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Government of Swaziland

NATIONAL BIOFUELS DEVELOPMENT STRATEGY AND ACTION PLAN (NBDSAP)

Ministry of Natural Resources and Energy

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Executive Summary

This National Biofuels Development Action Plan has been drafted from core elements contained within the National Biofuels Development Strategy.

This Action Plan outlines Government's approach to facilitating a viable biofuel industry in Swaziland that builds on existing strengths in ethanol production and gradually builds capacity to develop a biodiesel sector.

The Action Plan has been informed by global and regional trends and developments evident during its formulation. It recognises that the biofuel boom of the early 2000s has been tempered by concerns expressed by numerous organisations and stakeholders. Risks to food security and environmental concerns resulting from land conversions and increased use of water to grow essentially fuel crops have highlighted that, like many land-based agricultural operations, the impacts of biofuel production on already strained environments need to be reduced or avoided.

The issues surrounding the use of land to grow fuel crops rather than food crops at a time when global food demand is increasing and Swaziland has been unable to feed its own population for almost a decade, have called for a more focused but strategically prudent implementation plan.

Consequently Swaziland's biofuel strategy is to initially develop its existing bioethanol sector which is derived from molasses whilst at the same time create an enabling legislative and institutional framework that allows for blending, oversight and management and empowerment of rural farmers with tried and to be tested technologies and crops.

The biofuel industry will be self-financing and will require limited government finances. Levies on fossil fuels will accrue sufficient financial resources to facilitate the implementation of this Action Plan. Supplemental resources will have to be sourced to undertake the various studies and assessments needed to strengthen the research requirement and financial mechanisms.

The draft National Biofuels Development Strategy was developed by the Biofuels Task Team appointed by Cabinet in December 2007 with a mandate to develop a national Biofuels Strategy and an Action Plan. The Strategy is detailed and comprehensive but considered to be too broad (the Strategy encompasses both bioethanol and biodiesel - two very different fuels and production processes with few commonalities) and unfocused (the strategy encompasses both mechanized TDL experienced farmers as well as small-holder SNL subsistence farmers).

This Action Plan recognises that successful biofuel development is an extremely difficult task even for rich countries. The history of biofuels development suggests that they are usually uneconomic at the recent average price of oil with very few exceptions (e.g.: Brazil). It also recognises that Swaziland is a small resource-constrained country with limited financial capacity to sustain a long-term investment in a large-scale biofuels programme.

For these and other reasons, the Ministry is recommending a phased biofuel implementation plan that seeks to keep costs low as the nation learns how to build an economically and environmentally sustainable biofuels industry. In time building on the experience gained, the biofuel industry will mature and broaden the scope for participation of lower skilled and resourced producers.

The Action Plan is recommending that investment of time, money and effort into biodiesel feedstock production be delayed until proven feedstock is found. The Swaziland Biofuels Authority will monitor global efforts to create sustainable biodiesel and continue to monitor the progress of the jatropha plantations in the country. It will search for "low hanging fruit" to manufacture batch quantities of biodiesel (e.g.: used fryer oil or surplus rendered animal fats for small scale biodiesel production). The Action Plan does not recommend the avoidance of biodiesel feedstock production, but recognises the challenges biodiesel feedstocks face globally.

This Action Plan has been formulated cognisant of the economic, environmental and production challenges that exist in the sector today and has opted to:

- Focus near term on existing sugar producers to commercialize process by-products
    - Swaziland has good experience with sugarcane and has established businesses in the sector with some experience making bioethanol
    - Requirement is for development of downstream (production, blending and marketing) infrastructure and expertise - Swaziland has none at present
    - Critical to determine the appropriate stimuli: demand requirements (blending mandates) and price supports (fuel levies) to sustainably fund the industry
- Delay rural empowerment until functioning extension programmes, production modalities, crop selection and solid markets have been established
    - Initiate agronomic trials of promising biofuel crops that are suited to small-holder production constraints and opportunities
    - Protect the small-holder from market failure (ensure there is demand for their produce and a price history they can trust) and develop viable business plans for selected crops
    - Identify realistic and viable funding sources that can be accessed and utilised by small-holder farmers to develop their biofuel feedstock production
    - Train extension officers to focus on environment-appropriate and commercially viable feedstocks
- Delay investment in biodiesel feedstock production for the foreseeable future. There is presently no example of a profitable biodiesel industry anywhere in the world so the Ministry recommends waiting for other countries to prove viability first then re-evaluate the introduction of biodiesel feedstock production.
- Establish a biofuel regulator to manage and coordinate biofuel production, marketing and utilisation.

The Action Plan is framed around three implementation steps or phases. Although linked the implementation plan requires the successful completion of each step before moving on to the next.

- **Step 1: Create the Legislative Framework**: Create legal authority for biofuels production and use. It has three key deliverables:
    - Determination of Swaziland-specific laws and regulations to govern production, marketing and use of biofuels, specifically bioethanol
    - Determination of capital investment requirements and fuel levies required to fund development of the industry
    - Approval by Parliament of both the legal code and the financing plan to start the industry

Step 1 will:

- Establish key programme goals and definitions
- Enable production and sale of bioethanol
- Set mandatory blending requirements
- Create mechanism for funding industry (define formulae for tax/levy to finance biofuels industry and limits to tax incentives)

Step 2: Create the Institutional Capacity: Develop institutions to manage industry. It has three key deliverables:

- Establishing and operationalising the Swaziland Biofuels Authority and hiring quality staff

- Development of key performance objectives and governance protocols to ensure focus and integrity
- Establishment of independent R&D function to pro-actively investigate feedstock, marketing and non-transport-fuels energy uses of biofuels and by-products

Step 2 will:

- Create, staff and fund the Swaziland Biofuels Authority
- Establish a multi-sectoral National Biofuel Coordination Committee composed of key stakeholders who will be involved in production, processing marketing & trade of biofuels
- Finalize complete value-chain investment plan
- Initiate funding mechanism to capitalize investment plan
- Develop a Research and Development programme
- Develop a Capacity Development Plan for each link in biofuels value-chain
- Create a Biofuel Producers Association

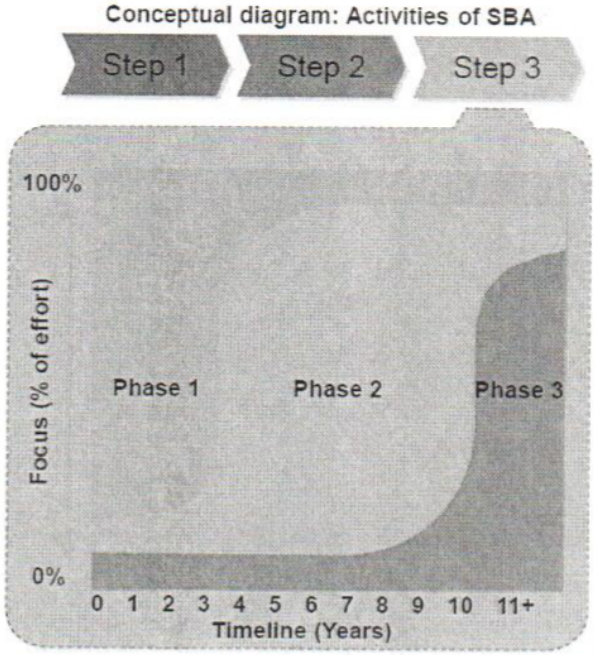
Step 3: Implementation: Phased implementation to "build slowly from strength". Step 3 is focused on commercializing existing sugar-industry byproducts (molasses) into fuel-grade ethanol and developing national markets for purchase and use of the fuel.

Step 3 will:

- Develop and monitor markets
- Develop and monitor quality and safety standards
- Monitor prices and set fuel-tax needs to ensure stable funding
- Implement Research and Development programme

Step 3 is divided into three phases:

Conceptual diagram: Activities of SBA



Key Elements of phased implementation plan

1	2	3
Develop downstream bioethanol markets	**Diversifi-cation of ethanol feedstocks (upstream)**	**Empower rural farmers**
• Work with existing sugar companies to commercialize by-products (molasses) • Focus on developing marketing and distribution capabilities • Keep capital costs to a minimum	• Targeted focus on feedstock diversification • Close partnership with limited number of established contract farmers • Leverage and extend marketing capability developed in Phase 1	• Use knowledge gained in Phase 2 to establish extension program to encourage small holders to grow appropriate feedstock • Use established market developed in Phase 1 to set reliable grain prices and quality standards

Chapter 4 of this Action Plan presents the activities and tasks required to achieve a sustainable and vibrant biofuel industry. It uses flow charts to illustrate the processes required and assigns indicative responsibilities and financial resources to achieve the tasks.

The activities are presented as:

4.4.1 Activities for Step 1: Create the Legislative Framework (page 32)

4.4.2 Activities for Step 2: Establish the Swaziland Biofuels Authority (page 37)

4.4.3 Activities for Step 3, Phase 1: Feedstocks (upstream) (page 43)

4.4.4 Activities for Step 3, Phase 2: Production & Markets (downstream) (page 47)

4.4.5 Activities for Step 3, Phase 3: Sustainability and Rural Empowerment (page 52)

The indicative costs of implementing this Action Plan are:

Step	**Year of cost**	**Fixed Cost**	**Recurrent Costs**	**Total**
Step 1: Create the Legislative Framework	2010	E650,000.00	-	E650,000.00
Step 2: Establish and run the Swaziland Biofuels Authority	2011	E2,860,000.00	E2,470,000.00	E5,330,000.00
Step 3, Phase 1: Feedstocks (upstream)	2012-2015	E1,430,000.00		E1,430,000.00
Step 3, Phase 2: Production & Markets (downstream)	2013-2015	E45,200,000.00		E45,200,000.00
Step 3, Phase 3: Sustainability and Rural Empowerment	2014-	E1,510,000.00		E1,510,000.00
TOTAL		E51,650,000.00	E2,470,000.00	

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Acronyms and Abbreviations

B5	Diesel blended with 5% Biodiesel
BTF	Biofuels Task Force
E10	Petrol blended with 10% ethanol
EIA	Environmental Impact Assessment
FAO	Food and Agriculture Organization
GoS	Government of Swaziland
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
MNRE	Ministry of Natural Resources & Energy
MOA	Ministry of Agriculture
NBDAP	National Biofuel Development Action Plan
NBDS	National Biofuel Development Strategy
NGO	Non-Governmental Organisation
PPO	Pure Plant Oil
ProBEC	Programme for Basic Energy and Conservation
PRSAP	Poverty Reduction Strategy and Action Plan
R&D	Research and Development
RSA	Republic of South Africa
RSSC	Royal Swaziland Sugar Corporation
SACU	Southern African Customs Union
SADC	Southern African Development Community
SBA	Swaziland Biofuel Authority
SEA	Swaziland Environment Authority
SNL	Swazi Nation Land
SSA	Swaziland Sugar Association
SWADE	Swaziland Water and Agricultural Development Enterprise
SWASA	Swaziland Standards Authority
TDL	Title Deed Land

1 INTRODUCTION

The Government of Swaziland has recognized the potential socio-economic and environmental benefits of properly planned biofuels development as a sustainable alternative to fossil fuels and has undertaken several information gathering studies to support a national decision making process.

In order the facilitate coordination and broaden stakeholder participation a Biofuels Task Force (BTF) was established and included as members the key ministries (Ministry of Natural Resources and Energy, Ministry of Agriculture, Ministry of Enterprise and Employment, Ministry of Foreign Affairs and Trade, Ministry of Finance, Ministry of Public Works and Transport, Department of Customs and Excise, Swaziland Environment Authority, Ministry of Economic Planning and Development and the Swaziland Water and Agricultural Development Enterprises (SWADE). A number of other organizations were given observer status on the BTF.

In 2008 the BTF commissioned the preparation of a National Biofuels Development Strategy (NBDS) that sought to identify a long-term direction for biofuel feedstock production, refining and use. The NBDS proposed the creation of a Swaziland Biofuels Authority (SBA) that would assume overall management and implementation powers to roll out a national biofuels programme. The NBDS also called for a review of the legislative framework and the drafting of specific legislation that initially creates the SBA and changes to existing legislation that would allow for the blending of fuels. Other recommendations included the creation of stakeholder awareness and involvement, establishment of national biofuels producers association, a capacity development plan, a research and development programme, regulatory structures, financial incentives and an action plan for the production, processing and marketing of biofuels in the country.

1.1 PURPOSE OF NATIONAL BIOFUELS DEVELOPMENT STRATEGY

The purpose of the NBDS is to provide guidance to the Government of Swaziland and other stakeholders to develop and nurture a biofuel industry in Swaziland, exploiting the country's opportunities and overcoming its key challenges.

The development of a biofuel industry will strengthen energy security, create employment, improve land utilisation, support rural farmers and contribute towards the global reduction of greenhouse gases. The production, marketing and use of biofuels locally will also stimulate foreign and national investment.

The energy challenge is especially acute in the transport sector, as most vehicles will continue to rely on liquid fuels for the decennia to come. Diesel and petrol, obtained from fossil oil, will gradually be blended with renewable liquid fuels. The most important among them are pure plant oil (PPO), biodiesel (diesel derived from PPO) and ethanol made from starch or sugar.

1.2 PURPOSE OF NATIONAL BIOFUELS DEVELOPMENT ACTION PLAN

The purpose of the National Biofuels Development Action Plan (NBDAP) is to describe the implementing activities or tasks required in order to give effect to relevant sections of the NBDS.

The NBDAP has been guided by the issues, strategy statements and actions presented in the NBDS. As will be discussed in a later chapter, the Ministry has opted to selectively implement the NBDS in a manner that is deemed fit and appropriate for the current and longer-term economic and developmental objectives.

The NBDAP presents in Chapter 4 the recommended implementation plan that identifies the activities, implementing agencies and indicative budgets needed to develop a viable and appropriate biofuel industry.

1.3 BIOFUELS AND FOOD PRODUCTION

Biofuel production has been widely associated with increasing competition with food production and the FAO High Level Conference on World Food Security in June 2008 agreed on the significant potential of bioenergy to contribute to rural development, in particular in developing countries, both as a source of economic growth and as a provider of energy services. However, it was also stressed that bioenergy growth should be managed

carefully to ensure essential food production activities are still able to continue and expand. It was generally agreed that food security should be put before energy policy goals, and that measures should be taken to avoid competition between food and energy.[1]

The FAO Conference generally agreed that the 2008 food price crisis resulted from many causes. These include weather-related production shortfalls, declining stocks, increasing fuel costs, increased demand for both food and biofuels, and export restrictions in some countries.

