



MINISTRY OF ENERGY

Renewable Energy Department

**Strategy for developing the Bio-Diesel Industry in Kenya
(2008-2012)**

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Preface

The supply and use of energy is very dynamic. The Ministry of Energy is committed to ensuring adequacy, reliability and security in the supply of energy, while protecting the environment. Development of indigenous energy resources offers security of supply. The oil prices in the world market have continued on an upward trend. The reliance on imported fuels for economic development and the attendant fluctuation of oil prices in the world market provides the justification for developing local energy sources, particularly with a view to reducing the foreign exchange expenditure on importing petroleum products. The government is aware of the current developments across the globe in search for green energy such as biodiesel.

This strategy provides the framework for implementing activities geared towards the development of the biodiesel industry. It provides an avenue for resource mobilization to facilitate the various activities outlined. It provides direction for developing the relevant rules and regulations for governing the industry, as well as prudent implementation of biodiesel programmes with due concern for food security, environmental protection and socio-economic development.

The strategy also outlines the various steps necessary for developing a vibrant biodiesel industry. The multidisciplinary nature of biodiesel development made it necessary to form the National Biofuels Committee whose efforts have made it possible to come up with this strategy. Every agency that is represented on this committee is important for the successful implementation of this strategy. The commitment by the strategy development taskforce to this task is immeasurable and they are commended for a job well done.

The formation of the Kenya Biodiesel Association will provide a forum for addressing and streamlining many issues pertaining to the industry in collaboration with the relevant Government organizations. It is my hope that all stakeholders will work towards the success of this initiative. It is envisaged that this strategy will enable more Kenyans to enjoy and derive comfort from the supply of biodiesel for agricultural production, employment creation, rural urban balance and blending in the motor vehicle industry.

It is my hope that the strategy leads to transformation of the country from an importer of liquid petroleum fuels to local self sufficiency and an exporter to the wider market abroad. I therefore urge wide readership and adoption of this strategy as the Government's initial step towards developing a vibrant industry.

Patrick Nyoike, CBS
PERMANENT SECRETARY

Acknowledgement

The Biodiesel strategy taskforce (Appendix 5) which was entrusted with developing this document wishes to acknowledge the contribution of the various institutions and individuals.

First, a lot of support and encouragement was received from the Permanent Secretary, Ministry of Energy.

Secondly, the Chairman of the National Biofuels Committee provided unlimited guidance and oversaw the whole process.

Thirdly, the members of the National Biofuels Committee gave a lot of input in terms of comments and participation in meetings.

The taskforce specifically wishes to acknowledge the input from the Study on “The Viability of *Jatropha curcas* as a Biofuel Feed Stock and its Potential Contribution to the Development of Kenya’s Biofuel Strategy”, that was commissioned by the World Bank, and undertaken by Mr. Robinson Ngethe of Agfor Technical Services in collaboration with the Kenya Forest Service and the Ministry of Energy.

A lot of appreciation goes to UNEP for providing financial support for polishing up the document in December 2007.

Last but not least, to all whose efforts contributed in one way or another, but are not mentioned individually, thank you very much for your contribution.

Acronyms and abbreviations

| | |
|-----------|--|
| ASALs | Arid and Semi Arid Lands |
| ASK | Agricultural Society of Kenya |
| CBOs | Community Based Organisations |
| CDM | Clean Development Mechanism |
| CIGs | Common Interest Groups |
| EIA | Environmental Impact Assessment |
| ERC | Energy Regulatory Commission |
| ESDA | Energy for Sustainable Development Africa |
| EU | European Union |
| GDP | Gross Domestic Product |
| GEF | Global Environment Facility |
| ICE | Information Communication and Education |
| ICT | Information and Communication Technology |
| ISAAA | International Service for the Acquisition of Agri-Biotech Applications |
| JKUAT | Jomo Kenyatta University of Agriculture and Technology |
| KARI | Kenya Agricultural Research Institute |
| KEBS | Kenya Bureau of Standards |
| KEFRI | Kenya Forestry Research Institute |
| KenGen | Kenya Electricity Generating Company Ltd. |
| KEPHIS | Kenya Plant Health Inspectorate Services |
| KFS | Kenya Forest Service |
| KIE | Kenya Industrial Estates |
| KIHBS | Kenya Integrated Household Budget Survey |
| KIRDI | Kenya Industrial Research Development Institute |
| KBDA | Kenya Biodiesel Association |
| KPC | Kenya Pipeline Corporation Ltd. |
| KPRL | Kenya Petroleum Refineries Ltd. |
| KRA | Kenya Revenue Authority |
| KTDA | Kenya Tea Development Authority |
| M & E | Monitoring and Evaluation |
| M of Educ | Ministry of Education |
| MOCD&M | Ministry of Cooperative Development and Marketing |
| MFP | Multifunctional Platforms |
| MGSCSS | Ministry of Gender, Sports, Culture and Social Services |
| MOA | Ministry of Agriculture |
| MOE | Ministry of Energy |
| MOYA | Ministry of Youth Affairs |
| NEMA | National Environment Management Authority |
| NGO | Non Governmental Organisation |
| NOCK | National Oil Corporation of Kenya |
| OP | Office of the President |
| PIEA | Petroleum Institute of East Africa |
| R & D | Research and Development |
| UNEP | United Nations Environment Programme |
| UNIDO | United Nations Industrial Development Organisation |

Executive summary

Biofuels have assumed significant importance globally as the world addresses changing patterns in energy supply and demand. Although Kenya is not at the moment obliged to cut down emissions of Green House Gases (GHG) by the Kyoto Protocol, it can be assumed that it is only a matter of time before the country subscribes to future global warming protocols. The transport industry is a major contributor to the emission of greenhouse gases. Current efforts to implement the necessary activities are constrained by the absence of a national strategy that would in effect harness and coordinate the efforts and resources on the ground and therefore, Kenya needs a strategy for development of a sustainable biofuels program. This is supported by the National Energy Policy (Sessional Paper No. 4 of 2004 on Energy) and the subsequent Energy Act, 2006. Whereas biofuels cover a wide range of biomass based forms of energy, this strategy focuses on the development of biodiesel.

Biodiesel refers to a diesel-equivalent processed fuel consisting of short chain alkyl (methyl or ethyl) esters, made by trans-esterification of vegetable oils or animal fats, which can be used (alone, or blended with conventional diesel fuel) in unmodified diesel-engine vehicles. Biodiesel is distinguished from the straight vegetable oils (SVO) or waste vegetable oils (WVO) used (alone, or blended) as fuels in some diesel vehicles. "Biodiesel" is standardized as methyl ester and other diesels of biological origin are not included (Wikipedia).

The major objectives of developing this strategy are to:

- a. Fast track the development of the biodiesel energy resource in Kenya.
- b. Increase security of energy supply by reducing vulnerability resulting from dependence on imported fossil fuels.
- c. Diversify rural energy sources by promoting substitution of kerosene with biodiesel and the use of decentralized energy systems.
- d. Contribute to poverty alleviation through diversification of income sources.
- e. Contribute to efforts to address global warming through substitution of petroleum fuels.

This strategy is driven by the fact that Kenya does not yet have locally produced fossil fuels and is net importer. It suffers the burden of importing fossil fuels depleting the limited foreign exchange resources available. The Economic Survey 2007, indicates that the petroleum import bill was Ksh.113.7 Billion in 2006.

At the rural level, bio-diesel can be used to benefit the rural communities, by using community managed bio-diesel electricity generators to provide lighting for rural households.

The presence of marginal lands in the country offers an opportunity of growing crops that are well suited to such conditions and to rehabilitate the lands for future use. It also offers an opportunity for income generation for the residents.

The major challenges in the developing the biodiesel industry include the adoption and uptake of new technology or product, which is highly dependent on level of understanding/awareness regarding the product. There is also need to avoid competition with food production and conflict with environmental policies. For sustainability of the industry, it will be necessary to protect exchequer incomes. The strategy will facilitate job creation through use of manual labour as opposed to mechanization, help build ownership in the local communities, and assist in the development of strategic infrastructure.

Targeted sectors for blending and substitution include retail pump outlets, road transport, industrial, commercial, and power generation. The entire target sectors combined comprise about 77.6% of the total consumption of petroleum products. According to the Insight Magazine, 61.6% of the total sales of petroleum products (3.73 Million Tonnes) in 2006 comprised diesel and kerosene.

The relevant policy framework for this strategy is the Sessional Paper No.4 of 2004 on Energy. However, policies in other public sectors such as Forests, Agriculture, Trade and Water and Irrigation are expected to impact on the industry.

