for growing and processing the new biofuel crops for both smallholder farms and agribusiness plantations. The challenge for the new biofuel industry is to strengthen support for smallholder farmers, so as to enable them to be the engine of agricultural growth and poverty reduction in sub-Saharan Africa. The vast majority of the population depends on traditional biomass such as wood fuel, charcoal and agricultural residue for their energy needs. The development of biofuels in Africa should not only fill the cars in the industrialised world but should primarily alleviate energy poverty in the country where the feedstock is grown.</td></tr>
<tr><td rowspan="4">Kenya</td><td>a) Biomass cogeneration – bagasse (molasses)</td><td>Over the past 10 years, bagasse production in the country has increased by nearly by 30%. In 2008, the sugar factories in the country crushed over 5 million tonnes of sugarcane thereby producing just above 2 million tonnes of bagasse.</td><td rowspan="4">Relatively well endowed with biomass resources. In summary there are three main potential sources of modern bioenergy, namely: use of naturally occurring biomass such as wood from trees and other plants to produce modern energy; conversion of biomass waste from processes of agro-industries into modern energy; and, commercially grown crops solely grown for modern energy production. In 1998, close to 25% of the country's electricity was generated from the sugar industry, largely using the by-product bagasse. By 2001, electricity generation from sugar estates stood at 40% (half of it from bagasse) of the total electricity supply in country.</td></tr>
<tr><td>b) Electricity from sugarcane factories</td><td>With current sugar production levels, assuming that all sugar factories had efficient high pressure boiler technology installed, sugar factories in Kenya have the potential to generate nearly 80 MW of electricity</td></tr>
<tr><td>c) Biogas - Landfill gas</td><td>Number of installed biogas digesters is about 500</td></tr>
<tr><td>d) Bioethanol – molasses and sugarcane</td><td>It is estimated that about 41 million litres of ethanol could be produced annually based on the existing production of molasses from the sugar production process. Like other aspects, the Kenya Bioenergy Report merely shows potential, not production data</td></tr>
</table>

Main findings of the Bioenergy countries reports - Africa					
Block of countries studied	**Existing biomass**	**Country**	**Proposed case studies**	**Production data**	**Main specific characteristics**
Mali, Ghana, Senegal	Traditional wood fuel and charcoal	**Block of countries**	Biodiesel - jatropha	West Africa recently began the commercial production of biodiesel. It has declared 10 metric tons of biodiesel produced from its 650 hectare jatropha plantation	
South Africa, Malawi, Mozambique	Traditional wood fuel	**Malawi**	a) Bioethanol – sugarcane		
			b) Biodiesel – Jatropha, soya		
			c) Improved wood fuel (?)		
		South Africa	a) Bioethanol: sugarcane and sugarbeet		
			b) Biodiesel: sunflower, canola, and soya beans		
			c) Pulp and paper mills		
			d) Landfill gas		
			e) Sugar bagasse: high pressure boilers, tops & trash		
		Mozambique	a) -Bioethanol- Sugarcane and sweet sorghum		
			b) Biodiesel - Jatropha curcas and coconut		
			c) Pellets		

Main findings of the Bioenergy countries reports - Asia					
Block of countries studied	**Existing biomass**	**Country**	**Proposed case studies**	**Production data**	**Main specific characteristics**
Thailand and Indonesia	Traditional biomass, agricultural residues for electricity production	**Thailand**		Residue available for energy (Mt, in 2005): 64.80 (including: Sugarcane, Paddy, Oil palm, Coconut, Cassava, Maize, Groundnut, Cotton, Soybean and Sorghum)	Biomass, which has been mostly used as fuel in rural households and industries, is now playing a greater role as fuel in power generation and as an energy source for bio-liquid fuel production for vehicles. The key factors for the successful promotion of bio-energy programmes are: priority of renewable energy in the national energy policy, authorised government institutions for promoting and implementing renewable energy policy and actions, and continuous and strong support from the government and other financing schemes.
			a) Bioethanol: sugarcane and others	As of March 2010, there were 19 ethanol plants in Thailand with a capacity of 2.93 million liters per day	
			b) Biodiesel – oil palm	As of March 2010, there were 14 biodiesel production plants with the total capacity of (B100) 5.9 million liters/ day	
			c) Biogas – rural areas	In 2008, total production capacity was 300 million m^3 of biogas per year, and this is used for heat and power generation. The installed capacity of biogas for electricity generation in Thailand is about 10.6 MW	
			d) Biomass power – bagasse, biogas, residues	Thailand's Ministry of Energy estimates that the potential of power generation in Thailand from biomass, municipal solid wastes (MSW) and biogas is 3,700 MW by 2011	
		Indonesia		**Installed Capacity (biomass) = 445 MW (in 2007)**	**-**
			a) Biogas – palm oil and other residues	The country has a history in domestic biogas, with about 6,000 units constructed. Before the year 2000, mostly fixed dome digesters were used, but in more recent years the plastic bag digester has become more popular. By the end of December 2009, 50 plants had been installed through partner organisations in Bandung, Garut, Pasuruan, Malang and Solo and a NGO Programme which aims to install 8,000 biogas plants, including 2,000 units outside of Java by	There is a vast potential to implement biomass power generation and cogeneration projects in Indonesia using agro-industrial residues, which still remains untapped. Biomass is one source of renewable energy that has the potential to substitute petroleum-based fuel. The government has issued policies to increase its usage, including mandates and incentives to promote biomass energy projects.