2 OVERVIEW OF BIOFUELS

This chapter provides a review of global and regional biofuels development and an overview of the benefits and risks of biofuel production. It outlines the importance of biofuels in the national context and presents information on present fuel consumption in Swaziland and on feedstock and biofuels production.

2.1 GLOBAL AND REGIONAL BIOFUELS DEVELOPMENT

Increasing energy costs, environmental impacts of fossil fuels, uncertainty regarding future energy supply and the need to reduce the energy import bills in both developing and developed countries, have given incentives to encourage the production of petroleum substitutes from agricultural commodities.

2.1.1 WHAT ARE BIOFUELS?

Biofuels can be defined as fuels produced from biomass for purposes such as transport, heating, electricity generation and cooking. They can be produced from agricultural and forest products and the biodegradable portion of industrial and municipal waste. This strategy focuses on liquid biofuels: bioethanol and biodiesel, which account for more than 90% of global biofuel usage. The main use of liquid biofuels is in the transport sector.[2]

Biofuels can also be used for purposes such as domestic lighting, cooking and heating, especially in poor rural communities in remote or land-locked developing countries where the costs of fossil fuels transportation makes them prohibitive. Their performance for these other uses, however, needs to be assessed against that of other technologies such as biogas, micro hydro, wind and solar.

Bioethanol is alcohol produced by fermenting and then distilling sugars from sugar-rich plants (e.g. sugarcane, maize, beet, cassava, wheat, sorghum). The alcohol is then purified to remove water. Both anhydrous bioethanol (<1% water) and hydrous bioethanol (1-5% water) can be used pure as fuels, but they are usually blended with gasoline. Blends of 5% or 10% of bioethanol in gasoline, denominated E5 and E10 respectively, do not require any modification to the vehicle engine.

Work is now underway to develop a "second generation" of bioethanol, based on cellulose rather than sugars. This technology will allow almost any plant biomass to be used for biofuels, including forestry products (e.g. short rotation coppices), sawmill wastes, crop residues (e.g. stalks, leaves and hulks) and energy grasses (e.g. switch grass), as well as waste paper and other industrial and domestic wastes. The most promising second-generation technology for bioethanol is enzymatic hydrolysis.

Biodiesel is produced from the reaction of vegetable oil with alcohol in the presence of a catalyst to yield mono-alkyl esters and glycerine, which is then removed. The oil comes from oily crops or trees (e.g. rapeseed, sunflower, soya, palm, coconut or jatropha), but also from animal fats, tallow and waste cooking oil. Some types of biodiesel can be used unblended or in high-proportion blends with modification to the vehicle engine. A blend of 5% of biodiesel is denominated as B5.

[1] FAO, 2008a. High-Level Conference on World Food Security, Rome, 3 – 5 June 2008. Report of the Conference.

[2] CFC (Common Fund for Commodities). 2007. Biofuels: strategic choices for commodity dependent countries. Note the difference between processed biofuels and unprocessed biomass fuels, such as firewood, charcoal, animal dung and crop residues that are burned directly for cooking, heating and industrial use.

The new second generation of biodiesel involves a number of different technologies to produce biodiesel directly from non-fat biomass. For example, Biomass to Liquid (BTL) uses the Fischer-Tropsch process, which involves gasification of wood, straw or municipal waste to produce biodiesel.

2.1.2 THE END USE OF BIOFUELS

One of the driving forces behind the increasing use and development of biofuels is that they offer a convenient alternative to petroleum-derived gasoline and diesel and the potential to reduce greenhouse gas emissions thereby offsetting the impacts of climate change. Since climate change has been highlighted as one of the main drivers of biodiversity loss, the mitigation of greenhouse gas emissions would contribute to reducing the rate of biodiversity loss in the future.[3]

Among current technologies it appears that ethanol produced from sugarcane and the manufacture of biodiesel from pure vegetable oil, animal fats and used cooking oil, can substantially reduce greenhouse gas emissions when compared with petrol and diesel. The combustion of 1 tonne diesel fuel or petrol leads to over 3 tonnes of CO_2 emissions.[4]

It is generally accepted that biofuels will have a limited ability to replace fossil fuels. Therefore progress towards a sustainable solution for transport requires an integrated approach which combines biofuels with other technological developments and broader transport policies, including public transportation.

2.1.3 GLOBAL DEVELOPMENTS

Biofuels offer a potential source of renewable energy and could lead to large new markets for agricultural producers. However, few current biofuel programs are economically viable, and most have social and environmental costs: upward pressure on food prices, intensified competition for land and water, and possibly deforestation. National biofuel strategies need to be based on a thorough assessment of those opportunities and costs. Globally, lower tariffs and subsidies in industrial countries will be essential for ensuring efficient allocation of biofuels production and guaranteeing social benefits to small farmers in developing countries.[5]

2.1.3.1 BIOFUELS MARKETS FOR AGRICULTURE

With high oil prices and with few alternative fuels for transport, Brazil, the member states of the European Union, the United States, and several other countries are actively supporting the production of liquid biofuels from agriculture, usually maize or sugarcane for ethanol, and various oil crops for biodiesel.

Possible environmental and social benefits, including mitigation of climate change, and contribution to energy security are cited as the main reasons for public sector support of the rapidly growing biofuel industries. As the economic, environmental, and social effects of biofuels are widely debated, they need to be carefully assessed before extending public support to large-scale biofuel programs. Those effects depend on the type of feedstock, the production process used, and the changes in land use.

Global production of ethanol as fuel in 2006 was around 40 billion litres. Of that amount, nearly 90 percent was produced in Brazil and the United States. In addition, about 6.5 billion litres of biodiesel were produced in 2006, of which 75 percent was produced in the European Union. Brazil is the most competitive producer and has the longest history of ethanol production.

2.1.3.2 ARE BIOFUELS ECONOMICALLY VIABLE?

Governments provide substantial support to biofuels so that they can compete with conventional fossil fuels. Such support includes consumption incentives (fuel tax reductions); production incentives (tax incentives, loan

[3] Firbank, L.G. (2008). Assessing the Ecological Impact of Bioenergy Projects.
[4] CBD (Convention on Biological Diversity). 2008. The potential impact of biofuels on biodiversity.
[5] World Bank. 2007. World Development Report 2008.

guarantees, and direct subsidy payments); and mandatory consumption requirements. More than 200 support measures, which cost around US$5.5 billion to US$7.3 billion a year in the United States, amount to US$0.38 to US$0.49 per litre of petroleum equivalent for ethanol. Even in Brazil, sustained government support through direct subsidies was required until recently to develop a competitive industry. Brazilian ethanol production is now no longer subsidized, but petrol is heavily taxed favouring ethanol fuel consumption (54% tax). Domestic producers in the European Union and the United States receive additional support through high import tariffs on ethanol.

The cost of biofuel production globally has been pushed up by increased feedstock prices during 2008. For example the cost of maize has risen over 60 percent from 2005 to 2007. Some have said this is due to increased biofuel production using essentially food crops, but it is now becoming clear that biofuels like ethanol and biodiesel have played virtually no role in the recent global surge in food prices. Prices of major grains and oilseeds that are used to make biofuels - like maize, wheat, soybeans, and palm oil - have sharply decreased in the second half of 2008.[6] The movements of all the internationally traded grains were part of a bigger speculative commodity boom, tied to oil, which itself fluctuated alongside the value of the dollar (and possibly in anticipation of the credit crunch). Biofuels output rose only very gradually over the course of the past two years, whereas prices for feedstocks jumped and then crashed. The same amount of biofuels is being produced, worldwide, than before the food price crash.

Feedstock supplies are likely to remain constrained in the near term. However, unless there is another major surge in energy prices, it is likely that feedstock prices will rise less in the long term. Farmers will respond to higher prices by increasing the planted areas and supply of these feedstocks. At the same time, rising prices will lower the demand for feedstocks because of the falling profitability of producing biofuels at these higher prices.

Future biofuel technology may rely on dedicated energy crops and on agricultural and timber waste instead of food crops (so called second generation feedstocks), potentially reducing the pressure on food crop prices. But second-generation technologies to convert cellulose from these waste products into sugars distilled to produce ethanol or to gasify biomass are not yet commercially viable and will not be for several years. Moreover, some competition for land and water between dedicated energy crops and food crops will likely remain.[7]

The success of biofuels varies from country to country and largely depends on the depth of government support. However, long term investments and increased efficiency have proved important in Brazil's case. Germany, the largest producer and user of biodiesel, is now reducing its incentives, to cut losses to the fiscus, and is moving to a mandatory target. This approach has problems as fuel off-takers will only buy until the annual mandate is reached. If mandates are fulfilled early in the year, then any additional biofuels produce could lose the market. Comparative analysis of international experience shows that the biofuels industry particularly as an infant industry is at the mercy of volatile oil prices, crop prices and exchange rates. It therefore requires government support in the initial stages.[8]

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[6] Corn and soybeans have lost more than half of their value, whereas wheat dropped even more and now costs 55% less than at its highpoint in March 2008. Canola fell from a high of $730 per ton early in 2008 to $400/ton by October 2008. Prices of other internationally traded farm products are following the same downward path. The best illustration of the role of biofuels in this 'food versus fuel' story can be found by looking at the price movement of rice, one of the world's staple crops. Rice has not been used as a biofuel feedstock on any significant scale, but its price suddenly accelerated at the beginning of 2008, in line with record oil prices, only to drop just as spectacularly during October 2008.

[7] World Bank. 2007. World Development Report 2008.

[8] Agra CEAS/UNDP, 2008. Study of the Biofuels Market in Swaziland.

2.1.4 BIOFUELS DEVELOPMENT IN SADC

A SADC biofuels feasibility study examined the potential of SADC agricultural production for biofuels development and concluded that there is a biofuels potential in the region.[9] The following crops were analysed: oil palm, sweet sorghum, sugar cane, sunflower seed, soybeans, jatropha and cassava and several countries were identified as having a sound feedstock base for bioethanol or biodiesel production. As a result of the study, the SADC Secretariat established a SADC Biofuels Task Force in April 2008 supported by technical expertise by GTZ to promote the development of a competitive and sustainable biofuels industry within Southern Africa. The Task Force has undertaken numerous activities around biofuels and bioenergy through its implementing partner Programme for Biomass Energy Conservation (ProBEC). ProBEC has a technical expert addressing sustainability issues for biofuels and attached to the ProBEC Mozambique office. The Technical Advisor, drawing on international and regional experience, is promoting sustainable biofuels activities and also provides support and advice to all Member States in their efforts to develop national biofuels strategies.

At the 30th Meeting of SADC Energy Ministers in April 2009, Ministers urged Member States to accelerate their initiatives in developing biofuels as a source of alternative and cheap environmentally friendly fuel but also for rural development and poverty reduction. Ministers also noted the efforts made by Member States in developing guidelines, strategies, and policies for biofuel production and utilization and urged the SADC Secretariat and Member States to identify innovative mechanisms of collaborating with Brazil, which has vast experience in biofuels development under the South to South arrangements.

Ministers directed the Secretariat to facilitate the development of an all embracing renewable energy regional strategy for consideration and approval at the next meeting and establish and coordinate a Regional Biofuels Task Force.

The SADC countries are increasingly interested in developing a biofuel sectors and steps have been taken to set up national and regional biofuel coordinating bodies and policies. Most SADC member states have started biofuel projects with ethanol derived from sugarcane molasses and jatropha for biodiesel being the most common. Only South Africa, Tanzania and Mozambique have developed biofuels strategies but all other member states are in the process of formulating similar strategies to guide national developments. In addition, biofuels projects have been announced in several other SADC countries, e.g. Malawi, Mozambique, Zimbabwe, Zambia, Madagascar, Tanzania and Mauritius.[10]

The following sections briefly present some background to regional activities that are on-going.

2.1.4.1 SOUTH AFRICA

The South African government has readily embraced the establishment of a biofuels industry, citing job creation, the need for clean and renewable energy and the creation of markets for small-holder farmers, as key motivators. The Biofuels Industrial Strategy, published in December 200, outlines the RSA Government's approach to policy, regulations and incentives.

The aim of the Strategy is to establish the enabling policy, legislative and fiscal framework for the production of up to 400 million litres of biofuels, constituting 2% of the total national consumption. Sugar cane, sugar beet, sunflower, canola and soya are to be feedstocks. A blending ratio of 8% bioethanol and 2% biodiesel is envisaged. Maize and Jatropha have specifically been excluded on food security and environmental grounds respectively.[11] Incentives for biofuel production are limited to rebates on the fuel levy and entail a 50% rebate

[9] SADC (2005). Feasibility Study for the Production and Use of Biofuel in the SADC Region.

[10] Mozambique is one of the countries having a large production potential (estimated by the government at more than 21 million litres of ethanol and 40 million litres of biodiesel annually). Mozambique is a large producer of cassava (6 million tonnes annually) and interest in using cassava in ethanol production is growing, as well as in jatropha-based biodiesel production.

[11] RSA-DME (2007), Biofuels Industrial Strategy of the Republic of South Africa. The strategy aims to achieve a biofuels market share of 2% of liquid road transport fuels by 2013. This target is to be based on local production which will exclude the food staple maize. The strategy assumes a Petroleum Products Licensing system to be put in place, which will require petroleum wholesalers to buy biofuels production

for biodiesel provided that no less than 1.2 million litres are produced per year. A 100% rebate will also be provided for bioethanol that forms part of a fuel blend. The Strategy links the granting of licenses and tax incentives to the use of feedstock grown by previously disadvantaged farmers on 'under-utilised' agricultural land. The strategy is also aimed at creating a development balance between previously disadvantaged farming areas and commercial farming areas. This will ensure the sustainable development of the biofuels industry as it looks both at creating commercial agricultural areas and providing firm opportunities for new and emerging farmers.