The main stakeholders in the biodiesel development activities include the Ministries of Energy, Agriculture, Cooperative Development and Marketing, Trade, Water and Irrigation, Transport, Environment and Mineral Resources, Kenya Forest Service, Local Government, Regional Development Authorities, Vanilla Development Foundation and Green Africa Foundation, with the Ministry of Energy as the lead institution.

The choice crop for this purpose is *Jatropha curcas*. Other oil crops will also be investigated for the purpose of creating diversity. Implementation of the strategy will be guided by coordination of the various institutions namely Government, Community Based organization (CBO), Non-Governmental Organizations (NGO), the Kenya Biodiesel Association (KBDA), Energy Regulatory Commission (ERC), local and foreign investors, and the private sector.

Key steps identified in the *Jatropha* value chain include:

1. Production: specifically the availability of land and clean planting material (seeds and seedlings)
2. Stakeholder sensitization and resource mobilization
3. Availability of adequate seeds for processing
4. Processing
5. Marketing, distribution and utilization

The strategic actions proposed to address these steps include:

Facilitating identification and allocation of land for developing *Jatropha* plantations; setting up appropriate institutional arrangements to ensure availability of certified seeds, seedlings, and establishment of nurseries and vendor. It will also be necessary to identify specific farmers through whom the certified seeds and seedlings will be obtained.

A strategy for communication and resource mobilization will have to be developed. An association that brings together all players along the biodiesel production chain will need to be formed (Kenya Biodiesel Association-KBDA).

The Cooperative movement will be supported through the Ministry of Cooperative Development and Marketing (MOCD&M) to integrate biodiesel development into their activities. Investors will be encouraged to start up new ventures.

The Ministry of Agriculture(MOA) and Kenya Industrial Research and Development Institute (KIRDI) will be encouraged to facilitate and support cooperatives and common interest groups (CIGs) to acquire extraction capacity and end use technology. The MOA will also be encouraged to work with MOCD&M to mobilize cooperative societies for production, marketing, finance and value addition

Specific technologies such as multifunctional platforms will be promoted to provide energy services for productive needs in rural development. Sensitization and awareness programs will be undertaken in collaboration with the relevant stakeholders.

Incentives will be promoted to encourage a shift from importing diesel and glycerol. Research and development as well as monitoring and evaluation will be undertaken. Rules, regulations and incentives will be developed. Local ownership of investments will be encouraged.

Mandatory blending targets will be set based on research using phased approach. An economic analysis will be undertaken to establish the appropriate levels of taxation, savings that can be realized from local production of glycerol and justify the concession given to biodiesel among other issues.

These activities will be implemented over a five (5) year period (2008-2012) by the various stakeholders as spelt out in Chapters 4, 5 and Appendix 2 of this strategy. It is estimated that within the first year a total amount of Ksh.121.6 Million will be required to kick start the activities. Thereafter subsequent budgets may be developed based on the guiding budget presented in Appendix 3.

1. Introduction

Biofuels have assumed significant importance globally as the world addresses changing patterns in energy supply and demand. Before 2030 the world is projected to experience net deficits of petroleum supplies as new oil discoveries are offset by depletions. Further, as the world focuses on global climate change, biofuels have assumed importance as the most practical alternative to petroleum fuels in efforts to reduce carbon emissions in the transport sector. Although Kenya is not at the moment obliged to cut down emissions of Green House Gases (GHG) by the Kyoto Protocol, it can be assumed that it is only a matter of time before this obligation takes effect. In addition to addressing the energy security and global warming, biofuels will address the issue of high energy costs associated with imported fossil fuels. Further, the beneficial socio-economic impacts on the Kenyan rural community by a successful biofuels program could be significant.

While bio-fuels comprise bio-diesel, bio-ethanol and other biomass based fuels, this document addresses bio-diesel as the area that requires immediate prioritization. Bio-ethanol and other biomass based fuels will be addressed in separate documents.

Biodiesel refers to a diesel-equivalent processed fuel consisting of short chain alkyl (methyl or ethyl) esters, made by transesterification of vegetable oils or animal fats, which can be used (alone, or blended with conventional diesel fuel) in unmodified diesel-engine vehicles. Biodiesel is distinguished from the straight vegetable oils (SVO) or waste vegetable oils (WVO) used (alone, or blended) as fuels in some diesel vehicles. "Biodiesel" is standardized as methyl ester and other diesels of biological origin are not included (Wikipedia).

There is currently plenty of bio-diesel activity on the ground with a number of NGOs, government ministries and agencies, and individual entrepreneurs, engaged in one way or another in the development of bio-diesel crops and associated processes. These efforts are however, frustrated by absence of a national strategy that would in effect harness and coordinate the efforts and resources on the ground.

For the above reasons Kenya has developed a strategy for development of a sustainable biodiesel program. Indeed the National Energy Policy (Sessional Paper No. 4 of 2004 on Energy) and the subsequent Energy Act, 2006 recognize importance of biodiesel development.

In developing the bio-diesel industry, Kenya will borrow from experiences in other developing countries, so that successes are replicated and pitfalls avoided.

1.1. Objectives

Development of bio-diesel is in conformity with the broad national objective. It has the following major objectives:

- a. Fast track the development of the biodiesel energy resource in the country
- b. To increase security of energy supply by reducing vulnerability resulting from dependence on imported fossil fuels. It is estimated that a 5% reduction in imported diesel can be achieved by year 2012 through substitutions with biodiesel.
- c. To achieve biodiesel blending ratio of B5 by 2012 and B10 by 2020. More definite blending targets will be informed by economic analysis.
- d. To diversify rural energy sources by promoting substitution of kerosene with biodiesel, and the use of decentralized energy systems. The number of people using kerosene for lighting can be reduced from 76.4% in 2005/06 to 50% by 2012 through this substitution.
- e. To contribute to efforts to address global warming through substitution of petroleum fuels.
- f. To contribute to poverty alleviation through diversification of income sources. A poverty incidence of 46.6% was recorded in 2005/06 according to the Kenya Integrated Household Budget Survey (KIHBS). The biodiesel industry is expected to contribute to a 6% reduction of poverty incidence by 2012. Through rural agricultural mobilization, especially in the marginal semi-arid areas, bio-diesel industry can increase household income levels by 30% by 2012.

1.2. Justification

Kenya does not yet have locally produced fossil fuels and is net importer. It suffers the burden of importing fossil fuels which depletes the limited foreign exchange resources available. Oil imports for the year 2005/06 consumed up to Ksh.95,188 billion which was 7.4% of the GDP and 25% of the foreign exchange earnings (Republic of Kenya, 2007). The Economic Survey 2007, indicates that the petroleum import bill increased by Ksh.18 Billion from Ksh.95.7 billion in 2005 to Ksh.113.7 Billion in 2006 (an increase of 18.8%). It also reported that importation of diesel in the year 2006 constituted 57% of the total oil imports. The cost of oil imports is dictated by factors well beyond the control of the nation and thus the need to have secure local oil supplies.

At the rural level, bio-diesel can be used to benefit the rural communities, by using community managed bio-diesel electricity generators to provide lighting for rural households. This has proved very successful in Tanzania. According to KIHBS 2005/06, only about 15.6% of the population has access to electricity. Biodiesel can be used to generate electricity and this could make it possible for more people to access electricity by using decentralised power generation systems. The use of biodiesel in such systems would help cut down on green house gas emissions associated with use of fossil diesel for power generation.

The same survey indicates that over 76.4% of the population relies on paraffin for lighting. 13.2% of the population use paraffin for cooking with Nairobi giving the highest percentage at 63.5%. Substitution of biodiesel for kerosene offers a cleaner alternative by minimizing the pollutant effects from use of kerosene for cooking and lighting.

Kenya is a signatory to the Kyoto Protocol. By reducing carbon emissions through bio-diesel it will be possible to export tradable carbon credits to the countries that immediately require them under the Kyoto Protocol. The transport industry is a major contributor to the emission of greenhouse gases and it would be good to replace the fossil diesel with biodiesel with a view to minimizing green house gas emission from the transport industry.

The presence of marginal lands in the country offers an opportunity of growing crops that are well suited to such conditions and to rehabilitate the lands for future use. Specifically, *Jatropha curcas*, which is a drought resistant perennial plant can be adopted as a biodiesel feed-stock in ASALs, leading to an improvement of the existing forest cover and thus mitigating against the effect of deforestation and degradation as well as serving as carbon sink. The use of marginal land ensures that the high potential areas are not converted to energy production areas and therefore it guards against competition between biofuels and food production.