Main findings of the Bioenergy countries reports - Asia					
Block of countries studied	**Existing biomass**	**Country**	**Proposed case studies**	**Production data**	**Main specific characteristics**
				the end of 2012	
			b) Biomass power – palm oil residues, rice husks	Existing plants include 10.3 MW palm oil residue plant in Pangkalanbrandan, Sumatra, 10.5 MW palm oil residue plant in Riau, Sumatra, and 3MW rice husk plant in Lampung, Sumatra.	
			c) Bioethanol – palm oil, jatropha, coconut oil	The production of ethanol in 2008, was 144 million liters	
			d) Biodiesel – corn, molasses, cassava	The production of biodiesel in 2008 was 1,238 million liters	
China	Agricultural residue, forestry residue, municipal solid waste and livestock waste, biogas, ethanol	**China**		It is estimated that exploitable biomass resources in China total about 700 Mtce	Bioenergy resources are scattered, mainly located in rural regions. Traditional use of biomass through direct combustion still accounts for about 98 percent of total bio-energy in the rural areas, resulting in serious waste of resources and environmental pollution. Utilisation of bioenergy with different biomass conversion technologies producing various types of high-grade, high-quality and low-polluting energy products, could meet the pressing demand of energy in rural areas, and also could improve biomass thermal efficiency to 35~40%. There are other benefits such as saving resources, improving farmers' standard of living. Will develop bioenergy in a wide range of forms, hopefully focusing on biofuel for transport in the long term.
			a) Biopower: agriculture and forestry/forest product wastes	By 2010, the installed capacity of biomass power based on agricultural and forestry waste and energy crop plantations (bagasse included) will be 4 GW	
			b) Biogas – rural/urban residues	14 billion cubic meters. Biopower from biogas: By 2010, the installed capacity of power generation based on MSW is expected to be 500 MW	
			c) Biomass for heating – pellets; residues gasification	By 2010, the annual consumption of biomass pellet fuels around the country are expected to reach 1 million tons	
			d) Bioethanol – grain; molasses; cassava; sweet sorghum and others; cellulosic ethanol . FFV	1.65 million tons (2008)	
			e) Biodiesel – waste oil	100 thousand tons (2008)	

Main findings of the Bioenergy countries reports - Asia					
Block of countries studied	**Existing biomass**	**Country**	**Proposed case studies**	**Production data**	**Main specific characteristics**
India		**India**		**The total potential of non-fodder crop residues available for energy is currently estimated to be 319 MT for 2009-10.**	With huge urban-rural disparity in terms of access to commercial energy forms such as grid electricity and LPG, bioenergy has an important role to play in not only contributing to the supply to meet future demand, but also in reducing the existing energy access in-equity. As biomass as a resource is more equitably distributed than other energy sources and also can be procured locally from a variety of sources, it addresses energy security (a relevant concern in a country that is already dependent on energy imports). Bioenergy contributes to nearly 90% of energy used in rural households and about 40% of energy used in urban households use. At the level of policy, a multi-pronged strategy for leveraging bioenergy for poverty alleviation and rural development was adopted : i) improving efficiency of the traditional biomass use (e.g. improved cook-stove programme), ii) improving the supply of biomass (e.g. social forestry, wasteland development), iii) technologies for improving the quality of biomass use (e.g.biogas, improved cook-stoves), iv) introduction of biomass based technologies for heat and electricity generation to deliver services provided by conventional energy sources, and v) establishing institutional support for programme formulation and implementation (formation of separate government wing to exclusively deal with non conventional energy sources).
			Improvements on the use of traditional biomass	Cumulative Achievements (as of 30-Sep-2006): Power generation from Surplus biomass = 466.5 MW; Power generation from sugar cogeneration = 571.83 MW; Waste to Energy = 34.95 MW; Bioenergy from Cattle dung = 1.12 billion m3/year; Ethanol for transport = > 1 MTOE/year	
			a) Biomass power for remote village – combustion and gasification	A variety of biomass gasifier based power generation systems using woody and non-woody biomass and capacities varying in the range of 5 to 1000 kWe have been developed indigenously for electrical applications. An aggregate capacity of 100 MWe of biomass gasifier systems (including both dual fuel and 100% producer gas mode systems) have been deployed in the country as on 31st August 2008 under various programmes.	