There are numerous biofuel projects currently going ahead, facilitated and funded by parastatal agencies and programmes specifically funded by government to kick start a biofuels industry in the country. The Central Energy Fund (CEF), Industrial Development Corporation (IDC), AsgiSA and various provincial departments form an interlinked and complex network of government agencies pushing the biofuels agenda forward. These initiatives almost without exception include private capital.

The country has already developed quality standards to regulate biofuel qualities:

SANS 465:2005 exists for bioethanol as fuel ethanol component and suppliers must meet this quality standard.

SANS 1935:2005 exists for biodiesel to be used as B5, and higher up to B100 and manufacturers must ensure compliance.

The country has four projects being implemented currently with five in the pipeline.

Biofuel projects are subject to environmental impact assessment if they fall within the set of "listed activities" in the 1998 National Energy Management Act. Although biofuel production is not specifically listed as an activity, it is covered by other activity classes involving industrial production and major changes to land-use. A major gap in South Africa's biofuel initiatives is the absence of specific government efforts to address international concerns over sustainability, and in particular to deal with the recent EU sustainability criteria. This would not be a problem for producers aiming at the local market, but would effectively close international markets to South African biofuels, and could also impinge on the ability of international companies to purchase the local product. Nevertheless, some private developers such as PhytoEnergy International appear to be dealing with this issue on their own, and are focusing on the export trade as a key component of their business model. The South African government is also aware of this issue and many developers are confident that it will be addressed in time.

2.1.4.2 MOZAMBIQUE

In Mozambique a "Political and strategic framework for biofuels of Mozambique" (Política e Estrategia de Biocombustiveis) was published in March 2009. In preparing their strategy, feedstock options were analysed closely recommending: sugarcane, sweet sorghum, cassava, maize (for ethanol), jatropha curcas, coco, sunflower, soy, ground nuts (for biodiesel).

Based on sustainability of feedstock as well as evaluating their potential for income generation, cost of production, socio-economic and environmental impacts, the selected crops are: sugarcane and sweet sorghum for ethanol, and Jatropha curcas and coco for biodiesel.

The strategy proposed a phased introduction of mandatory blending: Pilot Phase (2009-2015) – increase the level of blending up to 10% ethanol (E10) and 5% of biodiesel (B5); Operational Phase (2015-2021) - E10 and B5 available nationwide and possible increase up to E20 and B20; Expansion Phase (2021 onwards): development of parallel distribution network for blending above E75- E100 and B100.

In response to high foreign investment demand and interest, the government launched a land zoning exercise. The National Institute of Agronomic Research (Instituto de Investigação Agrária de Moçambique) undertook an

according to their national market shares. The current 40% fuel levy reduction for biodiesel is to be increased to 50%, while fuel ethanol will enjoy a 100% exemption. Blends of 8% for ethanol and 2% for biodiesel are envisaged in South Africa.

agro-climatic analysis and the National Directorate for Land and Forestry (Direcção Nacional de Terras e Florestas) undertook a land availability analysis.

The assessments identified nearly 7m Ha of land suited for large-scale agricultural activities and a map of land-availability in the country (capturing contiguous areas of more than 1,000 Ha) was prepared. Of the identified 7m Ha, 3,780,933 Ha (54%) was found suitable for agriculture (including biofuel developments), the other 3,185,097 Ha (46%) was identified for other purposes, such as forestry and grazing. The primary focus for biofuel developments has been identified as Manica, Sofala and Zambezia provinces.

2.1.4.3 TANZANIA

In April 2006, Tanzania established a National Biofuels Task Force to formulate and propose an enabling environment to facilitate the development of biofuels in Tanzania. The Task Force published guidelines for biofuels development in Tanzania and a comprehensive action plan. Tanzania is aggressively pursuing biofuels and bio-energy developments, both large and small-scale. The main thrust to date has been from private investors and a few key NGOs, supported by government in the form of the Tanzanian Investment Centre (TIC) and several key ministries. The TIC has so far registered a total of 8 developers, but there are at least 40 projects in various stages of development according to sources in the ministries.

2.1.4.4 ZAMBIA

Zambia has abundant agricultural land, well suited for a range of biofuel crops. The country also has favourable rainfall patterns in combination with and existing water resources and a well developed industry. Production of biofuel feedstock and value added processing looks very promising. Zambia uses its policy on renewable energy to guide biofuel developments. It provides for government incentives to private sector investment and gives blending targets and standards for biodiesel. The country now has 7 biofuel projects being implemented with two projects being formulated.

2.1.4.5 MADAGASCAR

Madagascar has five biofuel projects underway (4 jatropha projects, 1 sugar cane project), and eight biofuel production projects are in the pipeline. No land survey or agro-ecological zoning has been undertaken. The process of establishing a methodology to develop regional and communal land use planning has been started recently.

2.1.4.6 MALAWI

Malawi has the longest experience with use of biofuels. It started blending bioethanol (15-20%) in the 1980's but recently reduced this to E10 due to introduction of unleaded petrol. The country is currently developing a biofuels strategy that will guide existing and future developments as well as create the regulatory and legislative environment that supports sustainable biofuel production and use.

The country uses its 2003 National Energy Policy to guide biofuel developments. The country gazetted new regulations in February 2009 and is now rolling out regulations governing levies and related charges through Malawi Energy Regulatory Authority. Currently bioethanol is classified as alcohol punishing it with a 30% excise duty and a 17.5% VAT. This is proposed to change soon supporting the case to produce renewable energies.

2.1.4.7 ZIMBABWE

Zimbabwe's involvement in biofuels extends back to the 1970s, when the major sugar growers and processors in the lowveld area began to produce ethanol from waste molasses as a means of dealing with the sanctions being directed at the Rhodesian breakaway state. Production of ethanol (used in a petrol blend of between 15% and 20%) continued into the late '80s and early '90s under the new government, with production stopping around the time of a major drought, 2002-3, and has been effectively dormant since.

Zimbabwe is making serious efforts to reduce dependence on imported petroleum products through increased production of biofuels. In 2005 the government embarked on a new programme to displace imported diesel

with jatropha-derived biodiesel. This initiative in particular was approved by cabinet, and according to government is now the subject of stakeholder consultation. There are also plans to resume ethanol production in the lowveld and a plant is set to re-open in October 2009 with a production target of 25 million litres/annum.

Most biofuels development in Zimbabwe has occurred through actions by individual ministries and parastatals such as NocZim and Science & Technology, and not as part of a concerted national programme.

With assistance from a South Korean company and the Zimbabwe Reserve Bank providing most of the capital, a biodiesel plant was constructed in Mt Hampden with a potential output of 35 million litres/annum. The plant initially used cottonseed oil as an interim feedstock until jatropha oil could be provided. Plans were then developed to distribute jatropha seedlings to indigenous farmers as part of the land resettlement programme, targeting up to 120,000 ha of dedicated jatropha holdings by 2010, of which 40,000 hectares are said to be in place at present.

2.1.4.8 BOTSWANA

Botswana is moving forward aggressively with a national programme for biofuels development in two key areas:

1) Biodiesel from jatropha and animal fats

2) Bioethanol from sweet sorghum

This programme is the direct result of a study commissioned in 2007 and completed in 2008, which included a detailed assessment of crop suitability, market potential and technical feasibility. The study targeted several areas for jatropha and sweet sorghum, including the Pandamatenga area near Kasane for sweet sorghum and the central district was identified as the most suitable area for production of jatropha. The Pandamatenga option has not materialised due to problems gaining support from local farmers, and this option is now on hold. The biodiesel option has now expanded to potentially encompass more than one location for the crops. The study also suggested that it is economical to produce biodiesel at large-scale, i.e. around 50 million litres per year, while small-scale producers may also be able to benefit from biodiesel production provided that they focus on producing raw oil only. Although the study identified jatropha as the main source of biodiesel, the long lead times required to produce a mature jatropha oil crop has led government to consider the use of beef tallow as a substitute feedstock in the first few years, a possibility which arises because of Botswana's large commercial beef industry. The study further recommended that both forms of biofuels will only be competitive if government reduces the current fuel levy by 50% for bio-ethanol and 75% for bio-diesel. Other options including VAT rebates and green levies were also considered by the consultant.

By comparison, bio-ethanol is seen as having a lower potential for development and one of the main targets would be bioethanol gel for lamps and stoves in rural communities.

The Department of Energy Affairs is currently developing a national Energy Policy which will have a chapter on biofuels. The policy is almost complete with only the development of high level strategies, which will have clear targets to be finalized.

In National Development Plan 9, there is a mandate to promote research and development on new and renewable sources of energy, which implicitly includes biofuels; it is expected that government will provide a clearer policy direction for biofuels in NDP 10 (which will be starting in April 2010), particularly with regard to blending ratios and time frames.

The country is not implementing any biofuel projects at the moment pending the results of two feasibility studies. Both are centred on biodiesel using jatropha and animal fat.

Despite limitations of climate and arable land, Botswana is moving ahead aggressively to identify and implement biofuels opportunities, particularly for biodiesel. If the current plans for large-scale biodiesel

production are realized, they will also be the first country in African to use animal fats in biodiesel production. The country is also actively involved in the process of improving the sustainability of biofuels production, and the current plans for national guidelines will address this issue in particular.

2.2 BENEFITS AND RISKS OF BIOFUELS

The introduction of biofuels may lead to the realisation of a number of benefits to the country; however, challenges that face biofuel production (as opposed to use) need to be resolved.

The total economic benefits of the biofuels project are many and varied, ranging from employment creation, poverty alleviation, technology transfer, to positive externalities such as transport for haulage, sunflower oil for domestic use, carbon credit sales, etc. These initiatives and business spinoffs are expected to jointly or, in some cases, even individually, to improve economic growth through new savings, investments, reduced imports, leapfrogging due to enhanced human capital expertise and new technologies.[12]

2.2.1 GENERAL BENEFITS OF BIOFUELS PRODUCTION AND USE

Benefits may include:

- Decreasing fuel import expenditure
- Increasing export income
- Enhancing energy security, especially in the transport sector
- Diversifying agricultural production, including smallholder involvement
- Strengthening and diversifying rural economy and employment
- Contributing to soil conservation and improving degraded ecosystems
- Reducing greenhouse gas emissions.

The benefits that can be achieved relate to a variety of economic, social, and environmental conditions. Savings on fuel import constitute of savings of foreign exchange equal to the value of imports substituted. Local fuel production contributes to energy security.

The feedstocks planted for energy cropping involve more farmers and can improve farm incomes. Expansion of agricultural production, processing and marketing will strengthen and diversify the rural economy and create rural employment.

Environmental benefits can be achieved through halting and stabilising deforestation and desertification and partial restoration of ecosystems. Biofuel programs have also the potential to contribute to a cleaner environment through greenhouse gas savings (reduced CO_2 emission).

UNEP[13] observed that a green economy "has a particularly high potential to create employment" and that green jobs are likely to outstrip brown (dirty) jobs in the coming decade. The creation of green jobs within the Swaziland biofuel development will better equip the nation to face the challenges of climate change.

2.2.2 GENERAL RISKS OF BIOFUELS PRODUCTION AND USE

Risks may include:

- Growing competition for land and water
- Increasing food production insecurity

[12] GoS-MNRE, 2006 a. Bio-Energy Evaluation Study.

[13] UNEP, 2008. Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World.

- Decreasing biodiversity and ecosystems
- Increasing pollution of water and air
- Increasing greenhouse gas emissions.

The risks that have to be considered relate not only to general availability of land and water, but also to loss of habitat (ecosystems) and biodiversity. Depending on the type of land being used for feedstocks, biofuel programs may also increase greenhouse gas savings.

Biofuel production is a possible threat to food security through rising food and commodity prices for consumers due to new demand. Water and air pollution and other effects of the biofuel production may lead to human health risks.

2.3 BIOFUELS IN THE LOCAL CONTEXT

2.3.1 FARMING FOR ENERGY

The National Energy Policy calls upon Government to investigate and promote the use of environmentally friendly fuels, energy products and technologies. As part of the implementation of the National Energy Policy, the MNRE published in May 2006 the Bio-Energy Feasibility Study: Farming for Energy Project, which analyzed the possible volume of biomass potentially producible in Swaziland and an estimation of the commercial and technical opportunities to process this biomass into biofuels. In addition the study looked at how Swaziland could develop and establish her own sustainable agro-industrial sector based around biofuels. The study looked into a range of issues including the distribution and sales system, export opportunities, laws and regulations needed for implementation and investment regulations required for short and long term development goals.

The Bio-Energy Feasibility Study confirmed the viability of biodiesel and bioethanol based on locally grown and managed crops. Crops identified as having potential for the production of biodiesel included sunflower, soybeans, jatropha, sesame and safflower and for bioethanol sugarcane, sweet sorghum and cassava. The by-products of biofuels can also stimulate other industrial activities like soap from glycerine production, cogeneration from bagasse, seedcake and vegetable oil production.

Fuel production through farming would develop a new energy economy in Swaziland that has the potential to create more jobs and development in the rural areas and will have significant direct and indirect (multiplier effect) economic, social and environmental benefits to the whole economy.

2.3.2 FUEL CONSUMPTION AND DEMAND IN SWAZILAND

The energy picture in Swaziland is characterised by heavy dependence on imported energy from South Africa, which dependence has increased steadily over the years. The country has no refining capacity and hence imports all of its fuel from South Africa. The total petrol consumption in Swaziland in 2007 was 115m litres, the total consumption of diesel 122m litres, and that of paraffin about 8m litres. The demand for petroleum products amounts to 23% of the total energy demand. On average, a total amount of E1,564,658,333 was spent on the purchase of fuel by consumers in 2007.

According to demand projections, the consumption of petrol will increase to about 183 million litres and that of diesel to about 170m litres by 2015. Consumption of paraffin has remained reasonably constant over the last 10 years, and is therefore expected to remain at present levels for the foreseeable future. The consumption of fuel is not expected to show a linear increase in relation to the number of vehicles due to more economical use of fuel in modern engines and the change in motorist behaviour at increasing fuel prices.

Biofuel blending needs to be phased in to make sure feedstock production can meet the blending requirement. Final blending targets of B10 and E10 are currently aimed at.

The current production of ethanol (Royal Swaziland Sugar Corporation and USA Distillers) in Swaziland is approximately 60m litres per year (the RSSC produces 134,000 litres/day at 96.4% strength and USA Distillers produces 120,000 litres/day).