According to the KIHBS 2005/06, the national poverty incidence was 46.6% against an estimated population of 35.5 million. Development of a biodiesel industry is expected to alleviate this situation with incomes from feed-stock production and job creation in bio-diesel production activities.

1.3. Issues and Challenges Relevant to Bio-Diesels

In developing a bio-diesel strategy, an attempt has been made to ensure all relevant issues and conflicts are considered and as far as possible interventions and solutions offered:

- a. The adoption and uptake of any new technology/product is highly dependent on level of understanding/awareness regarding the product. A biofuel communication strategy aimed at creating awareness on biofuels as an alternative energy source, and the socio-economic and environmental benefits associated with biofuel production is essential. Adoption and uptake of biofuels will largely depend on effective communication involving all stakeholders.
- b. Kenya is yet to be self sufficient in food and diversion of food growing resources (land, water and labor) can work against food security. To avoid competition with food production, the bio-diesel strategy will focus on non-food crops (e.g. *Jatropha curcas*, castor oil, etc.) for biofuel feedstock. Use of crops adaptable to marginal climatic conditions of arid to semi arid areas (ASALs) is recommended.
- c. This strategy guards against conflict with environmental policies to increase or preserve forest cover and maintain water availability. Primary forests will not be sacrificed for bio-diesel feedstock production. On the other hand, introduction of

biofuel value-chain activities shall be aimed at providing an alternative economic activity to the ASALs and discourage ongoing environmental degradation through charcoal production from natural ASAL vegetation. Emphasis will be put on utilization of idle or unused land.

- d. Significant positive socio-economic benefits can accrue from a successful bio-diesel program. The immediate benefit accruing to the marginal lands will mainly be socioeconomic in nature. In the long term, it is anticipated that sufficient stocks will be attained for the purpose of substituting fossil fuels with biodiesel through blending at appropriate levels. The bio-diesel industry shall strive to sustain itself with minimum or no state financial subsidies, except in areas of research, extension services and quality assurance regulation. The industry may initially require assistance but in the medium to longer term it will develop a critical mass that is able to cover production, and marketing overheads, and still remain competitive with alternative fossil fuels.
- e. To protect exchequer incomes, and to ensure fair competition with competing alternative fuels, it is assumed that bio-diesel, unless specifically exempted, will bear excise taxes as determined by economic analysis. However, it is worth noting that subsidies have been applied in most countries during the initial stages of biofuel introduction. Some of these incentives could be subsidized through carbon credits. Rebates will also be considered.
- f. To ensure that consumers “trust” bio-diesel, a quality assurance program will accompany introduction of bio-fuels so that established standards are actually enforced to protect consumer interests.
- g. With regard to job creation, use of manual labour is encouraged wherever possible, such as in the production, processing and distribution of products as a way of employment creation. Mechanised practices may be considered where increased production is desired but they will need a thorough evaluation before implementation to avoid displacement of manual labour.
- h. The strategy aims at achieving a farmer/community based ownership structure. Identification and involvement of existing community groups such as CIGs, Community based Organizations (CBOs) and NGOs involved with CBOs will be undertaken to accelerate adoption and uptake. The farmers will produce as well as be owners of value added processing and manufacturing facilities. Farmer owned crop production and oil processing systems will therefore be encouraged in the short to medium term as a poverty reduction measure. The farmer co-operative system will be encouraged with a view to tapping on the gains of a farmer centered approach.
- i. Bio-refineries will be located with the objective of improving the local economy as a whole. For example, the location is expected to lead to the improvement of social amenities and infrastructural development such as construction of good roads,

improved access to potable water, etc. The development of rural enterprises will encourage direct utilization of biodiesel in un-modified stationery engines. Production of oil for electricity generation to power rural enterprises is also encouraged. It will be necessary to develop the non oil uses of *Jatropha* for the purpose of having a wide range of rural enterprises for income generation.

1.4. Target estimates

Targeted national requirements for biodiesel are based on the major consumers of diesel and kerosene. These include retail pump outlets and road transport (50.8%) of the total consumption (3.04 million tonnes estimated for 2006), aviation industry (19.5%), industrial, commercial and other users (13.4%), and power generation (12.7%), based on estimated consumption for the year 2006, (Economic Survey, 2007).

It should be borne in mind that retail pump outlets service both petrol and diesel vehicles and therefore the biodiesel component will be targeted at blending with biodiesel. Introduction of biodiesel in the Kenyan economy will target all the above consumers except the aviation industry.

Even though Government is not a major consumer of diesel, consuming about 1.02% (petrol & diesel combined) of the total consumption, it will be used as a vehicle to prime the industry by making it mandatory for all government diesel vehicles to run on biodiesel blends. The public service vehicles which run on diesel sourced from retail service stations will serve as another entry point particularly for blending. The entire target sectors combined comprise about 77.6% of the total consumption of petroleum products.

According to the Insight Magazine (July – September 2007) produced by the Petroleum Institute of East Africa (PIEA), the total sales of diesel products and kerosene in the year 2006 were recorded as follows:

| Product | Quantity (Mil. Tonnes) | % of total sales |
|-------------------|------------------------|------------------|
| Kerosene | 0.36 | 9.70 |
| Industrial Diesel | 0.05 | 0.12 |
| Fuel oil | 0.71 | 19.10 |
| Gas Oil | 1.22 | 32.70 |
| Total | 2.34 | 61.62 |

The same magazine indicates that the total sales of petroleum products in the same year were 3.73 Million Tonnes.

2. Policy, Legal and Institutional Framework

2.1. Policy

The relevant policy framework for this strategy includes Sessional Paper No.4 of 2004 on Energy. However policies in other public sectors like Forests, Agriculture, Trade, and Water and Irrigation are expected to impact on the industry.

Sessional Paper No. 4 of 2004 on Energy seeks to encourage wider adoption of renewable energy technologies, thereby enhancing their role in the country's energy supply matrix. It recognizes the potential for producing biodiesel from locally grown crops and thus the need to set aside land for the production of energy crops from which biodiesel can be obtained. Formulation of appropriate strategies to optimize land use and harmonize the existing land use policy with the energy policy is also recognized as a key issue. The Policy calls for mobilization of resources for research and development to facilitate the introduction of biodiesel as a motor blend in the medium term.

According to the policy, there is need to shift from primary sources to cleaner biomass based fuels particularly for the development of the rural economy. People need to be encouraged to grow trees as a commercially viable business enterprise not only for sustainable charcoal production but also for other biomass based fuels. Development of biodiesel will take into consideration the environmental and food security concerns by conducting environmental impact assessment.

Development of bio-diesel is in conformity with broad national energy development objectives and specifically addresses the provision of increasing the security of energy supply by reducing vulnerability resulting from dependence on imported fossil fuels, noting that Kenya does not yet have locally produced fossil fuels and is a net importer. Kenya suffers the burden of importing fossil fuels depleting the limited foreign exchange resources available.

Development of the biodiesel industry supports the policy of promoting interfuel substitution and the promotion of fast maturing trees for energy generation. It is also in line with the policy on promoting private sector initiatives to enter the clean biomass market.

The policy on international and regional trade offers an opportunity for reliable and cost effective energy supply and will ensure that the country exploits the inherent gains offered by international and regional energy markets. Research and development need to be supported to come up with home grown solutions to local problems. Private sector participation is encouraged in the production, distribution and marketing of biodiesel.

The policy recognizes the importance of providing tax incentives to producers of biodiesel technologies, related components and accessories, and fiscal incentives to financial institutions to provide credit facilities to consumers and entrepreneurs. Capacity building needs to be enhanced to upgrade human resource capacity to keep up with the dynamic

technological and policy issues. Formulation and enforcement of biodiesel standards and codes of practice is necessary to safeguard consumer interests.

The policy on Arid and Semi Arid Lands (ASALs) indicates that available opportunities for investment in these areas have not been utilized. Mainstreaming the *Jatropha curcas* value chain initiatives into ongoing activities in the ASALs will be pursued with a view to achieving the objectives of this strategy.

The growing of *Jatropha* is not restricted to ASALs and selection of the, areas will be guided by extent of competition with food crops (no threat to food production); rainfall regime (300-1500mm); altitude (0-1500m above sea level); temperature (20°C-32°C); and soils (low fertility and alkaline).

The Strategy for Revitalizing Agriculture (2004) offers development opportunities through the Agriculture Product Value Chain which aims at developing business linkages through new extension approaches between producers, suppliers, processors and the market. It also recognizes the importance of new and emerging crops including *Jatropha* and *Aloe Vera*.

2.2. Legislation

The relevant legislation includes the Energy Act No. 12 of 2006. Other legislation expected to impact on the industry include Forest Act 2005, Agriculture Act, Trade & industry Act and the Water Act.