Main findings of the Bioenergy countries reports - Asia					
Block of countries studied	**Existing biomass**	**Country**	**Proposed case studies**	**Production data**	**Main specific characteristics**
			b) Biogas – animal waste	In addition to the biomass combustion and gasifier programme, MNRE also started a scheme called Biogas Based Distributed/Grid Power Generation Programme from 2005-06 onwards with a view to promote biogas based power generation, specially in the small capacity range, based on the availability of large quantity of animal waste, waste from forestry, rural based industry waste (agro / food processing), kitchen waste, etc. Under the programme MNRE provides CFA at a maximum of Rs.30,000 to 40,000 per kW depending upon capacity of the power generating projects in the range of 3 kW to 250 kW of different rating limited to 40% of the plant cost. The projects could be taken up by any village level organisation, institution or private entrepreneur in rural areas.	

<table>
<tr><th colspan="6">Main findings of the Bioenergy countries reports - South America</th></tr>
<tr><th>Block of countries studied</th><th>Existing biomass</th><th>Country</th><th>Proposed case studies</th><th>Production data</th><th>Main specific characteristics</th></tr>
<tr><td rowspan="5">Brazil, Colombia, Bolivia and Ecuador</td><td rowspan="5">Ethanol, biodiesel, wood fuel, charcoal, biogas and agricultural and forestry residues</td><td rowspan="3">Brazil</td><td>a) Bioethanol - sugarcane</td><td>Brazil produced 27,5 billion litres of sugarcane ethanol in 2008/2009</td><td rowspan="3">Huge experience in biofuels and bioenergy in general. Existing zoning from Federal Government and from some states define which areas are adequate for sugarcane crops without putting pressure on fragile biomes. Key players in the international market (and context) of bioenergy.</td></tr>
<tr><td>b) Biodiesel – soya, animal fat, palm oil, …</td><td>1.6 billion litters of biodiesel in 2009</td></tr>
<tr><td>c) Electricity production from bagasse</td><td>In 2007, the electricity production from sugarcane bagasse contributed with 3% of the total electricity production in Brazil. The installed capacity of electricity production at the sugarcane mills is estimated as about 3,400 MW (ANEEL, 2008), being about 1,800 MW the capacity of surplus electricity production.</td></tr>
<tr><td rowspan="2">Colombia (similar to Brazil, smaller scale)</td><td>a) Bioethanol – mainly from palm oil</td><td>327.2 million litters of ethanol were produced in 2009</td><td rowspan="2">Starting a biofuel programme and local perspectives are quite positive. New legislation is being introduced to incentivise biofuels, as well as to guarantee their sustainable production.</td></tr>
<tr><td>b) Biodiesel – palm oil</td><td>350 million litters of biodiesel in 2008</td></tr>
<tr><td rowspan="4">Argentina, Chile, Paraguay and Uruguay</td><td rowspan="4">Biodiesel, wood fuel, agricultural residues</td><td>Block of countries</td><td></td><td>Biomass Electricity Generation, kTOE, in 2007: Argentina = 271; Chile = 534 ; Paraguay = 0; Uruguay = 1</td><td></td></tr>
<tr><td rowspan="3">Argentina</td><td>a) Gasification, anaerobic digestion, small scale biodiesel, PPO, biomass steam cycles</td><td>The estimated production of biodiesel in Argentina is of 2.3 million tons for 2010</td><td>The most abundant biomass resources are located in the north east and north central part of the country, mainly associated with forest biomass</td></tr>
<tr><td>b) Forest biomass</td><td></td><td>Enforced a national biofuels programme, which includes biodiesel, bioethanol and biogas</td></tr>
<tr><td>c) Agricultural residues</td><td>The number of agricultural and livestock exploitations with poverty profiles in Argentina was around 130,000 in year 2002</td><td></td></tr>
</table>