Current biofuel feedstock production in Swaziland is limited to a pilot bioethanol project. Production of bioethanol from the RSSC plant has been at 2,444 litres since the project began in February 2008.

Biodiesel feedstock production was limited to the activities of D1 Oils Swaziland, which has started an ambitious programme to cultivate 10,000 Ha of Jatropha over the next five to ten years to supply 13 million litres of refined Jatropha oil for blending. However, D1 Oils ceased operations in May 2009 and are looking for new investors. Initial plantings are still in place but no further development is anticipated unless a new investor can be found.

The lack of a clear policy direction from Government is viewed as one reason behind the slow introduction of biofuel technologies and feedstock. Challenges around the utilisation of land for biofuel production and production costs remain critical obstacles to further feedstock development.

2.3.3 BIOFUEL QUALITY STANDARDS

For the introduction of biofuels in a new market it is necessary to produce such biofuels to a national quality standard to ensure widespread adaptation by vehicle engine manufacturers. Therefore the appropriate standards have to be in place before biofuel use can proceed. The Swaziland Standards Authority (SWASA) has the legal and institutional mandate to facilitate and develop national standards and is pivotal in mandating relevant biofuel standards.

Both biodiesel and bioethanol have their own handling, storage and dispensing requirements that need to be met to ensure adoption. The most important point for the production of bioethanol is the replacement of water to avoid corrosion and the segregation of ethanol blends. The ethanol content of fuel ethanol has to be at least 99.5% which is even higher than the Brazilian standard for anhydrous ethanol.

Standards for biofuels already exist worldwide and have been developed over years. The standards for biofuels in Swaziland should mirror those developed in South Africa, ie SANS 465:2005 for bioethanol as fuel ethanol component and suppliers must meet this quality standard and SANS 1935:2005 for biodiesel to be used as B5, and higher up to B100 and manufacturers must ensure compliance.

SWASA have a well documented procedure for introducing and adopting new standards and this procedure must be followed to ensure national adoption.

2.4 NATIONAL LEGISLATIVE FRAMEWORK RELEVANT TO BIOFUELS

2.4.1 CURRENT STATUS OF BIOFUELS RELATED LEGISLATIVE FRAMEWORK

There is currently no comprehensive legal framework to domesticate and enforce the provisions of the NBDAP. The country relies on partially outdated pieces of legislation, none of which provide a satisfactory coverage of biofuels production and trade.

2.4.1.1 ENERGY LEGISLATION

The Swaziland Electricity Company Act (2007) transforms the Swaziland Electricity Board from a public enterprise into a company, the Swaziland Electricity Company (SEC), which is wholly owned by the Government. This development along with the establishment of the Electricity Act of 2007 removes the monopoly in the electricity supply industry. The corporatization of the SEB, in conjunction with the internal restructuring ensures a commercialisation of operations and will in the future allow other players to compete on an equal footing. During the Plan period, other elements of the restructuring will continue to be implemented, including the establishment of the Energy Regulatory Authority, according to the Energy

Regulatory Authority Act of 2007. Under this Act, the Authority will amongst other functions, be responsible for the issuing of licences for activities in the energy sector.

2.4.1.2 TRANSPORT, TRADE, TAX AND INVESTMENT LEGISLATION

There are ancillary pieces of legislation that regulate areas of close importance to the biofuel industry framework. These pieces of legislation require amendments to include biofuel as a product similarly seeking regulation.

The Fuel Oil Levy Act no 1 of 1979 is to facilitate the collection of fuel levy by imposing levies on "any fuels" including petrol, diesel, aviation spirit, kerosene, distillate fuel, residual fuel oil, grease and petroleum gas.

The Price Control Order no 25 of 1973 provides for the regulation and marketing of goods at prices fixed by the Price Controller appointed in terms of the Act. The Price Controller in terms of this Act is empowered to:

- Fix the maximum price at which any goods may be sold by any person;
- Fix the maximum price at which any person may purchase any goods from any other person;
- Fix the maximum charge that may be made by any person for any specified service;
- . Prohibit any person from making any change for any specific services.

This Act is utilised in the fuel sector to guide and control the pricing of fuel to safeguard the interests of the consumers. Pursuant to this objective as well as other considerations, a petroleum unit was established to implement Legal Notice No. 65 of 1996 which amongst other things seeks to curb and prevent rebates in petroleum trade as well as ascertaining "the correct pricing model to be used for assessing the necessary review of the oil industry profit margins" in Swaziland.

The Customs & Excise Act No 21 of 1971 provides for the levying of customs, excise and sales duties and a surcharge, the prohibition and control of the import, export or manufacture of certain goods and for incidental matters.

The Income Tax Order No 46 of 1973 regulates tax that is levied on the annual income of individuals, companies, corporations and unincorporated businesses based upon the amount earned.

The Control of Supplies Order 46 of 1973 controls and regulates the supply of goods to the public or a section of the public to uphold their interest as well as the supply of goods to any particular area as mentioned in the regulations.

The Disposal or Use of Petrol Regulations No 46 of 1973 designates the legal times and dates upon which a reseller may sell or dispose of petrol. It further limits the quantities to be supplied by the wholesalers to their bulk consumers. It also prohibits the delivery of petrol other than directly to the tanks.

2.4.1.3 ENVIRONMENTAL LEGISLATION

The Environment Management Act of 2002, which is the supreme law governing environmental matters in Swaziland, is to promote the enhancement, protection and conservation of the environment and where appropriate, the sustainable management of natural resources.

The Act is intended to provide and promote the enhancement, protection and conservation of the environment and the sustainable management of natural resources. It also turned the Swaziland Environment Authority (SEA) into a body corporate and established the National Environment Fund. In terms of this Act, the SEA has the power to halt any and all developments that have not been adequately scrutinised for their environmental impact. Any policy, bill, regulation, programme or plan requires a Strategic Environmental Assessment.

The Environmental Audit, Assessment and Review Regulations of 2000 is to provide for prior environmental assessment before undertaking any developmental activity in the country so as to practically avoid and/or mitigate adverse impacts on the environment during their implementation. They make provision for a

systematic implementation of the most important principle in environmental matters, viz.; sustainable development, and its application. This ensures, to a large extent, conservation of some ecosystems and habitats. They further put into practice the concept of public participation during projects implementations that are likely to have adverse impacts on the environment.

The Flora Protection Act of 2001 provides protection for plant species and requires that an Environmental Impact Assessment (EIA) be carried out in respect of any activity that would impact on indigenous flora.

The Biodiversity Conservation and Management Bill (2008) is intended to provide for the management and conservation of biodiversity in the Kingdom of Swaziland and to give effect to ratified international agreements affecting biodiversity in the Kingdom and to matters connected therewith and incidental thereto, enacted within the framework of the Environment Management Act No. 5 of 2002.

The Access and Benefit Sharing of Genetic Resources Bill (2006) captures issues on the access and use of biological diversity. Although not made in terms of the Environment Management Act of 2002, it recognises its supremacy. The Bill supplements the Act and deals with such issues as community rights, including plant breeders' rights. It proposes institutional arrangements for the management of ABS issues. The Bill supplements the Seed Varieties Act and further protects the country's indigenous knowledge system and establishes a certification system.

2.4.2 NEED TO IMPROVE LEGAL FRAMEWORK IN SUPPORT OF BIOFUELS DEVELOPMENT

With no specific legislation covering biofuel use and production, the NBDS identified a need for a comprehensive petroleum legislation framework that will deal with all the issues surrounding fuels including biofuels as well as other issues that are in the process of evolution. Such legislation should not be too restrictive but accommodative of the ongoing developments and use of biofuels and other alternative energy sources. It is recommended that the legislative framework is broadly couched in an enabling language, providing for necessary accommodation for future developments, facilitating use of biofuels through recognition and removal of legal barriers. The legislation will provide empowering, guiding or delimiting provisions that may be spread across a number of primary and secondary legislative instruments or consolidated in a single instrument.[14]

2.5 LAND USE AND AGRICULTURAL PRODUCTION

2.5.1 LAND TENURE

The two main forms of land tenure in Swaziland are Swazi Nation Land (SNL) and Title Deed Land (TDL).

SNL is held in trust for the nation by the King and is mostly administered by the chiefs. SNL accounts for about 74% and consists of arable land, grazing land, and forests. Individual rights of use are held for agriculture (subsistence crop production); communities use the remaining land as a common resource (communal extensive grazing and community forestry). However, about 25% of SNL is not communally used but controlled by government, parastatals or companies. Unlike TDL, SNL cannot be used as collateral; consequently farmers on SNL generally lack access to commercial finance.

TDL is individually or corporately owned, covers about 26% of the country and is mainly used for industrial timber plantations, livestock production (ranching) and commercial farming under irrigation (mainly sugarcane, but also fruit).

Under the 2005 Constitution, all people have equal access and rights to land. The pressure on land is driven by the growing population and the demand for more land for competing land uses, e.g. agriculture and residential in peri-urban areas, forestry and grazing in the Highveld, sugarcane and biodiversity conservation in the

[14] GoS-MNRE, 2006a. Bio-Energy Feasibility Study.

Lowveld. Mechanisms of land allocation and administration are not adequate to appropriately deal with the multifaceted physical planning, which is exacerbated by poor chiefdom demarcation and disputes, as well as lack of discussion fora.

2.5.2 PRESENT LAND USE

The main land use in Swaziland is extensive grazing: communal extensive grazing covers 50% of the country and commercial ranching 19%. Grazing takes places on natural grasslands, savannas and woodlands, which areas are also used for community forestry. Small-scale subsistence rainfed agriculture covers about 12%, and large-scale commercial irrigated and rainfed crop production 6%. Plantation forestry covers about 8%, and the remaining 5% is made up of national parks and urban areas.[15]

Land suitable for arable cultivation is rather limited; it is estimated at about 20% of the country or 350,000 Ha. The area under crops is estimated (2005) at 120,000 Ha (70,000 Ha rainfed and 50,000 Ha irrigated), which is a substantial decrease of the percentage rainfed compared to levels in the 1980s and 90s.[16] Land under irrigation is increasing annually with 1,000-2,000 Ha, mostly driven by expansion of the sugar industry, although alternatives are now being sought due to decreasing profitability of the production of sugar in Swaziland and insufficient surface water. The newly irrigated land - mainly in large irrigation schemes such as of the Komati River - was formerly used for subsistence farming or grazing.

There are strong indications that an increasing proportion of arable land is no longer used; most likely as the combined result of the HIV/AIDS weakened labour force and recurrent droughts affecting the country and region as a whole. However, some of this rainfed arable land, together with land used for grazing, is converted to residential use, in particular in informal peri-urban areas, but also as part of formal urbanisation. Changes in land use for industrial timber plantations or for conservation have been very minor in recent years, although there has been pressure to convert more land to either of these uses.

2.5.3 AGRICULTURAL PRODUCTION

Agriculture is the backbone of the Swazi economy and is critical for achieving the overall development objectives of the country. The agriculture sector of Swaziland is acutely dualistic. A dynamic commercial sub-sector established on TDL that occupies 26 percent of the land, holds an estimated 90 percent of available irrigation infrastructures, and uses modern technologies to produce mainly cash crops. A traditional sub-sector, based on communal tenure in the Swazi Nation Land (SNL) involves semi-subsistence smallholder agriculture with communal grazing.

2.5.3.1 AGRICULTURE IN THE ECONOMY

The agricultural sector's share of GDP decreased from about one-third at independence in 1968 to less than nine percent in 2003. However, agriculture is far more important for Swaziland's population and for national economic development than its contribution to GDP suggests. Crucially, agriculture plays a key role in the lives of the majority of the population, since over 70 percent of the population and households rely on agricultural output as a major source of income and food security, either as small-scale producers or as recipients of income from employment on medium and large-scale farms and estates.

Commercial TDL agriculture remains the principal catalyst for agricultural economic development and income generation. Commercial estates generate more than 70 percent of all agricultural output. The share of crop production on SNL of total agricultural output has dropped from 33 percent in 1996 to 14 percent in 2003.

[15] FAO/GoS-MOAC, 1994. Present Land Use. The figures quoted for arable use are gross figures including infrastructure, grass strips, etc.; net figures are at least 30% less. Land Use has changed since 1994, in particular small-scale farming has decreased, notably in the Dryland areas (Lowveld).

[16] Murdoch, 1970; FAO/GoS-MOAC, 1994; FAO/GoS-MOAC, 2005; Agricultural Diversification Policy 2008 (preliminary)

Commercial estates employ about 20,000 people, whereas about 650,000 people depend to a greater or lesser extent on the traditional subsistence sector.

Although the contribution of agriculture to GDP is substantially less than the 35 % of the manufacturing sector, agricultural output forms the raw material base for about one third of value added within the manufacturing sector. Agriculture and agriculturally-based manufacturing also contribute substantially to national export earnings, thereby allowing increased government expenditure through their contributions to the direct and indirect tax base.

2.5.3.2 AGRICULTURAL PRODUCTION

Crop production mainly consists of sugarcane (the main cash crop on TDL) and maize (the main staple crop on SNL). Other important cash crops include citrus and pineapple. Cotton used to be widely grown on both TDL and SNL, but has very much declined in the last few years, as has tobacco.

Sugar is the most important agricultural produce of Swaziland and the area under sugarcane has continuously increased since the sixties, reaching 52,000 ha in 2006/07, with expansion currently slowing down. The 2007/08 production of sugarcane was about 5 mt and production of sugar 631,000 tons. Presently, the industry has about 500 small-scale growers, which were virtually non-existent in the early 1990s.

The major agro-industrial activities in Swaziland are the sugar industry, the production of pulpwood and the processing of fruit (canned fruit and liquid concentrates). These activities take place in the private sector, with high technology and management levels. The main orientation of agro-industrial activities is on the export market, which accounts for more than 90 percent of all agro-industrial output.

Following maize as the most important subsistence crop, moderate quantities of groundnuts, pumpkins, beans, sweet potatoes and vegetables are grown on SNL as well as very limited quantities of sorghum, cowpeas, melons, watermelons, cassava, bananas, peaches and avocados.