The Energy Act was operationalized in July 2007. This legislation embraces petroleum, electricity and other forms of energy. It encourages enhancement of incentives to the private sector and promotes prudent regulation of the energy sector. It allows duty free importation of energy hardware to promote widespread usage. It also allows renewable energy systems not exceeding 3 MW or if operating in hybrid mode, in which the oil fired component does not exceed 30% of the total capacity to operate in any area of the country without any license, irrespective of any other existing distribution license. It provides for the determination of energy price by the market mechanism and regulation only where necessary, and empowers the Minister to promote the development and use of renewable energy technologies including biodiesel and bioethanol.

The Energy Act established the Energy Regulatory Commission (ERC) which is responsible for regulating the production, distribution, supply and use of renewable and other forms of energy. It also protects the interests of consumers, investors and other stakeholder interests. It is also responsible for monitoring and ensuring the observance of the principles of fair competition. The Commission has powers to issue licenses and permits for all undertakings and activities in the energy sector, and to make proposals to the Minister on regulations which may be necessary. The Commission also has powers to formulate, enforce and review environmental, health, safety and quality standards for the energy sector. It will also enforce and review regulations, codes and standards.

The Forests Act (2005) offers opportunity for *Jatropha* production through rehabilitation of degraded sites and mitigation against dry-land forest destruction, especially through charcoal production activities. There is opportunity to exploit the 9.5 million ha of farmland and settlements by establishing public-private sector partnerships whereby small out grower farmers feed into nuclear estates.

2.3. Institutions

2.3.1. Major stakeholders

The biodiesel industry in Kenya is an Energy function. However, given the fact that the raw materials are agricultural in nature, the Agricultural function fits in very well. The biodiesel production has an impact on the agricultural value chain in terms of providing better off-take security with regard to quantities, prices and long term contracts. The choice of *Jatropha curcas* (which is considered to fall between a shrub and a tree) as a feedstock crop brings in the Forestry function as well.

The main stakeholders in the biodiesel development activities include the Ministries of Energy (MOE), Agriculture (MOA), Ministry of Cooperative Development and Marketing (MOCD&M), Trade & Industry (MTI), Water and Irrigation (MWI), Transport (MOT), Environment and Mineral Resources (MEMR), Kenya Forest Service (KFS), Local Government (MLG), Regional Development Authorities (MORDA), Vanilla Development Foundation (VDF) and Green Africa Foundation (GAF). The MOE is the lead institution entrusted with the mandate and responsibility of facilitating the provision of secure & sustainable supplies of energy for socioeconomic development. The Ministry has constituted a National Biofuels Committee (NBC) which is currently addressing biodiesel issues. The membership of the NBC is presented in Appendix 6.

The MOE will coordinate the institutions that are undertaking activities related to biodiesel production. It will also collaborate with other stakeholders including but not limited to: MOA for advisory and awareness creation; MOCD&M for mobilization of cooperative societies for production, marketing, finance and value addition; KBDA for disseminating information on the available processing technologies; KIRDI for equipment fabrication, development and procurement; KEBS for product standardization; PIEA for awareness creation; NEMA for Environmental Impact Assessment; Research institutes and universities for further studies, and CBOs for community awareness creation and implementation. The MOE will commission a technical and economic feasibility study to inform formulation of targets for blending of biodiesel with mineral oil.

2.3.2. Government organizations

Government support in the form of policy, creation of enabling environment and incentives will be necessary especially for seed distribution programs, minimum price warranties, organization of farmers and cooperatives, information exchange, awareness raising, technical assistance and training among other aspects.

2.3.3. Community Based Organizations and NGOs

NGO's, Cooperative Societies, CBOs and CIGs will play an important role in mobilization, training and general promotional activities in the development of the biodiesel industry. The involvement of these groups will lead to faster adoption of the various technologies, along the value chain.

2.3.4. Foreign Investors

In line with existing Government policies, foreign investors will be encouraged. It is however recommended that they come in as strategic partners to existing local Groups.

2.3.5. Kenya Biodiesel Association (KBDA)

The MOE, in liaison with the MOCDM will facilitate the formation and registration of the KBDA. This will be an apex body and the lead institution in bringing together all major players in the supply chain, namely producers of planting materials, feedstock producers, processors, marketers and distributors, and large consumers. Feedstock producers will be either large scale producers or small scale. The small scale producers will be organized as biodiesel cooperative societies or common interest groups. Their production will be coordinated as individual farmers and outgrowers. The management of these cooperatives will be governed by the regulations in the MOCD&M. The KBDA will formulate a framework that will define the relationship among the stakeholders.

The KBDA will coordinate the establishment of buying centres and price setting of the feed stock. The buying centres will serve as collection points for transportation to the oil extraction facilities and some will offer oil extraction services. The Association will assist small scale farmers who wish to extract oil at farm level for local use to acquire the necessary technology and other relevant services.

The KBDA will provide a one stop shop for biofuels issues and will thus collaborate with other relevant institutions in research and development, seed certification and product quality assurance and marketing. The constitution will be formulated to cater for both biodiesel and bioethanol. It will provide a single entry point to oil marketers, coordinate the attainment of a critical mass along the value chain and manage other marketing options. It will liaise with revenue authorities with respect to revenue collection. It will be an avenue for lobbying for incentives, advancing loans, extension services etc. The Association will also play a role in monitoring and evaluation, working in close collaboration with other players along the value chain. The proposed structure of the KBDA is presented in Appendix 7.

2.3.6. Energy Regulatory Commission (ERC)

The role of regulating the energy sector is vested with the Energy Regulatory Commission (ERC).The Commission will issue licenses and permits for all undertakings and activities in the development and use of biodiesel, and make proposals to the Minister for regulations which may be necessary. The Commission will in liaison with other statutory bodies,

formulate, enforce and review environmental, health, safety and quality standards as well as regulations, codes and other standards for the biodiesel industry. In developing standards, the Commission will liaise with the KEBS.

3. Choice of Bio-Diesel Crops

Bio-diesel can be produced from virtually any oiliferous vegetation including seeds from rape, soya bean, sunflower, peanut, cotton, avocado, *Melia volkensii*, *Croton megalocarpus*, *Jatropha curcas*, castor and coconut palm as well as animal fats. It can also be made from algae, waste vegetable oils, fats from fish, chips or fried chicken. In Sub-Saharan Africa and particularly in Kenya the potential for production of biodiesel from these sources is high due to favourable climatic conditions. However, food insecurity and poverty are serious challenges to the country and the African continent at large.

This strategy therefore focuses on promotion of non-food crops for bio-diesel production in order to address the above challenges especially in marginal areas and ASALs. It has the dual benefit of increasing socio-economic activity for rural communities, while providing increased vegetation cover. Non-food biodiesel crops in marginal areas will not compete with food production resources.

The opportunity cost of producing bio-diesel from food crops is much higher than producing from non-food crops since the country is not self-sufficient in food. Furthermore non-food biodiesel crops in marginal areas will not compete with food production resources. *Jatropha curcas* stands out among others as the primary non-food biodiesel crop that will be promoted for development for the bio-diesel industry.

Research and development will be initiated on other non-food crops with high oil potential which include croton, cotton and castor. This does not necessarily preclude any other non-food crops that can flourish in the country. For the cotton industry which is being revived in the country, there will be a ready market for cotton seed.

3.1. Justification for *Jatropha*

There are many *Jatropha* species in the section *curcas*. They include; *J. pseudo-curcas*, *J. afrocurcas*, *J. macrophylla*, *J. villosa* (syn: *J. wightiana*), *J. hintonii*, *J. bartletti*, *J. mcvaughii* and *J. yucatanensis*. McVaugh (1945) considered *J. yucatanensis* to be a synonym of *J. curcas*. One species, *J. villosa*, is of Indian origin (Ahmedullah and Nayar, 1987). Two species, *J. afrocurcas* and *J. macrophylla*, are of East African origin, whereas all the other species in this section are native to the Americas.

The strategy zeroes down on *Jatropha curcas* which is already naturalized in the country, has wide climatic adaptability in marginal areas and degraded sites or wastelands and has diverse uses. *Jatropha curcas* requires minimal irrigation even when grown on marginal land and therefore will not pose a threat to water availability. The potential for growing *Jatropha* ranges from the coastal lowlands and the vast ASALs to the midlands (<1600 m above sea level) (Ngethe, 2007). Its water requirement is extremely low and it can withstand long periods of drought. It grows in areas with rainfall regime of 300 – 1500mm. Its tolerance of a wide range of soils nutrient content and low soil moisture minimizes the need for irrigation and use of fertilizers (Maundu and Tengnas, 2005; Jones and Miller, 1992).