Main findings of the Bioenergy countries reports - South America					
Block of countries studied	**Existing biomass**	**Country**	**Proposed case studies**	**Production data**	**Main specific characteristics**
		Chile	Black liquor wood and forest residue.	The country has a 73 MW (nominal) installed capacity (thermal steam generation for 2007) using black liquor as energy source; and 118 MW from wood and forest residues.	Biofuel commercialisation was authorised in mixtures of 2% or 5% (volume basis) for both ethanol (with gasoline) and biodiesel (with diesel). In April 2008, a National Law, was enacted, mandating that 5% of the electricity generated be renewable, an obligation that binds commercialisation agents
		Paraguay	Biodiesel –, animal fat	In Paraguay, in 2007, 1.6 million litres of biodiesel from bovine fats were produced	The most promising niches in Paraguay lie in the production and use of vegetable oil, biogas and eventually biodiesel for self consumption
		Uruguay	Forest biomass	Forestry Industry Residues in Uruguay (2003) = 260.000 cubic meters	Has an ethanol blending mandate of up to 5% until 2015 and minimum 5% from that year on. Blending mandate will be completed during 2010. For biodiesel the blending mandate started at 2% in 2009 and will reach 5% in 2012. Has a policy (National Decree 77/06) for developing electricity generation from biomass, including its connection to the national grid

ANNEX II – Previous Results from Inception Reports

Centers	Countries studied in the Inception Phase	Existing biomass	Proposed case studies
AFREPREN (Kenya)	Ethiopia, Kenya, Sudan, Tanzania and Uganda	Wood fuel, ethanol, biodiesel, biogas	Kenya - Biomass cogeneration – bagasse - molasses - Biogas - Landfill gas - Bioethanol – sugarcane
AIT (Thailand)	Thailand and Indonesia	Traditional biomass, agricultural residue for electricity production	Thailand - Bioethanol: sugarcane and others - Biodiesel – oil palm - Biogas – rural areas - Biomass power – bagasse, biogas, residue Indonesia - Biogas – palm oil and other residues - Biomass power – palm oil residue, rice husks - Bioethanol – palm oil, jatropha, coconut oil - Biodiesel – corn, molasses, cassava

Centers	Countries studied in the Inception Phase	Existing biomass	Proposed case studies
CENBIO/CentroClima (Brazil)	Brazil, Colombia, Bolivia and Ecuador	Ethanol, biodiesel, fuel wood, charcoal, biogas and agricultural and forestry residue	Brazil - Bioethanol - sugarcane - Biodiesel – soya, animal fat, palm oil, … - Bagasse cogeneration Colombia (similar to Brazil, smaller scale) - Bioethanol – sugarcane - Biodiesel – palm oil - Bagasse cogeneration
Enda (Senegal)	Mali, Ghana, Senegal (West Africa)	Traditional fuel wood and charcoal	Mali - Biodiesel - jatropha Ghana - Biodiesel - jatropha Senegal - Biodiesel - jatropha

Centers	Countries studied in the Inception Phase	Existing biomass	Proposed case studies
ERC (South Africa)	South Africa, Malawi, Mozambique	Traditional wood fuel	Malawi - Bioethanol – sugarcane - Biodiesel – Jatropha, soya - Improved wood fuel (?) South Africa -Bioethanol: sugarcane and sugarbeet -Biodiesel: sunflower, canola, and soya beans -Pulp and paper mills -Landfill gas - Sugar bagasse: high pressure boilers, tops & trash Mozambique - Bioethanol - Sugarcane and sweet sorghum - Biodiesel - Jatropha curcas and coconut

Centers	Countries studied in the Inception Phase	Existing biomass	Proposed case studies
ERI (China)	China	Agricultural residue, forestry residue, municipal solid waste and livestock waste, biogas, ethanol	- Biopower: agriculture and forestry/forest product waste - Biogas – rural/urban residue - Biomass for heating – pellets; gasification residue - Bioethanol – grain; molasses; cassava; sweet sorghum and others; cellulosic ethanol (?), FFV - Biodiesel – waste oil
Fundación Bariloche (Argentina)	Argentina, Chile, Paraguay and Uruguay	Biodiesel, fuel wood, agricultural residues	- Gasification, anaerobic digestion, small scale biodiesel, PPO, biomass steam cycles Forest biomass Agricultural residues Livestock waste
MEDREC (?) (Tunisia)	Tunisia	Woody biomass, biogas and biodiesel	Pellets Biogas *Jatropha curcas*

Centers	Countries studied in the Inception Phase	Existing biomass	Proposed case studies
TERI (India)	India	Fuel wood, agricultural residues, biogas, biodiesel and ethanol.	- Improvements on the use of traditional biomass - Biomass power for remote village – combustion and gasification - Biogas – animal waste