As a result of low productivity on SNL Swaziland is unable to produce enough maize to meet domestic needs. During the 1980s and 1990s the maize production in most years has been well over 100,000mt, with some peaks of 140,000mt and some lows of 50,000mt as a result of drought. Since 2001 the total annual production has largely fluctuated between 60,000 and 80,000mt, with an absolute record lowest harvest of 27,000 mt in 2007, only one-third of the five-year average. Domestic needs are normally estimated at around 160,000 to 180,000mt.[17]

It is essential that food production levels in Swaziland are restored to pre-2000 levels. However, food production should also be boosted by exploring and exploiting alternative possibilities in addition to the current more traditional and conservative ways of producing food. Opportunities to improve overall food and agricultural production can be found by diversifying arable crops through selecting and cultivating new or underutilised crops.

3 RATIONALE AND OBJECTIVES FOR THE DEVELOPMENT OF BIOFUELS IN SWAZILAND

3.1 JUSTIFICATION FOR BIOFUELS

[17] GoS-MOAC/FAO, 2005. Strategy Brief for National Food Security and Agriculture Development: Horizon 2015; A July 2008 report by the UN Food and Agriculture Organization (FAO) and WFP Crop and Food Supply Assessment Mission said Swaziland would need 212,000mt of cereal for the marketing year 2008/09 (April-March), against an estimated domestic availability of around 75,500 tonnes. The country would need to import around 136,500mt of cereals, comprising 81,000mt of maize, 42,500mt of wheat and 13,000mt of rice. An estimated 20 percent of the population is thought to be going hungry.
The poor harvest evoked a flow of aid from donors, which helped boost anticipated overall 2008 production, but the improved yields so far have created a catch-22 situation: the food security crisis has been mitigated to some extent and donors have reduced their support; now, input prices are sharply higher, but there is not enough money to subsidise the cost to farmers.

The production and use of biofuels have entered a new era of global growth, with both the scale of the industry and the number of countries involved reaching unprecedented levels. Surging investments in biofuels production are being driven by a variety of factors, which include countering rising international fuel costs and a desire to reduce energy dependence on oil exporting countries thereby increasing energy security.

Underlying the growing commitment of governments to biofuels development is the desire to find new markets for farmers and their products - thereby providing employment, diversifying livelihoods, enhancing energy security and reducing emissions of carbon dioxide and other gases that are contributing to global warming.

The combination of the certainty that crude oil and energy prices will increase in the short to medium term, the fact that carbon credits can be developed and traded, as per Kyoto Protocol, the knowledge that particular trees and crops suited to biofuel production can grow under rainfed and irrigated conditions in Swaziland, and the fact that such biofuel can relatively easily be mixed into diesel or petrol to make biodiesel and bioethanol, makes it very attractive for Swaziland to develop a strategy on how to achieve the many opportunities that could arise from biofuels.

A national biofuels strategy will provide incentives for investments that take advantage of these opportunities while also taking into account the need to minimize risks to food security for the poor, address environmental concerns, protect the rights of indigenous peoples and achieve a net reduction in emissions.

3.2 BIOFUELS POLICY FRAMEWORK

3.2.1 THE VISION OF GOVERNMENT

Subject only to the provisions of the Constitution, all policies in Swaziland should facilitate the Vision of the Government, as expressed by the Prime Minister in 2004: *"To build a truly twenty-first century Kingdom of Swaziland, culturally united, integrated and stable, economically prosperous and socially well organised with equal opportunities for all, irrespective of gender, and responsibility from all"*.

In line with the Vision, the Mission of the Government of the Kingdom of Swaziland is: *"To provide a climate and infrastructure that will progressively maximise the quality and security of life of the people of Swaziland and make the best use of the country's natural and human resources"*.

To this end, the 1999 National Development Strategy (NDS) includes a subsidiary Vision and Mission Statement that is intended to inspire and direct socio-economic development up to 2022: *"By the year 2022, the Kingdom of Swaziland will be in the top 10% of the medium human development group of countries founded on sustainable economic development, social justice and political stability"*.

3.2.2 GOAL AND OBJECTIVES OF THE BIOFUELS ACTION PLAN

The National Biofuels Development Action Plan is predominantly driven by the need to address issues of economic development and environmental benefits. The NBDAP seeks to take advantage of the country's existing skills and knowledge in sugarcane production and utilisation of molasses for ethanol production whilst cognisant of the urgent need to stimulate rural development and to reduce poverty by creating sustainable income-earning opportunities. Furthermore, the NBDS contributes towards the achievement of the renewable energy goals and the reduction of greenhouse gas emissions – an important step to combat global warming.

3.2.2.1 ACTION PLAN GOAL

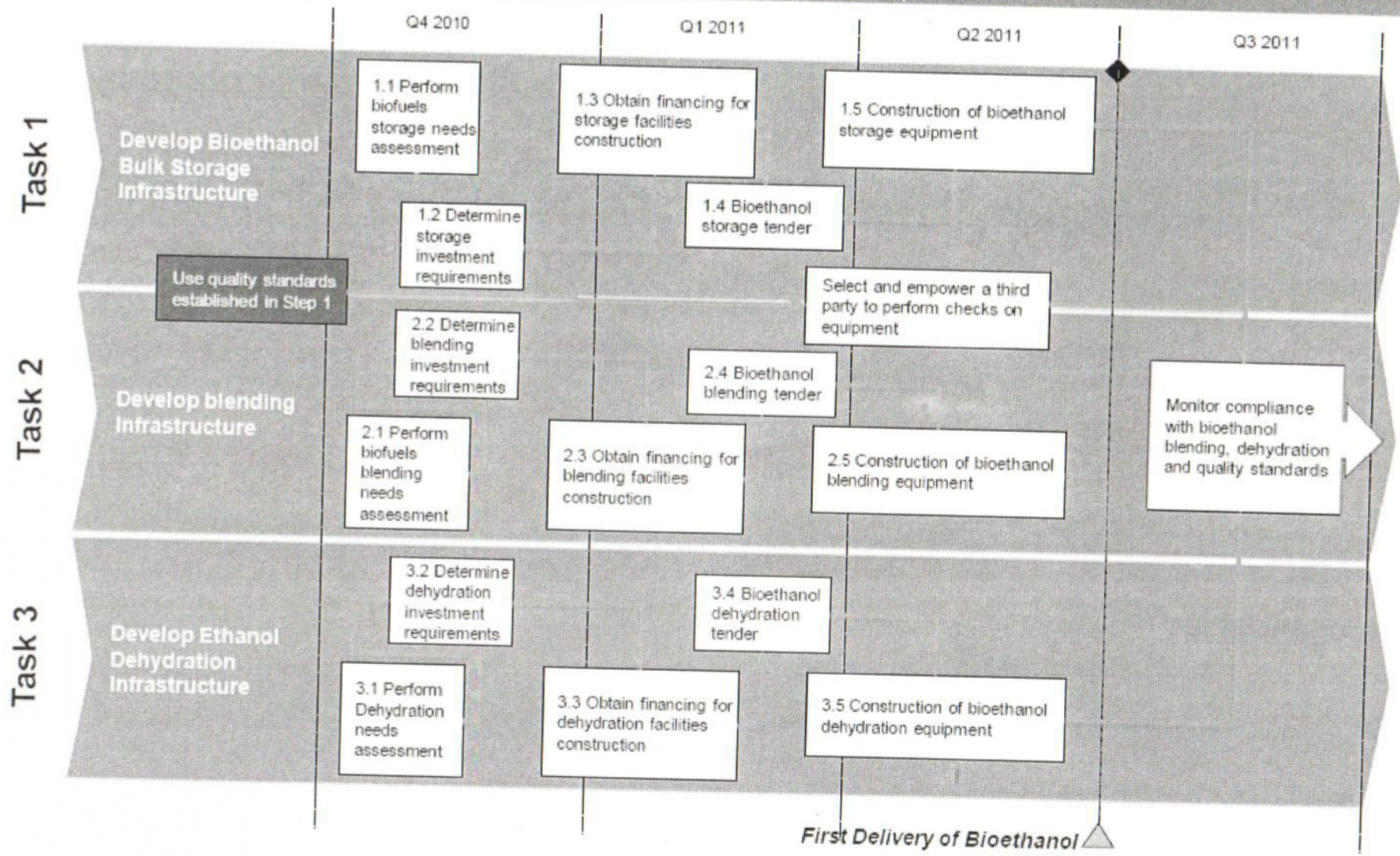
The goal of the National Biofuels Development Action Plan is to ensure that:

> *"The biofuel potential of Swaziland is developed and the production managed in an environmentally sustainably way, without constraining food security and benefiting all people in Swaziland"*.

In striving for this goal the following key aims will be sought:

Tier 0 activities	Tier 1 Activities	Tier 2 & 3 Activities	Key stakeholders	Estimated cost to completion (E 2009)
			Association	

4.4.4 ACTIVITIES FOR STEP 3, PHASE 2: PRODUCTION & MARKETS (DOWNSTREAM)



Tier 0 activities	Tier 1 Activities	Tier 2 & 3 Activities	Key stakeholders	Estimated cost to completion (E 2009)
	biofuel feedstocks and appropriate use technologies	energy uses of process by products • Define opportunities for rural use of biofuels energy outputs • Define potential uses of biofuels crops to meet small-holders energy needs • Assess global case examples and map to Swaziland capacity to implements • Plan, schedule and execute pilot projects • Apply for grant funding of appropriate-use energy technologies from donor organizations (e.g. Technoserve)	• Research Council • UNISWA • NGOs	

4.4.3 ACTIVITIES FOR STEP 3, PHASE 1: FEEDSTOCKS (UPSTREAM)

Tier 0 activities	Tier 1 Activities	Tier 2 & 3 Activities	Key stakeholders	Estimated cost to completion (E 2009)
1 - Define Governance for SBA	1.1 Appoint board representatives for SBA	• Determine relevant representation from government and industry • Set board constitution and performance requirements • Create budget for board activities	• SBA • MNRE	E200,000
	1.2 Appoint and fund independent Auditor	• Define method for providing feedback on SBA performance	• SBA • MNRE	E100,000
	1.3 Define job requirements and compensation for senior officers	• Develop performance contract and evaluation plan • Determine variable compensation related to performance • Succession planning	• SBA • MNRE • NBCC	E100,000
	1.4 Engage executive search firm		• SBA	E80,000
	1.5 Define functions, governance protocols and oversight requirements	• Set board schedule • Determine plan for dispute resolution	• MNRE	E80,000
2 - Staff SBA	2.1 Hire Executive Director	• Hire Executive Assistant	• SBA	E270,000 pa
	2.2 Hire Financial Controller	• Hire Accountant	• SBA	E250,000 pa
	2.3 Hire Director of Markets (Downstream)		• SBA	E250,000 pa
	2.4 Hire Director of Compliance, Monitoring and Evaluation		• SBA	E250,000 pa
	2.5 Hire Director of		• SBA	E250,000 pa

Tier 0 activities	Tier 1 Activities	Tier 2 & 3 Activities	Key stakeholders	Estimated cost to completion (E 2009)
	R&D Programs			
	2.6 Determine and fill additional staffing needs	• Develop job criteria for the Director of Feedstocks Production (Upstream) to be filled prior to Phase 2	• SBA	E200,000
3 - Create office and logistical facilities for SBA	3.1 Identify and lease office space	• Consult with MNRE for possible co-location at MNRE offices • Determine annual operating costs	• SBA	E1,200,000 pa
	3.2 Obtain SBA vehicle(s)	• Determine vehicle usage protocols and accounting	• SBA	E1,500,000
	3.3 Develop MIS	• Develop integrated market information systems & Infrastructure	• SBA	E200,000

4 - Plan and initiate Research and Development Programmes	4.1 Global biofuels trends monitoring and evaluation	• Evaluate lessons-learned from major biodiesel feedstocks and markets
		  • Track evolution of global biodiesel market and regulations
		  • Determine prospects for biodiesel production for either internal consumption or export
		• Develop research program for higher concentration bioethanol/gasoline blends
			• SBA
			• Biofuels Producers Association
			• Research institutions
				E150,000

	4.2 Biomass-to-power potential and development	• Create incentives to encourage generation of power from biomass and waste products for sale to SEC
		• Develop investment plan for commercialization of electric power from biofuel by-products
		  • Develop investment plan for commercialization of sugar-case bagasse power generation
		  • Liaise with RSSC and USA Distillers to evaluate progress
		  • Develop relationships with SEC to enable sale and purchase of excess power
		  • Ensure that co-generation plan includes stillage and glycerine inputs
			• SBA
			• Biofuels Producers Association
			• Private sector
			• SEC
				E200,000

	4.3 Village level use of	• Develop marketing plan and incentives to commercialize non-	• SBA	E200,000

Step 2 has three key deliverables:

- Establishing and operationalising the Swaziland Biofuels Authority and hiring quality staff
- Development of key performance objectives and governance protocols to ensure focus and integrity
- Establishment of independent R&D function to pro-actively investigate feedstock, marketing and non-transport-fuels energy uses of biofuels and by-products

Key risks for Step 2 are:

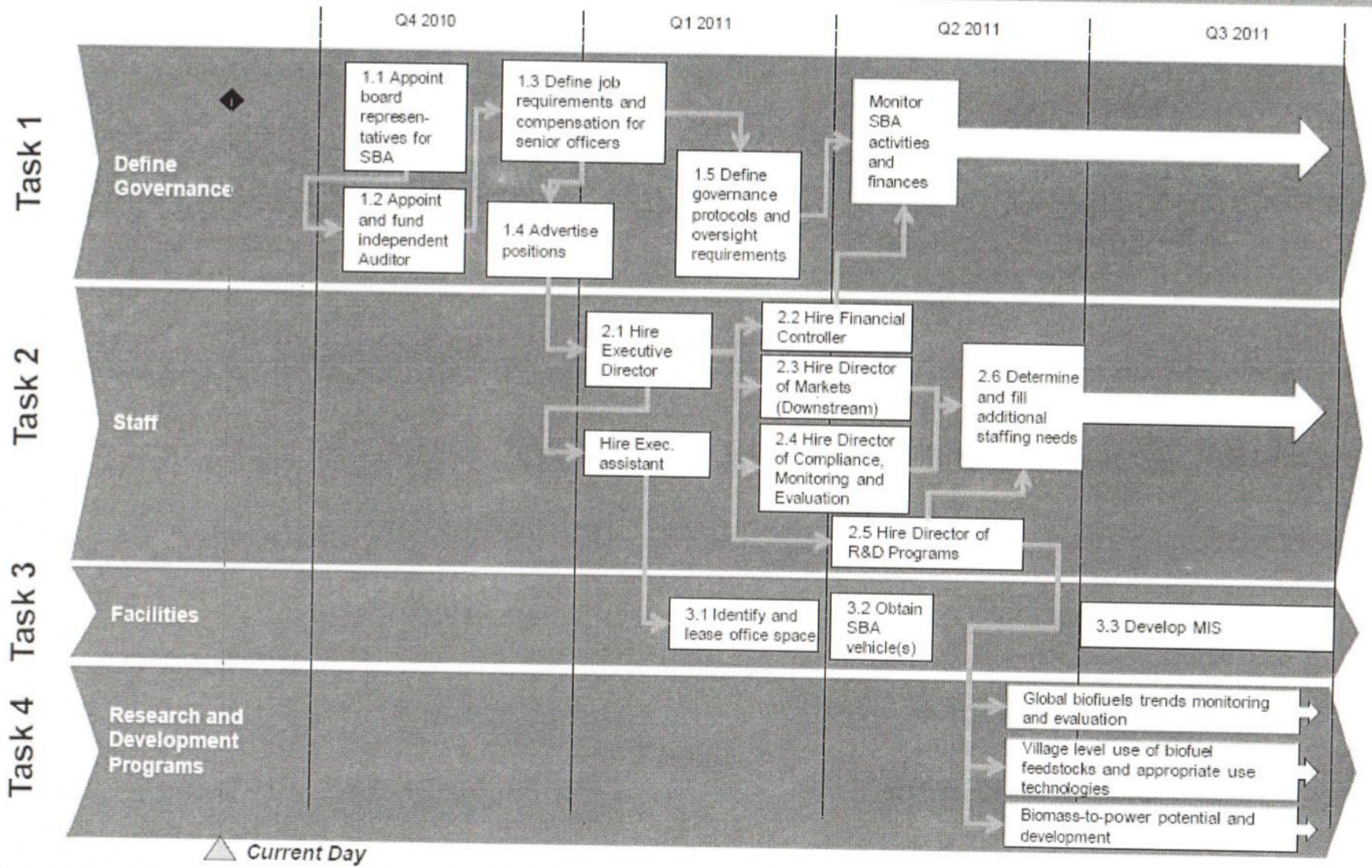
- Scope creep: Step 2 is purely an enabling action, and care needs to be taken to ensure that no operations / implementation work begins until Step 2 is completed
- Focus and accountability: Care must be taken to ensure that the goals and expectations of the SBA principles are made clear and measured to ensure that the organization does not become a "do nothing" regulatory overseer
- Working capital: SBA must be fully-funded for the start-up period (until such-time as revenues from fuel levies can be raised)

4.4.2.1 SETUP OF SBA AND IMPLEMENTATION OF STRATEGY

Order of Execution

Stand-up organization Approx. 9 months	First year: Development Activities	Operating Activities (years 1 - 10)
Staffing and set-up (Pillar 1) • Select Board • Recruit and fill key executive positions • Commission feasibility studies • Secure offices, equipment and logistics • Secure budget and controls • Recruit administrative staff • Develop monitoring framework • Develop Research and Development Plan	**Pillar 2: Feed-stocks (upstream)** • Define crop types for bioethanol feedstock • Assess land suitability and identify • Set production targets • Set crop quality standards • Initiate crop R&D programme	• Monitor costs / benefits • Add new contract farmers • Develop extension program to export benefit to rural farmers
	Pillar 3: Production & Markets (down-stream) • Identify marketing & trade channels • Develop fuel processing and blending infrastructure • Set blending requirements and quality standards	• Administer price supports • Monitor costs / benefits • Evaluate and enhance logistics and transport capabilities • Create public awareness
	Pillar 4: Sustain-ability & Rural Empowerment • Develop monitoring method to evaluate impact • Develop safety regulations • Develop rural farmer associations and groups for feedstock production	• Monitor environmental impact • Monitor social impact • Validate and document GHG impact • Prepare CDM projects

4.4.2 ACTIVITIES FOR STEP 2: ESTABLISH THE SWAZILAND BIOFUELS AUTHORITY



Tier 0 activities	Tier 1 Activities	Tier 2 & 3 Activities	Key stakeholders	Estimated cost to completion (E 2009)
		• Approve global quality standards for biofuels • Evaluate Brazilian and South African bioethanol (eg SANS 465:2005) and biodiesel (eg SANS 1935:2005) standards		
	1.3 Identify key environmental and social sustainability criteria and mandates	• Define environmental sustainability criteria • Define plan for periodic environmental surveys and identify audience	• MNRE • MTEA (SEA)	E100,000
	1.4 Identify conflicts with other existing laws and regulations and propose remediation	• Create specific legal framework for promotion and removal of barriers to trade (internal and international)	• MNRE • MFAT	-

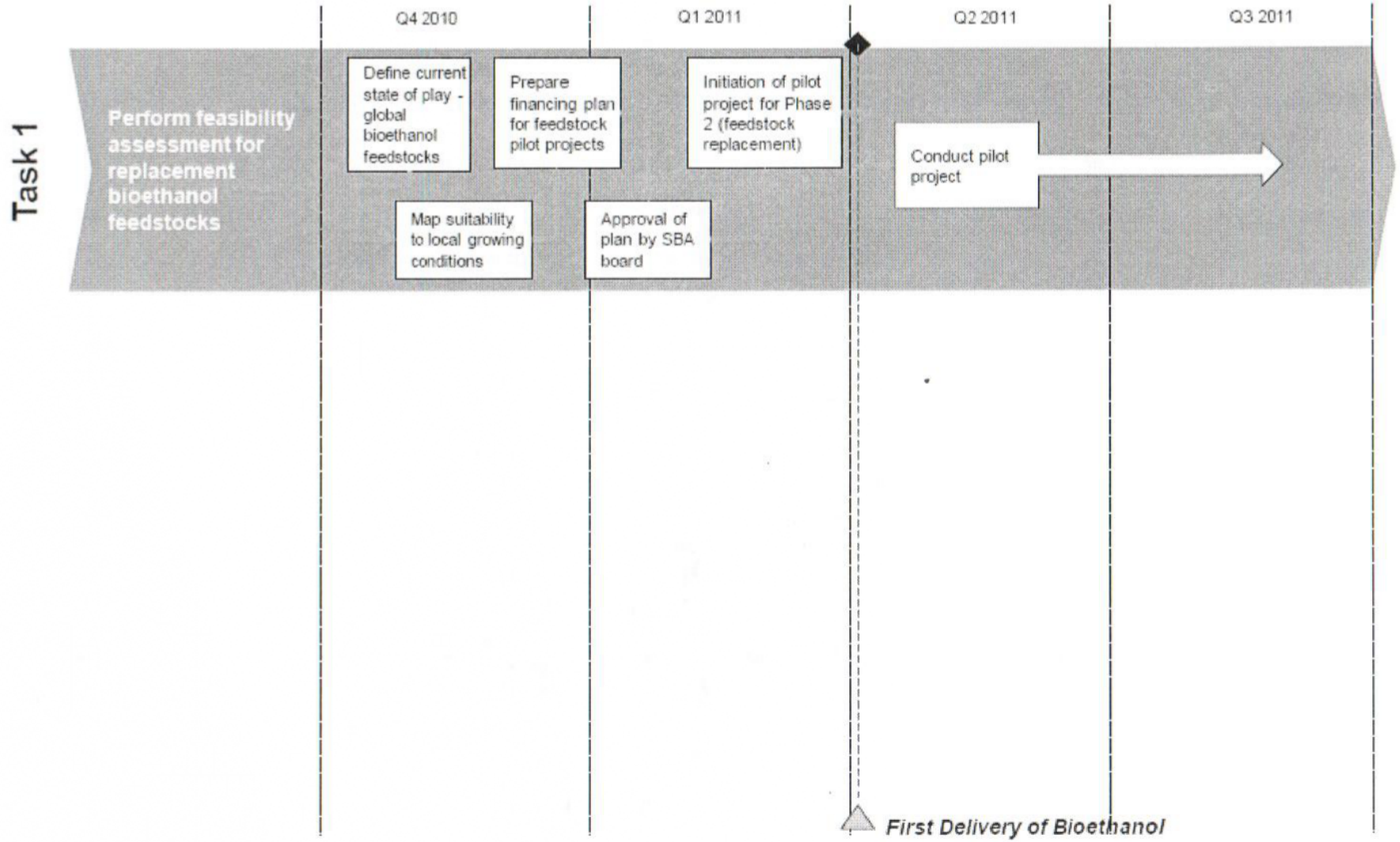
2 - Determine financing requirements and funding options to commercialize biofuels industry	2.1 Establish National Biofuel Coordination Committee (NBCC) of key stakeholders who will be involved in marketing & trade of biofuels	• Develop task team of relevant institutions involved in marketing and trade of biofuels
		• Draft Capacity Development Plan for each link in biofuels value-chain
		  • Identify gaps for individual players and opportunities to bridge them
		  • Develop Capacity-building process to address gaps in value-chain
		• Identify and price individual contributors' investment requirements
			• MNRE	E100,000

	2.2 Perform study to estimate investment financing requirements	• Create and test economic viability model • Perform total value-chain cost / benefit analysis • Set up national biofuels investment fund	• MNRE • MCIT • SIPA • NBCC	E100,000

Tier 0 activities	Tier 1 Activities	Tier 2 & 3 Activities	Key stakeholders	Estimated cost to completion (E 2009)

	2.3 Create independent biofuels producers association	• Train existing stakeholders on how to manage new biofuels legislation
		  • Create constitution
		  • Create distinct legal entity
		  • Register with Dept. Home Affairs
		• Identify and adapt marketing and trade channels
			• MNRE
			• NBCC
				E100,000

	2.4 Define formulae for tax/levy to finance biofuels industry	• Define limits to tax incentives • Determine required taxation / duty status of imported biofuels or feedstocks • Create import/export monitoring plan and resource requirements	• MNRE • MOF • MEPD • NRA • NBCC	E100,000
3 - Obtain Parliamentary approval of biofuels legislation	3.1 Draft legislation that creates Swaziland Biofuels Authority and identifies financing measures provided by government	• Determine Authority composition, functions, mandate and accounting processes	• MNRE • NBCC	E100,000



Phase 1 is primarily concerned with commercializing existing sugar-industry by-products (molasses) into fuel-grade ethanol and developing national markets for purchase and use of the fuel

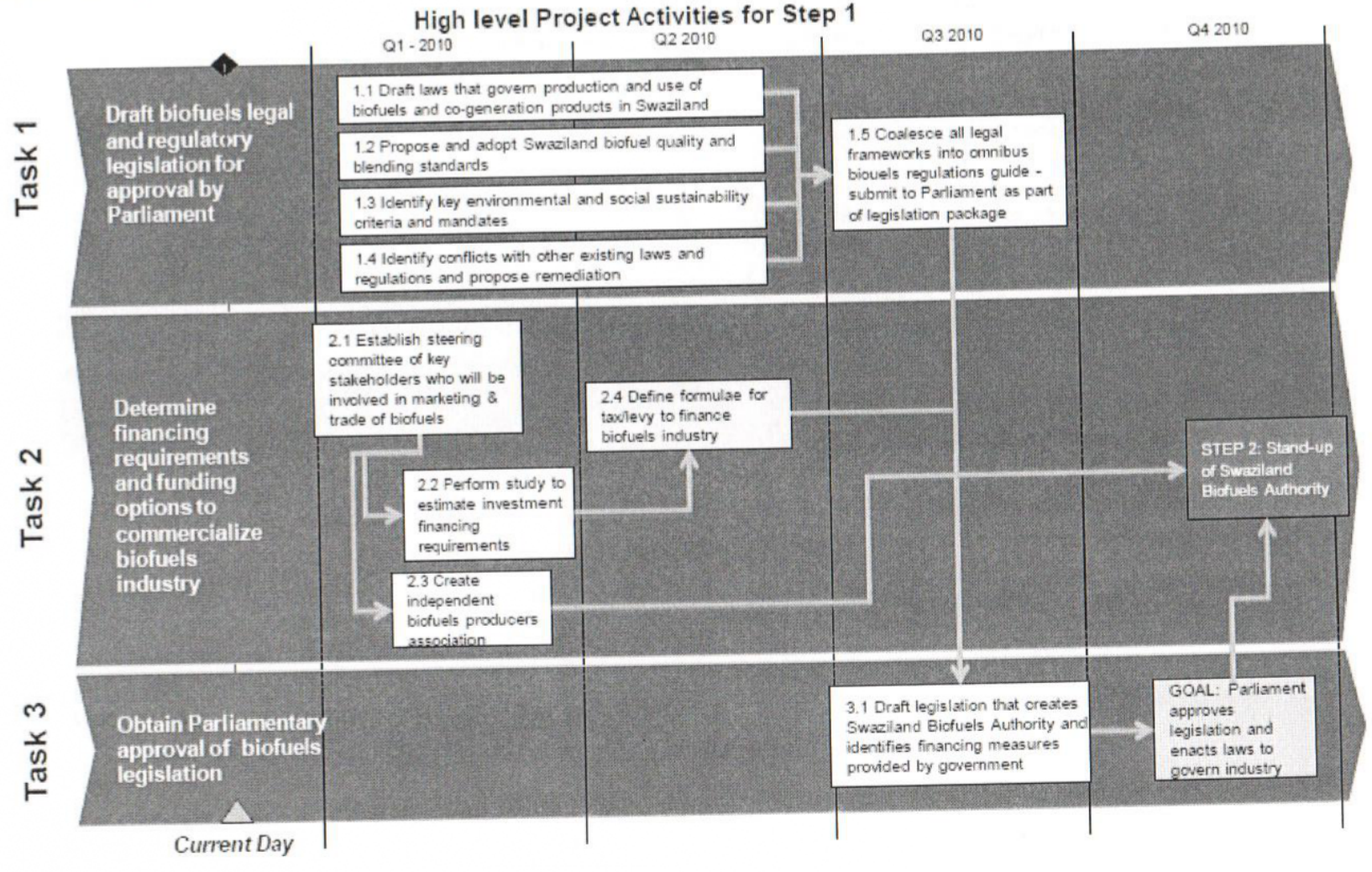
- Consequently, agricultural activities (upstream) focused on producing bioethanol (and biodiesel) feedstocks are restricted to research and pilot-programs only
- NO LARGE SCALE BIOFUELS FEEDSTOCKS PLANTING IS EXPECTED IN PHASE 1 - IT IS FOCUSD ON DEVELOPING FUELS AND FUEL MARKETS
- Phases 2 and 3 of Step 3 will address development of new feedstocks