It is worth noting that yields in ASALS may not be as high as in high potential Agro ecological zones. Although production in ASALS may be low, its adaptability poses minimum competition with food production and hence minimal impact on food security. Since the plant is not browsed on by animals, there is low risk of destruction through browsing by livestock or wild-life, and hence it can be inter-cropped within the natural pastures and provide shade. The plant is easy to propagate from seeds and cuttings and grows rapidly. The proposal to use one major crop is also driven by the need to establish national standards whereby it is easier to manage feedstock production, monitor and enforce standards for one crop as opposed to many crops.

Apart from oil, *Jatropha* has other by-products that could be used to develop other rural enterprises. It offers alternative livelihood for the Arid and Semi Arid inhabitants in addition to addressing land degradation and climate change in a strategic manner. Glycerine, one of the byproducts during the conversion of bio-oil into biodiesel has a ready local and export market. The seed cake can be used to provide energy in other forms other than oil, for example biogas production, briquettes, pellets, and for electricity generation. It can also be used as organic fertilizer.

Other uses of *Jatropha curcas* include prevention of water-erosion, soil conservation, shelterbelts to control sand-drift, and as a hedge around homes and fields (Budowski, 1987; Crothers, 1998). It can also be used as traditional medicine for example as a laxative, emetic, for cough treatment, and healing wounds (Crothers, 1998; Heller, 1996, Thomas, 1989). *Jatropha* can be used to produce a dye which is used to give tan and brown shades, and for making ink. The bark yields about 37 percent tannin.

A feasibility study undertaken by Energy for Sustainable Development Africa (ESDA) at the Coast demonstrated that *Jatropha* is the most promising species for biodiesel production in Kenya because of its minimum requirement for inputs and its ability to grow in otherwise unproductive land.

3.2. International experiences

In Europe the supply of feed stocks is crucial to the success of the biofuel strategy as they represent the primary cost component in the production process. In 2004, biodiesel accounted for nearly 80% of the European Union (EU) biofuel production, over half of which was produced by Germany (EU Strategy on Biofuels). The EU has set a target to replace 10% of its transport fuels with biofuels by 2010. It however does not have adequate agricultural resources to meet this target and may have to import biodiesel.

Experiences in India indicate that biofuels promotion results in improved energy security, economic gains, rural development and greater energy efficiency. There are some promising experiences on non-transport applications of *Jatropha* oil for instance in India, China, Mali, Zambia, Burkina Faso, Cameroon etc.

Experiences in Mali indicate average yields of 3.5 – 5 tons of *Jatropha* seed per ha. In countries like Mali and Tanzania, *Jatropha* oil is used to operate multifunctional platforms (MFP) which result in more effective use of energy (DESA/DSD/2007/2). A typical MFP is a 10 Horsepower diesel engine that drives an oil press, a generator for supplying electricity, a mill for grinding cereals or a compressor for inflating tyres.

The Mali Government initiated a national Programme for the Development of *Jatropha* implemented by the national Renewable Energy Centre. This Programme installed several hectares of *Jatropha* plantations and electrified one village with more than 3000 inhabitants with generators run on *Jatropha* oil as fuel (DESA/DSD/2007/2).

In Tanzania, Kakute Ltd. worked with women groups on marginal land donated by the communities involved. The project successfully demonstrated livelihood benefits of *Jatropha*, helping to launch *Jatropha* farming as a cash crop. Kakute Ltd has now partnered with other organizations to advocate for an improved policy environment with promising results (DESA/DSD/2007/2). Recently, Sun Bio-fuels Plc of United Kingdom has invested US\$20 million in bio-fuel feedstock (*Jatropha*) production and processing in Tanzania.

As at July 2007 the Government of Malaysia had plans to enforce mandatory blending of bio-fuels with conventional fuel within a year.

Thus, the global trend is in bio-fuels as a way forward in ensuring energy security and Kenya should be no exemption. The initial priority is to satisfy the local market before venturing into the export market.

4. Proposed Supply Chain

Key steps identified in the *Jatropha* value chain (Appendix I) include:

- Production (Availability of land and clean planting material - seeds and seedlings)
- Stakeholder sensitization and Resource Mobilization
- Availability of adequate seeds for processing
- Processing
- Marketing, distribution and utilization

4.1. Production

The salient factors necessary for production of biodiesel include land, clean planting material, growers, oil extraction and biodiesel conversion facilities. Before engaging in the *Jatropha* biodiesel production value chain an environmental impact assessment (EIA) should be conducted. It will also be necessary to conduct specific EIAs for processing facilities. All EIAs should be conducted in accordance with the NEMA regulations.

4.1.1. Land

The land tenure system across the identified *Jatropha* growing areas is not uniform. In areas where land tenure system is defined it is possible to promote growing of *Jatropha* and cooperative societies and CIGs would be most appropriate vehicles for the promotion of this industry. However, in most ASAL districts where pastoralism is the key economic activity, land is communally owned and CIGs can be formed or land can be contracted from the community. In ASAL areas one of the most notable problems is charcoal burning, in the absence of other income generating activities. *Jatropha* growing will alleviate the twin problem of lack of other viable economic activities while providing the much needed vegetation cover. In the long run, when this activity is fully developed it will also provide fuel for cooking as well as lighting, reducing the need to cut down trees to meet domestic fuel needs.

*The MOE will in liaison with Ministry of Lands, KFS, Local Authorities and RDAs facilitate identification and allocation of land for developing *Jatropha* plantations.*

4.1.2. Clean Planting material

This is the most critical aspect in the development of the *Jatropha* industry. It has been noted from the outset that there are no adequate arrangements for the provision of clean planting material, seeds of certified quality, and known potential in the production of *Jatropha* seed. There is need for the lead research institutions in the country to assist in the identification, selection and propagation of high yielding varieties of seed for the various areas identified for growing *Jatropha*. Available information indicates that there are pockets of *Jatropha* growing across the country promoted by NGOs involved in the industry. There is however

need to bring in key national players like KEFRI, KARI, KEPHIS, KFS, National Universities, NGOs involved and the farmers to chart the way forward in a coordinated manner.

The NGOs have been at the forefront of the establishment of nurseries. However these efforts need to be scaled up to meet the projected demand. There is need to establish nurseries in close proximity to the areas identified for *Jatropha* development, and the farmers should be in the fore front in the development of nurseries. Banks and micro finance institutions could provide the necessary funding to promote these activities along the value chain.

There is need to establish vendors who will supply seedlings under terms determined by the KBDA.

The MOE will facilitate identification of appropriate institutional arrangements to ensure availability of certified seeds, seedlings, establishment of nurseries and vendors.

KEPHIS, KEFRI and KARI will be responsible for testing and certifying planting material before they are released to farmers, both for the domestic and external market.

KEFRI will register specific farmers through whom the certified planting material will be obtained.

4.1.3. Stakeholder Sensitization and Resource Mobilization

It is recognized that *Jatropha* is an emerging crop and biodiesel is a new product in Kenya. There will be need for sustained consumer and producer sensitization and mobilization. This will entail an appropriate communication strategy to articulate issues of concern. The available resources are inadequate to meet the projected demand. As such it will be necessary to mobilize resources.

The MOE will facilitate the development and implementation of the communication strategy and resource mobilization.

4.1.4. Availability of adequate seeds for processing

It will be necessary to mobilize producers in order to realize the critical mass for oil production. To achieve this, growers, cooperatives, and large scale commercial farmers will be encouraged to produce for the industry through incentives.

The MOE will determine the incentives to be used.

4.1.5. Growers

It is envisioned that to meet the demand for seed for processing, there will be need to engage all kinds of growers including nuclear estates and out growers. Willingness to support this

initiative has already been expressed by KenGen, KTDA, Bamburi Cement, Athi River Mining, Safaricom and Magadi Soda among others.

The MOE will encourage such companies to support the establishment of nuclear estates. The KFS will provide technical assistance.

4.1.5.1. Small scale farmers

Communities will be encouraged to grow *Jatropha* on their own land. It will be the responsibility of the KBDA to ensure that the community does not displace food crops with *Jatropha*.

The MOE will facilitate the setting up and operationalization of the KBDA which will be responsible for coordinating the activities of the stakeholders.

4.1.5.2. Cooperatives

Small scale growers of *Jatropha* will be encouraged to form cooperative societies for ease of access to financing and lobbying. The societies will be members of the Kenya Biodiesel Association (KBDA). Under this model, farmers shall own small pockets of *Jatropha curcas*. They will also own processing plants for seed processing and oil extraction. Inputs will be supplied through KBDA.

Large scale cooperative societies with capacity will be encouraged to diversify into *Jatropha* production as an additional business opportunity. Such cooperatives have access to capital through institutions like the Cooperative Bank. Those who need financial assistance will also be advised to liaise with KBDA. By virtue of their large scale they may be able to own their own processing plants for oil extraction. Communities living in the immediate neighbourhood will be encouraged to take up this activity on the small holder farms and to benefit from the processing capacity of the large scale cooperatives. This will also be an opportunity for strategic partners to team up with the cooperatives to supplement financing and provide the much needed technical know how eventually leading to technology transfer to the local population. An example is B2 Yatta Ranching Cooperative Society Ltd. in Kitui, already involved in growing *Jatropha*. All farmers will commit to deliver the produce through KBDA.

The MOE will support the cooperative movement through the MCD&M to integrate biodiesel development into their activities.

4.1.5.3. Large Scale Commercial Producers

Local and international commercial ventures will be looking into investing in large-scale bio-diesel plantation and production. They will provide an opportunity for linkages with small out-growers in their areas of operation. By so doing they will provide essential extension services, logistics support and the market.

The MOE will encourage and facilitate such investors like any other new investment in Kenya.

4.2. Processing of biodiesel

The key activities in biodiesel processing include oil extraction, trans-esterification and blending.

4.2.1. Extraction:

Technology for small scale crushing of seeds to extract oil is readily available and is the same technology used for crushing sunflower seeds. Technology for large scale oil extraction can be imported with incentives such as tax and duty waivers. Oil Extraction can be undertaken by individuals, cooperatives or common interest groups. The resources required for extraction are facilities, equipment and transport for the oil.

4.2.2. Direct consumption of the crude oil

The crude oil can be used for household lighting and cooking. However this will require development of appropriate end use technology. Rural enterprises can directly utilize biodiesel in un-modified stationary engines and for electricity generation to power rural enterprises.

The MOE will collaborate with MOA and KIRDI to facilitate and support Cooperatives and CIGs to acquire extraction capacity and end use technology.

The MOE will promote the use of specific technologies for example the use of the multifunctional platform as a way of providing energy services for productive needs in rural development.

4.2.3. Trans-esterification:

Trans-esterification is the conversion of the oil into biodiesel and this process can be carried out by a private investors. The technology for this process exists.

The MOE will assist in acquisition of such technologies through incentives such as duty and tax waivers.

4.2.4. Blending:

Available information on blending indicates that up to 20% blending, conventional engines can be used without modification. Currently there is no blending, standards and targets in the country hence the need for a policy. There is also need for a central blending facility to ensure consistency and compliance to standards. It is envisaged that KPC could serve as such a centre. However, this would entail installation of auxiliary facilities.

KEBS will develop the standards and monitor industry compliance to set standards.

The Ministry of Energy will commission a technical and economic feasibility study analysis to inform blending policy. The MOE will ensure that blending targets are achieved. The preliminary target is to achieve blending ratio of B5 by 2012 and B10 by 2020 using a phased approach. Exact figures will depend on the outcome of the economic analysis.

4.3. Marketing, Distribution and Utilization

4.3.1. Biodiesel

Biodiesel is a new and relatively unknown product in the Kenyan market and as such the consumers will need to be sensitized. In order to enhance acceptance, it will be crucial to start the implementation with large diesel consumers (fleet operators, power generators etc.). The existing diesel distribution system will accommodate biodiesel.

The MOE will undertake sensitization and awareness programs in collaboration with the relevant stakeholders. It will also prioritize the implementation of the biodiesel utilization within the transport and domestic industries.

4.3.2. Glycerol

This is the main by product of biodiesel processing. This product can be used in the pharmaceutical and soap manufacturing industries, which currently import the product.

MOE will promote and provide incentives to encourage shift from imports.

4.3.3. Other non-oil uses

It will be necessary to develop the non-oil uses of *Jatropha* for the purpose of having a wide range of rural enterprises for income generation, and to start a programme for biogas production, briquetting and pelletization of the seed cake with *Jatropha* farmers in the medium term.

*MOE will promote programmes to develop other uses of *Jatropha*.*

4.4. Research and development

A number of initiatives are already ongoing in the following institutions: Kenya Agricultural Research Institute (KARI); Kenya Forestry Research Institute (KEFRI); Kenya Industrial Research Development Institute (KIRDI) and Jomo Kenyatta University of Agriculture and Technology (JKUAT). They are encouraged to continue. In addition, specific research needs identified by other stakeholders will be channeled through these institutions. KIRDI and JKUAT will be responsible for conducting research on processing and utilization technologies as well as on the products obtained from the *Jatropha* plant.

The immediate research agenda on production will involve among others the development of propagation of high yielding varieties; breeding for yield improvement, suitability – Agro Ecological Zones (AEZ), pest and disease resistance/tolerance, pest and disease control, seed production/multiplication, agronomic package (production guidelines), and impact on the environment.

On processing, the areas of concern are oil extraction methods; small scale processing machines/equipment; large scale processing; and quality standards.

On utilization the main concern is domestic utilization (large and small scale); blending targets; usage in machinery and equipment; use of oil for electricity generation for rural enterprises; and development of non-oil uses of *Jatropha* in order to broaden the demand base.

4.5. Monitoring and Evaluation

Monitoring and evaluation will need to be undertaken at all stages along the value chain.

The institutions that are spearheading the activities presented in Appendix 1 will be responsible for monitoring the implementation of respective activities.

5. Rules and Regulations

Where regulations already exist they will be applied as appropriate for example:

- Environmental Impact Assessment: EMCA, 1999
- Child labour: Children's Act and National Labour laws.
- Penalties for non-compliance with set standards: in the Energy Act, 2006
- Handling and safety standards applicable to the biodiesel industry.
- Prescribing a material safety data sheet to prevent accidents.
- Occupational safety and health regulations

The Energy Regulatory Commission will liaise with relevant institutions to develop the necessary regulations for the industry. The regulations will encompass the following issues among others:

- a) Zoning of the growing areas
- b) Registration of propagation nurseries, growers and processors
- c) Non compliance with set standards.
- d) Kenya is a signatory to the Convention on Biological Diversity

5.1. Environmental Impact Assessment

Initial studies indicate that *Jatropha* is a tree crop that can have positive impact on the environment including soil conservation, mitigation of climate change, and rehabilitation of degraded lands among others. There are concerns that *Jatropha curcas* is classified as invasive under the Global Invasive Species Programme (GISP). Kenya is a signatory to the Convention on Biological Diversity. Since *Jatropha* is a new and emerging crop in the Kenyan environment, it will be necessary to carry out EIA to address the following:

- i. The use of risk assessment protocols to evaluate the risk of invasion for proposal to grow *Jatropha curcas* or any other species that is classified as invasive.
- ii. Incorporation of risk management measures, including monitoring and contingency planning in proposals especially in cases of escape and according to the results of risk assessments. Control procedures will have to be viable and well tested.
- iii. Undertaking a cost/benefit analysis to show the real benefits for proposed activities before funds are made available.

The Energy Regulatory Commission in collaboration with Kenya Plant Health Inspectorate Service and other relevant organizations will be responsible for developing appropriate regulations to safeguard the country in this respect.

5.2. Incentives

Taxes are pre-paid on all petroleum products. Introduction of biodiesel means less tax will accrue from petroleum products (diesel). For market stability and to maintain the Kenya Revenue Authority (KRA) tax revenue base, taxes will be collected as appropriately identified by the Kenya Biodiesel Association in collaboration with the ERC and KRA. Taxation of competing imported products such as vegetable oil meant for biodiesel production will be at par with the biodiesel produced from local sources to prevent diversion to other uses. All tax regimes for exported products will be applicable for biodiesel exports. An economic analysis will be undertaken to determine details of taxation incentives that should be offered to stakeholders to encourage growth of the industry. The analysis will also ensure that the country does not lose the revenue previously accruing from taxation of mineral diesel. Incentives will only apply to biodiesel for local consumption.

The MOE will encourage local ownership of investments and incentives such as tax waivers on imported equipment for use in the biodiesel industry as detailed in the Energy Policy, among others.