Key risks for Step 3, Phase 1 are:

- Moving too quickly to phase 2 before solid fuels and feedstocks markets have been created
- Political pressure to focus on sugar-cane in lieu of more environmentally and water appropriate feedstocks
- Political pressure to extend feedstock production to rural small-holders and SNL farmers before functioning fuels markets and reliable alternative feedstocks have been developed

Tier 0 activities	Tier 1 Activities	Tier 2 & 3 Activities	Key stakeholders	Estimated cost to completion (E 2009)
1. Undertake feasibility assessment for replacement bioethanol feedstocks	1.1 Define current state of play - global bioethanol feedstocks	• Develop guidelines for suitable bioethanol crops • Create Plan for promotion of bioethanol-specific agricultural technologies	• SBA • MOA	E80,000
	1.2 Map suitability to local growing conditions	• Prepare water impact assessment protocol and define key indicators for bioethanol feedstock production • Liaise with traditional authorities to assist in land-use planning for biofuel feedstock • Evaluate and identify SNL for feedstock production	• SBA • MOA	E250,000
	1.3 Prepare financing plan for feedstock pilot projects	• Define pilot project for ONE alternative bioethanol feedstock crop • Prepare all-in business plan and budget for development	• SBA	E50,000
	1.4 Approval of plan by SBA board		• SBA	E50,000
	1.5 Initiation of pilot project for Phase 2 (feedstock replacement)		• SBA • Biofuels Producers	E1,000,000

4.4.1 ACTIVITIES FOR STEP 1: CREATE THE LEGISLATIVE FRAMEWORK



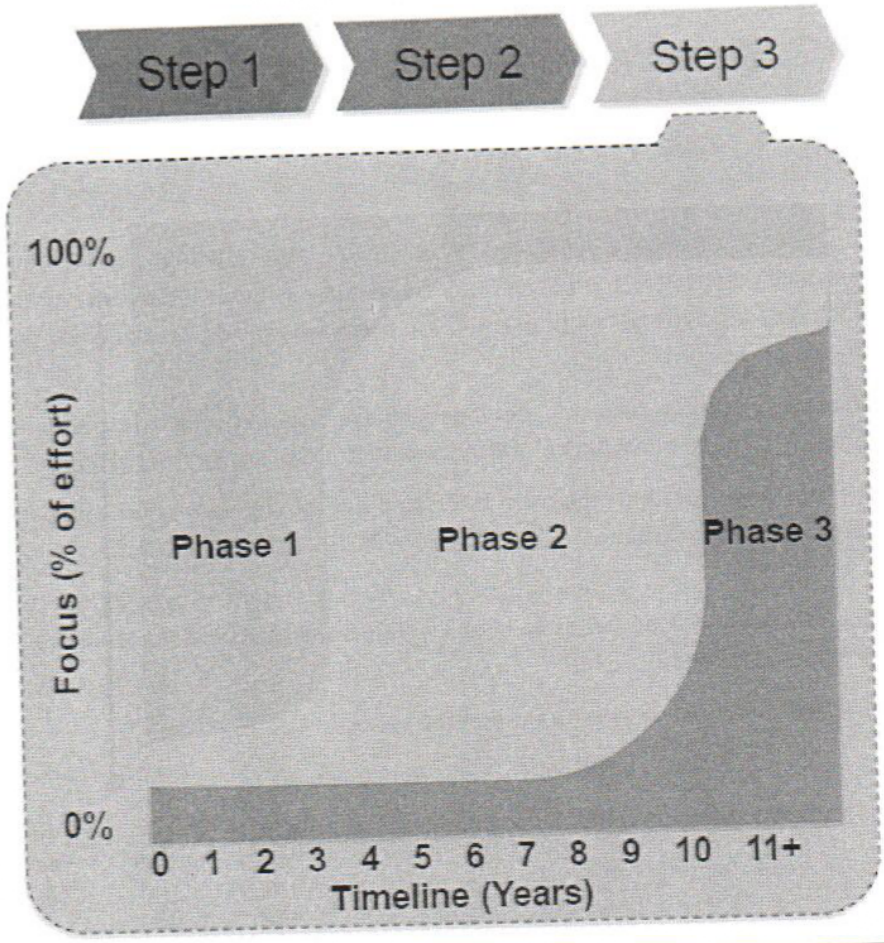
Step 1 has three key deliverables:

- Determination of Swaziland-specific laws and regulations to govern production, marketing and use of biofuels, specifically bioethanol
- Determination of capital investment requirements and fuel levies required to fund development of the industry
- Approval by Parliament of both the legal code and the financing plan to start the industry

Key risks for Step 1 are:

- Scope creep: Step 1 is purely an enabling action, and care needs to be taken to ensure that no operations / implementation work begins until Step 1 is completed
- Timelines: Rapid approval by Parliament is not assured
- Incomplete finance plan: All capital requirements and price supports must be determined in Step 1 to ensure that banks will underwrite loans for capital projects and working capital. The finance plan must explicitly state government's obligation to pay and the method by which the funding will be obtained (e.g. levy on price of fuel)

Tier 0 activities	Tier 1 Activities	Tier 2 & 3 Activities	Key stakeholders	Estimated cost to completion (E 2009)
1 - Draft biofuels legal and regulatory legislation for approval by Parliament	1.1 Draft laws that govern production and use of biofuels and co-generation products in Swaziland	• Determine which fuels are covered in legislation • Enable MNRE to add levy to petrol and/or diesel price to fund biofuels development • Create specific legal framework for promotion of biofuel marketing • Develop farmer contract enforcement process and governing body • Develop co-generation legal framework	• MNRE • MOF • MEPD • SEC	E50,000
	1.2 Propose and adopt Swaziland biofuel quality and blending standards	• Create specific legal framework for establishment of biofuel quality standards • Coordinate common standard for biofuels quality and blending specifications	• SWASA	-



4.4 ENABLING THE ACTION PLAN

This chapter describes the specific tasks required to implement the NBDAP via its three steps. It provides timelines, relevant stakeholders, task owners and likely budget to implement the task or activity.

Each appropriate suggestion or recommendation listed in the NBDS was slotted into an action hierarchy using a tier system as follows:

Tier	Description	Criticality	Action Example
0	The four pillars of the strategy	N/A	Pillar 2: sustainable Biofuel Feedstock Production
1	Key action items	**High** – success of the strategy is dependent on implementing the action completely	Commission a study to determine target feed-stocks and current food and non-food uses
2	Major sub-steps	**Medium** – Steps may need to be revised / changed as necessary as the strategy is implemented	Convene stakeholder discussion to review current and expected future production of each feedstock
3	Details	**Low** - a punch list of "to-	Determine guest list

Scope of Strategy Document

		dos" required for implementing the sub-steps	
4	Sub details	**Base Level** - Tactical operations	Send invitations and arrange venue

The top Tier (0) is the pillar, the second tier (1) are key actionable items, the third tier (2) are the major steps required of the actionable items. For the purposes of the biofuels action plan, lower level tiers (3 to 4) are considered to be too detailed to be of practical use. These lower tiers will be developed by the SBA or others during implementation of specific activities.

The following tables present the results of a storyboarding exercise that sought to translate the goals and expectations referenced in the National Biofuels Development Strategy into **discreet actions**.

The following series of graphics presents the critical tasks and subtasks for each of the four pillars of the NBDS with supporting details and documentation.

A top-level "Gannt" chart of the Tier 1 steps for the four pillars is supported by additional Gannt charts for each pillar with the tier two and some tier three tasks identified. Linkages between steps are included on the chart and key milestones identified.

The resulting activities from these processes are presented as:

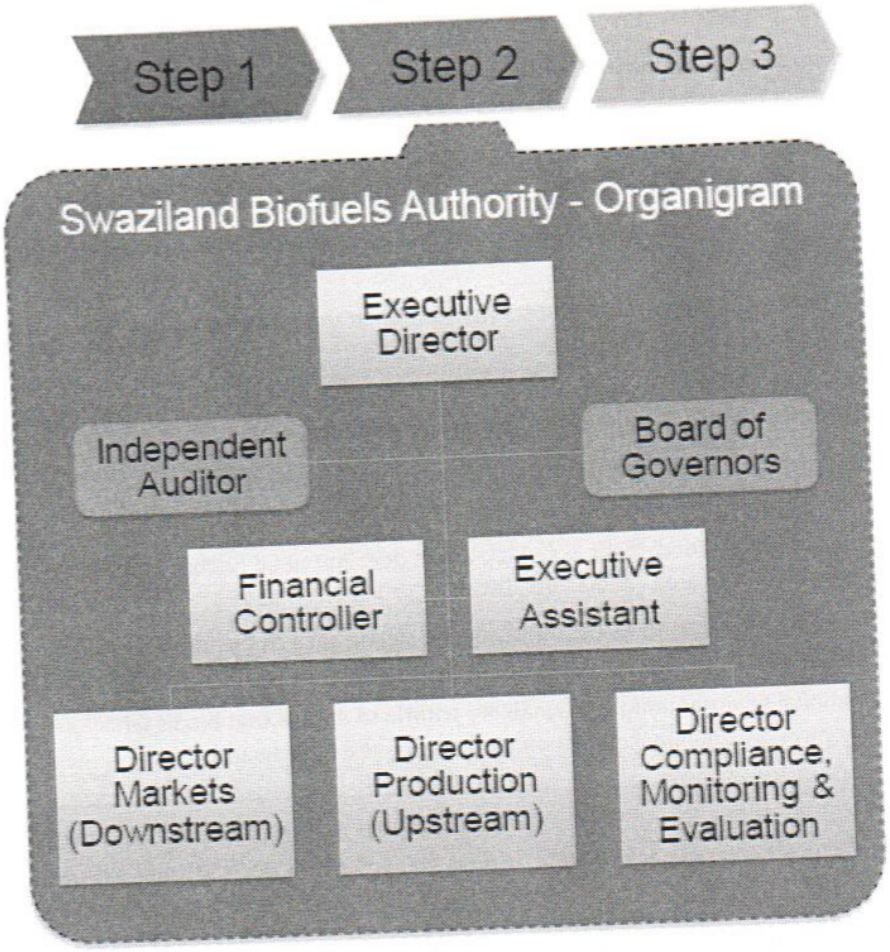
4.4.1 Activities for Step 1: Create the Legislative Framework (page 32)

4.4.2 Activities for Step 2: Establish the Swaziland Biofuels Authority (page 37)

4.4.3 Activities for Step 3, Phase 1: Feedstocks (upstream) (page 43)

4.4.4 Activities for Step 3, Phase 2: Production & Markets (downstream) (page 47)

4.4.5 Activities for Step 3, Phase 3: Sustainability and Rural Empowerment (page 52)



Biofuel producers will be encouraged to form their own representative association, a National Biofuels Association, which will interact with the SBA and Government on trade, marketing and regulatory matters including codes of conduct and adherence to set standards and general representation of the interests of producers and distributors.

A monitoring framework will be designed and used by the SBA to assess the results of the biofuels programme relative to its objectives. Data collection will cover: production and consumption of biofuels, feedstock production including that of small scale farmers, area cultivated, prices paid at each level of the value chain, sales of co-product, jobs created and the price of fossil fuel. Environmental performance of the industry will also be monitored.

Government action is needed to establish the SBA and, in consultation with key stakeholders, define its mandate. The SBA should be a forward thinking institution to put in place the frameworks that will promote, encourage and support biofuel development and use. Initial SBA activities and investment programmes will be financed from fuel-levies established in Step 1.

The SBA:

a) will co-ordinate and lead the involvement of relevant institutions into the marketing and trade of biofuels.

b) will control the production of feedstocks and liquid biofuels though production and processing licenses.

c) will monitor the import and export of feedstocks and liquid biofuels in line with SACU's regulations and national laws.

d) will ensure that the safety regulations required for the marketing and sales of biofuels are enforced.

e) will, with the cooperation of the SWASA, develop and uphold national biofuel quality standards.

f) will arrange for mechanism of selling liquid biofuel or co-generation products with the required safety measures.

g) will identify key capacity challenges and opportunities in trade and marketing aspects of the biofuels industry.

h) will facilitate the establishment of a capacity building process that strengthens the industry's ability in respect of trade and marketing functions.

i) will facilitate the establishment of a Biodiesel Producers Association in the country and develop a registration system for biofuel production.

j) will establish a National Biofuel Coordination Committee (NBCC) of key stakeholders (public, private and civil society representatives) who will be involved in marketing and trade of biofuels

k) will promote research in agronomy, production and distribution on biofuel feedstock and technologies of suitable biodiesel feedstocks.

l) will investigate the options of biofuel feedstocks, e.g. PPO, which does not need further processing and can easily be used, also in remote areas and at small scale.

m) will undertake water impact assessments to assess the scale and significance of the impact in full cognisance of national water assessments and plans.

n) will develop and apply national environmental sustainability criteria to ensure that biodiesel feedstocks and processing have only minimal impact on biodiversity and food security.

4.3.3 STEP 3: PHASED IMPLEMENTATION

Step 3 is the core implementation plan for biofuel development. It is broken down into three distinct phases to "build slowly from strength".