The Ministry will facilitate the process of conducting an economic analysis in order to:

- *establish the appropriate levels of taxation*
- *establish the savings that can be realized from local production of glycerol*
- *justify the concession given to biodiesel among other issues.*

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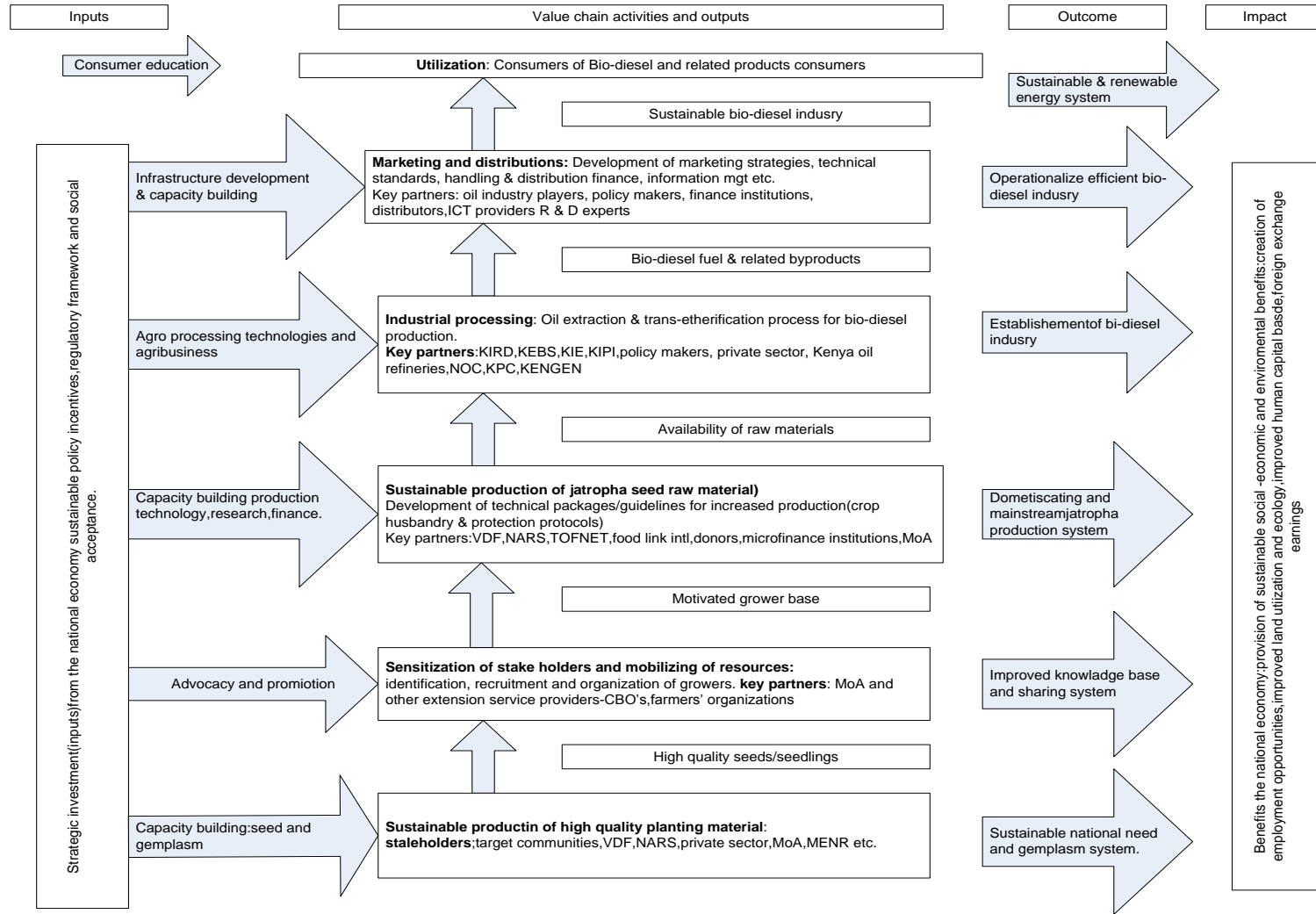
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Appendix 1: Jatropha Value Chain

FUTURE INTERVENTION OPTIONS FOR JATROPHA VALUE CHAIN



Appendix 2: Jatropha Value Chain Implementation matrix

| Activity | Responsibility | How | Scheduling | Resources needed | Remarks (challenges, concerns, constraints) |
|--|--|---|----------------------|---|---|
| Sustainable Production of high quality planting material | <ul style="list-style-type: none"> • NEMA • Farmers • MOE • KEFRI • NGOs • CBOs • MOA • KARI • KEPHIS • KFS • M. of Education • MOYA • Universities | <ul style="list-style-type: none"> • Environmental Impact Assessment • Capacity building • Selection of high quality seeds • Establishment of nurseries • Research and development • Seed bulking by farmers • Collaboration with development partners • Benchmarking of best practices | 2008 (continuous) | Funds for: <ul style="list-style-type: none"> • Field activities • Personnel • Nursery materials & equipment • Information, Education & communication | <ul style="list-style-type: none"> • Responsive farmers • Support of collaborators • Availability of funds |
| Sensitization of stake holders and mobilization of resources | <ul style="list-style-type: none"> • Farmers • MOE • NGOs • CBOs • MOA • KFS • OP Admin • MOYA | <ul style="list-style-type: none"> • Barazas • Field days • Demonstrations • Shows and exhibitions • Training • Media • Leaders' meetings | Immediately | Funds for: <ul style="list-style-type: none"> • Field activities • Personnel • Information, Education & communication • Training • Shows & exhibitions | <ul style="list-style-type: none"> • Responsive farmers • Support of collaborators • Availability of funds |

| Activity | Responsibility | How | Scheduling | Resources needed | Remarks (challenges, concerns, constraints) |
|---|---|--|------------|--|--|
| | <ul style="list-style-type: none"> • MGSCSS • MOCD&M • Local Authorities | | | | |
| Sustainable production of Jatropha seed (raw material for processing) | <ul style="list-style-type: none"> • Farmers • MOA • KFS • MOCD&M • CBOs • NGOs • MOE • KEFRI • KARI • Private Investors • Development partners • Microfinance institutions • Universities | <ul style="list-style-type: none"> • Establishment of plantations • Small holder production units • Formation of the Kenya Biodiesel Association • Development of Production guidelines • Monitoring and evaluation • Research and Development • Identification of zones for planting | 2008 | Funds for: <ul style="list-style-type: none"> • Field activities • Office for the Association • Monitoring and evaluation • Production of guidelines • Extension services | <ul style="list-style-type: none"> • Low yielding varieties • Availability of market • Land availability • Pricing of the raw material • Pests and diseases • Competition with other crops • Planting in unsuitable agro ecological zones • Lack of capital for investment • Lack of technical know how |

| Activity | Responsibility | How | Scheduling | Resources needed | Remarks (challenges, concerns, constraints) |
|--|---|--|------------|--|--|
| | | | | | <ul style="list-style-type: none"> • Unpredictable weather patterns |
| Industrial Processing <ul style="list-style-type: none"> • Oil Extraction • Trans-esterification • Blending • Technical Standards | <ul style="list-style-type: none"> • KIRDI • KEBS • KIE • KPRL • NOCK • KPC • KENGEN • Private Sector • Policy Makers (MOE) • Cooperatives / CIGs • PIEA • NEMA • Research Institutes & Universities • KBDA | <ul style="list-style-type: none"> • Selected oil extraction centers, • Oil extraction will carried out on cooperative basis / common interest group, • Trans-esterification – to be carried by National Oil Company, • Blending – KPC | TBD | <ul style="list-style-type: none"> • Oil extraction facility, equipment, quality stewardship at the centers, • Transport of the oil / seed, • Trans-esterification - facility, equipment, quality stewardship at the centers, • Blending – tanks, pipelines, | Key Stakeholders <ul style="list-style-type: none"> • Oil extraction – Coops / CIGs, • Processing – private oil companies, • Blending – KPC • Standards- KEBS |

| Activity | Responsibility | How | Scheduling | Resources needed | Remarks (challenges, concerns, constraints) |
|--|--|--|--------------------------|---|---|
| <p>Marketing & Distribution / Utilization</p> <ul style="list-style-type: none"> Marketing Strategy Handling & Distribution Information Management Finance Consumers of Bio-diesel Monitoring & evaluation | <ul style="list-style-type: none"> Oil Industry KEBS Policy Makers (MOE) Financial Institution Distributors ICT Providers R & D Experts Fleet Owners Power Plants PIEA KBDA | <ul style="list-style-type: none"> Economic analysis of biodiesel & its by-products, Create consumer awareness, National targets for mandatory blending with mineral oil, Replace imported glycerol with locally produced, | <p>TBD</p> <p>TBD</p> | <ul style="list-style-type: none"> Economic analysis funds, Awareness IEC materials, Promotional materials/lobbying, | <p>Key stakeholders</p> <ul style="list-style-type: none"> MOE – policy, economic analysis, PIEA – awareness / promotion, Oil industry - awareness / promotion |
| <ul style="list-style-type: none"> Crude Oil | Households e.g. lighting & cooking | | TBD | | |
| <ul style="list-style-type: none"> Other products (e.g. Cake) | Biogas Producers & Farmers | | TBD | | |
| <ul style="list-style-type: none"> Glycerol | Manufacturers | | TBD | | |

Prioritization:

Immediate: (2008 -2009)

1. Economic Analysis
2. R&D activities
3. Policy development
4. Awareness creation

Medium Term: (2009- 2012)

1. Take or pay marketing strategy
2. KIRDI to develop / fabricate oil extractors,

Long Term (2012 +)

1. Processing & commercialization of bio-diesel
2. Commercialization of the by-products,

Appendix 3: Action Plan

| Activity | Time Frame | Estimated cost (Ksh.) | Outcome |
|--|--|--|---|
| Sustainable Production of high quality planting material <ul style="list-style-type: none"> • Environmental Impact Assessment • Capacity building • Selection of high quality seeds • Establishment of nurseries • Research and development • Seed bulking by farmers • Collaboration with development partners • Benchmarking of best practices | 2008 - 2009 2008 - 2012 Feb 2008 - 2012 April 2008 - 2012 2008 - 2012 Feb 2008 – 2012 2008 – 2012 2008 - 2012 | 30 Million for 30 districts for 1 year | Adequate high quality planting materials |
| Sensitization of stakeholders and mobilization of resources <ul style="list-style-type: none"> • Barazas • Field days • Demonstrations • Shows and exhibitions • Training • Media | 2008 – 2012 | 30 Million for 30 districts for 1 year | Awareness and adoption Availability of resources Skilled out growers Demonstration plots established Participation in shows and exhibitions Training reports |
| Sustainable production of Jatropha seed (raw material for processing) <ul style="list-style-type: none"> • Establishment of plantations • Small holder production units • Formation of the Kenya Biodiesel Association • Development of Production guidelines | 2008 – 2012 | 30 Million for 30 districts for 1 year | Adequate feedstock KBDA operational |

| Activity | Time Frame | Estimated cost (Ksh.) | Outcome |
|---|-------------------|------------------------------|---|
| <ul style="list-style-type: none"> • Monitoring and evaluation • Research and Development • Identification of zones for planting | | | |
| Technical and Economic feasibility analysis | 2008 | 5 Million | Report on Socio-Economic viability of bio diesel |
| Establishment/co-opting of Cooperatives/Common Interest Groups | 2008 | 1.3 Million | Formation of producer groups for biodiesel feedstock production |
| Establishment of planting material nurseries for micro propagation and hardening | 2008 | 2.5 Million | Availability of adequate, high quality planting materials |
| Establishing of centers for oil extraction | 2008-2009 | 4 Million (Revolving Fund) | Ten Oil Extraction centers |
| Establishment of trans-esterification center in oil company | 2008-2009 | 5 Million | Biodiesel processing facility Availability of biodiesel |
| Development of Blending targets | 2008 | 1.3 Million | Policies and standards |
| Upgrading of blending facilities | 2009-2010 | 5 Million | Blending centers |
| Biodiesel awareness and promotion | 2008 | 4 Million | Acceptability/adoption |
| Glycerol promotion | 2008-2009 | 1.3 Million | Consumption of locally produced glycerol |
| Monitoring and Evaluation | 2008-2012 | 15 Million per year | Progress report |

Subsequent budgets will be prepared for the period 2009 -2012 depending on the level of up-scaling or downscaling of the activities.

Appendix 4: On going activities in Kenya

Vanilla Development Foundation distributed over 1.19 Million seedlings between 2005 and 2007. 58% of the distributed seedlings were distributed from Nairobi, 28% from Kambu (in Kibwezi district) and 14% from Kisumu. The farm sizes range from 0.5 acres to 29 acres. Each acre can accommodate at most 500 trees depending on the spacing preferred. Most of the initial seeds produced are being used to scale up production. Plans to utilize the seeds are to give opportunity to private investors who are interested to buy back the seed.

Green Africa Foundation distributed over 3 Million seedlings between November 2006 and September 2007. These seedlings were planted in various provinces namely Eastern, Western, Rift Valley, central and Nairobi. The organisation plans to achieve a target of 4,250,000 seedlings by the end of 2007. It works with both individual farmers and groups. As at September 2007, over 337 farmers had been assisted to grow *Jatropha* both on large and small scale.

Some of the obstacles experienced by the two NGOs include the limited capacity (all potential players); lack of public and private sector coordination, inadequate policy and regulatory frameworks, high cost of capital investment.

Magadi Soda Company has initiated a process of developing a nucleus *Jatropha* plantation of 10 ha for possible use in energy switch program together with an out-grower scheme where communities will grow *Jatropha* for use by the firm.

Global Environment Facility (GEF) has provided funding through the Critical Ecosystem Partnership Fund to develop *Jatropha* plantations for bio-diesel program in the coastal districts of Kwale, Malindi and Kilifi.

Government Initiatives: In an effort to promote *Jatropha* growing, the Ministry of Agriculture is involved in capacity building for staff and farmers. KEFRI and KARI are involved in provenance trials and production of germ plasm as well as trans-esterification processes. KIRDI is involved in design and fabrication of oil expellers. Public universities are undertaking research on different aspects on *Jatropha* and biofuel development. The Ministry of Energy is at the forefront in implementing policy in collaboration with other stakeholders.

Appendix 5: Members of the Taskforce for developing the Strategy

| | NAME | ORGANISATION |
|----|-----------------|-------------------------------------|
| 1) | Eng. Isaac Kiva | Ministry of Energy |
| 2) | J. K. Waihenya | Ministry of Cooperative Development |
| 3) | Rukiya Bakari | Vanilla Development Foundation |
| 4) | David N. Kamau | ISAAA Africentre |
| 5) | Bibiana Walela | Ministry of Agriculture |
| 6) | James Onchieku | Kenya Forest Research Institute |
| 7) | Jennifer Gache | KenGen |
| 8) | Faith Odongo | Ministry of Energy |
| 9) | Pascal Vusa | Kenya Bureau of Standards |

Appendix 6: Members of the National Biofuels Committee (Biodiesel)

1. Permanent Secretary, Ministry of Energy (Chairperson and Secretariat)
2. Petroleum Institute of East Africa (Deputy Chairperson)
3. Agfor Technical Services
4. Commissioner General, Kenya Revenue Authority
5. Director General, National Environmental Management Authority (NEMA)
6. Director, African Centre for Technology Studies
7. Director, Community Project Support Organisation (COPSO)
8. Director, Energy for Sustainable Development Africa (ESDA)
9. Director, Green Africa Foundation
10. Director, Kenya Agricultural Research Institute
11. Director, Kenya Forest Service
12. Director, Kenya Forestry Research Institute
13. Director, Kenya National Federation of Agricultural Producers (KENFAP)
14. Director, Kenya Plant Health Inspectorate Service
15. Director, Kenya Women Poverty Eradication Education Organisation (KWPEEO)
16. Director, Vanilla Development Foundation
17. Director, Kenya Industrial Research and Development Institute (KIRDI)
18. GTZ Energy Regional Advisory office
19. International Service for the Acquisition of Agri-Biotech Applications (ISAAA)
20. Managing Director, Kenya Bureau of Standards
21. Managing Director, Kenya Electricity Generating Company
22. Managing Director, Kenya Pipeline Company Ltd.
23. Managing Director, National Oil Corporation
24. Managing Director, Tana and Athi River Development Authority
25. Permanent Secretary, Ministry of Agriculture
26. Permanent Secretary, Ministry of Cooperative Development and Marketing
27. Permanent Secretary, Ministry of Environment and Natural Resources
28. Permanent Secretary, Ministry of Finance
29. Permanent Secretary, Ministry of Gender, Sports, Culture and Social Services
30. Permanent Secretary, Ministry of Higher Education, Science and Technology
31. Permanent Secretary, Ministry of Lands
32. Permanent Secretary, Ministry of Local Government
33. Permanent Secretary, Ministry of Regional Development Authorities
34. Permanent Secretary, Ministry of Trade
35. Permanent Secretary, Ministry of Transport
36. Permanent Secretary, Ministry of Water and Irrigation
37. Permanent Secretary, Ministry of Youth and Sports
38. Total Kenya Limited
39. Vice Chancellor, Jomo Kenyatta University of Agriculture and Technology
40. Vice Chancellor, University of Nairobi

Appendix 7: Structure of the proposed KBDA

KBDA STRUCTURE