Phase 1: Develop downstream bioethanol markets – equates to Pillar 3 of the NBDS

- Work with existing sugar companies to commercialize by-products (molasses)
- Focus on developing marketing and distribution capabilities
- Keep capital costs to a minimum

Phase 2: Diversification of ethanol feedstocks (upstream) – equates to Pillar 2 of the NBDS

- Targeted focus on feedstock diversification
- Close partnership with limited number of established contract farmers
- Leverage and extend marketing capability developed in Phase 1

Phase 3: Empower Rural Farmers – equates to Pillar 4 of the NBDS

- Use knowledge gained in Phase 2 to establish extension program to encourage small holders to grow appropriate feedstock
- Use established market developed in Phase 1 to set reliable grain prices and quality standards

- Develop and monitor markets
- Develop and monitor quality and safety standards
- Monitor prices and set fuel-tax needs to ensure stable funding
- Implement R&D programs

4.3.1 STEP 1 - CREATE THE LEGISLATIVE FRAMEWORK

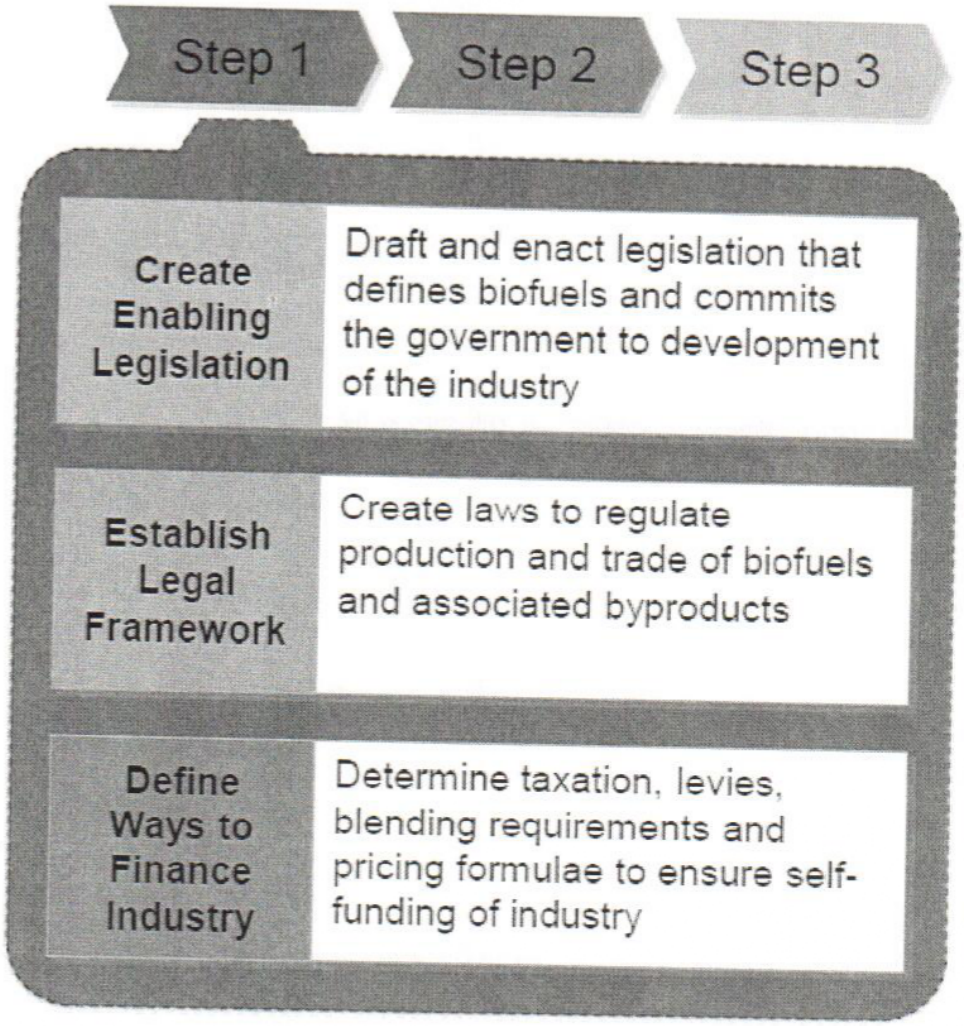
Step 1 is the establishment of biofuel supportive laws and regulations. The cornerstone of a successful biofuel industry rests with a supportive and conducive legislative and regulatory environment that encourages biofuel investments, blending and fiscal support measures whilst at the same time is regulated to ensure fair and equitable benefits, defined operational limits and is environmentally sustainable.

Biofuel development has to be guided by legal mandates that amongst other things, mandates biofuel production, processing and use. Such an industry also requires regulations to manage what is a complex organizational and logistical process.

Investors need assurance that they will be able to achieve returns on their investment and that the system in which they operate is transparent and free from interference and only market forces and inherent risks will determine the level of their success.

Therefore, an umbrella biofuel act or amendments to existing laws must be drafted and adopted that gives rise to a conducive legislative and regulatory environment. Such laws will guide:

- Fuel quality standards
- Biofuel price-control mechanisms
- Mandatory biofuel blending rates
- Marketing and trade related benchmarks
- Fiscal incentives and supportive financial governance and accountability.



4.3.2 STEP 2: CREATE THE INSTITUTIONAL CAPACITY

Step 2 is the establishment of the Swaziland Biofuels Authority (SBA) that will develop and regulate the industry.

The NBDS recognized the importance of creating a coordinating and managing body to manage the complex processes needed to establish and manage a viable biofuel industry. The NBDS called this body the Swaziland Biofuels Authority and would be established via an Act of Parliament.

The establishment of the SBA will follow national procedures already in existence in terms of the Public Enterprise (Control and Monitoring) Act of 1989. The SBA is the coordinating and regulating institution that will have the authority over biofuels.

SBA operations will be guided by a governing board which will comprise members from the relevant ministries, the private sector (i.e. growers and processors) and representatives of civil society. The SBA will manage, coordinate and report on all the aspects and activities of the development of biofuels in Swaziland.

Though the SBA will have to identify sustainable long-term funding, funding sources could comprise of government, donors, budgetary transfers, disbursements from the CDM projects, and selected levies on some goods.

- Crops suited for small-holders (ie jatropha, sorghum, cassava, castor beans) would increase rural empowerment but are unlikely to achieve consistent yield and quality requirements needed for processors.
- Crops suited for large-scale producers (ie sugarcane, soya, oil seeds such as sunflower and canola) would not create significant rural empowerment but would be highly efficient in consistent yields and quality requirements.

The Ministry is also aware of the increasing concern over the conversion of land from food production to fuel production and that integrating small-holders into a biofuel sector could threaten the country's ability to produce sufficient food to feed its growing population. Associated with this are the potential increases in environmental degradation and risk as more and more land is converted to biofuel crops affecting many important ecosystem services and goods.

The Ministry is also very aware of the challenges rural farmers have faced in the past when converting from subsistence based production to more commercialised production. The history of cotton production which used thousands of contracted rural farmers to produce cotton seed for processing, has been marked with many unfortunate challenges and failures that left many farmers in debt and unable to produce sufficient cotton to keep the processing plant operating. The Ministry acknowledges that such challenges can be overcome through well planned interventions, capacity building and access to financial resources, but in the short-term and in a global economic environment that has not favoured cotton production in Swaziland, attempting to solve the challenges is beyond the country's capacity at this time.

The Ministry is also aware that globally there is no demonstrable viable biodiesel production model that the country could adapt or adopt that would achieve the sustainable provision of economic feedstock. Attempts by D1-BP Fuel Crops from 2005-2009 to grow and commercialise Jatropha failed. The failure was partly economic but mostly agronomic difficulties with jatropha. Swaziland does not have an ideal agro-ecological environment for jatropha. In addition there have been few international successes in jatropha production and the trend now is focusing more on research and domesticating wild varieties before it can be viably introduced to farmers. The majority of biodiesel is derived from traditional food crops such as soy, sunflower and canola.

The Ministry is also aware of Swaziland's comparative advantage regionally and internationally, in producing sugar from sugarcane and the significant global demand for bioethanol.

Swaziland produces some 620,000t of sugar annually with the resulting availability of some 190,000t of molasses (the most common feedstock for bioethanol). The country has already some 52,619 Ha of land under sugarcane which yields, after processing, around 190,000t of molasses. The current potential, therefore, for producing fuel grade bioethanol from molasses is about 50 million litres per annum (using a conversion ratio is 4 kg of molasses / 1 litre of ethanol). The total petrol consumption in Swaziland in 2007 was 115m litres and by 2015 is estimated to be 183m litres. If an E10 blend was implemented, some 18m litres of bioethanol would be needed by 2015 and this is well within feedstock availability.

RSSC installed ethanol production capacity is 32m litres/year. RSSC ethanol production from 2004 to 2008 is presented below.

Production	2009	2008	2007	2006	2005	2004
Potable (litres)	25,853,00	24,152,000	9,100,000	13,062,000	13,660,000	13,101,447
Fuel grade (litres)		2,444				

The environmental benefits of using bioethanol derived from cane molasses are also advantageous. The greenhouse-gas savings (% vs. petrol) for cane derived bioethanol is between 87–96%. Molasses derived bioethanol also has a favourable energy balance and returns from 8 to 9 units of energy for each unit expended.

4.2 FOCUSSING NATIONAL BIOFUEL DEVELOPMENT

Cognisant of the economic, environmental and production challenges, the Ministry makes the following recommendations:

- Focus near term on existing sugar producers to commercialize process by-products
    - Swaziland has good experience with sugarcane and has established businesses in the sector with some experience making bioethanol
    - Requirement is for development of downstream (production, blending and marketing) infrastructure and expertise - Swaziland has none at present
    - Critical to determine the appropriate stimuli: demand requirements (blending mandates) and price supports (fuel levies) to sustainably fund the industry
- Delay rural empowerment until functioning extension programmes, production modalities, crop selection and solid markets have been established
    - Initiate agronomic trials of promising biofuel crops that are suited to small-holder production constraints and opportunities
    - Protect the small-holder from market failure (ensure there is demand for their produce and a price history they can trust) and develop viable business plans for selected crops
    - Identify realistic and viable funding sources that can be accessed and utilised by small-holder farmers to develop their biofuel feedstock production
    - Train extension officers to focus on environment-appropriate and commercially viable feedstocks
- Delay investment in biodiesel feedstock production for the foreseeable future. There is presently no example of a profitable biodiesel industry anywhere in the world so the Ministry recommends waiting for other countries to prove viability first then re-evaluate the introduction of biodiesel feedstock production.
- Establish a biofuel regulator to manage and coordinate biofuel production, marketing and utilisation.

4.3 IMPLEMENTATION ROAD-MAP: BIOFUELS DEVELOPMENT IN SWAZILAND

This NBDAP proposes the implementation of a focused and refined NBDS through a phased implementation plan:

Step 1: Create the Legislative Framework: Create legal authority for biofuels production and use.

- Establish key program goals and definitions
- Enable production and sale of bioethanol
- Set mandatory blending requirements
- Create mechanism for funding industry

Step 2: Create the Institutional Capacity: Develop Institutions to manage industry

- Create, staff and fund the Swaziland Biofuels Authority
- Finalize complete value-chain investment plan
- Initiate funding mechanism to capitalize investment plan
- Develop R&D programs

Step 3: Implementation: Phased implementation to "build slowly from strength"

- **Unfocused**: The strategy encompasses both mechanized TDL experienced farmers as well as small-holder SNL subsistence farmers
- **Costs unknown**: The draft strategy does not venture an opinion on the likely costs and benefits of developing a biofuels capability for Swaziland
- **Difficult task even for rich countries**: The history of biofuels development suggests that they are usually uneconomic at the recent average price of oil with very few exceptions (e.g.: Brazil)
- **Swaziland is a small resource-constrained country**: It has limited capacity to sustain a long-term investment in a large-scale biofuels program
- **Too fast**: The Draft plans to meet large national blending targets within five years, requiring a large scale biofuels industry development in a very short time frame

For these and other reasons, the Ministry recommends a phased biofuel implementation plan that seeks to keep costs low as the nation learns how to build an economically and environmentally sustainable biofuels industry. In time building on the experience gained, the biofuel industry will mature and broaden the scope for participation of lower skilled and resourced producers.

4.1.2 INTERNATIONAL EXPERIENCES AND LESSONS LEARNED

In developing this NBDAP, the Ministry has had time to reflect and assess regional and global success and failures in biofuel production. The original 'biofuel boom' that saw millions of Dollars invested into a wide range of international projects has not yet seen any return on those investments. International concerns on environmental, financial and social impacts of biofuels, has caused many countries to review their biofuel programmes and to scale back or investigate further the most appropriate benefits whilst avoiding the negative impacts.

The Ministry is aware that international biofuel production, once considered as a tool for poverty alleviation and rural development, has failed to achieve these noble aims. There are continental examples where small-scale biofuel production for village level energy needs has worked, e.g. Mali but there are no examples of large-scale production having achieved this. To date all large-scale production projects have been private sector funded often utilising communal land that has resulted in a variety of social, institutional and environmental concerns. Ghana, Tanzania and Mozambique have all experienced these forms of impacts and each country has tried to tackle them using their own institutional instruments. It should also be noted that the countries cited are physically much larger and have the land area available for a variety of uses whereas Swaziland is much smaller in comparison and after decades of poor land use planning no longer has contiguous land areas suited for large-scale agricultural activities that would not require the resettlement of large numbers of residents.

The Ministry is also acutely aware of the importance of introducing alternative livelihoods to the thousands of rural farmers battling with poverty and a degrading environment and using biofuel crops as one tool to contribute towards resolving their situation. However, the Ministry is aware of the low level of successful penetration of biofuel feedstock production by rural resource poor farmers in many neighbouring countries. The Ministry has not been able to identify a single successful programme that produces feedstocks for processing into biofuel. Nor has it found, apart from sugarcane derived ethanol in Malawi and Zimbabwe, any suitable crops that could fulfil national biofuel demands at even negligible blending ratios. As a consequence, the Ministry is proposing that rural empowerment through biofuel feedstock production be delayed until such time as the country has identified and tested suitable crops and processing technologies. Currently sweet sorghum is a preferred candidate for rural farmers as its production is suited to small-scale and is a dryland crop, but with little or no previous national experience with this crop, intensive research and testing has to be carried out to ensure that should it be introduced to rural farmers, they are assured of its economic viability and availability of extension support. An advantage of sweet sorghum is that it can provide both food and fuel

as its grain can be harvested for use as food and its stalk processed for its carbohydrate and sugar. It potentially offers a win win situation and is increasingly being used in regional biofuel projects.

The Ministry is cognisant of the route taken by the sugar industry when it first began in the 1950s. It started small, built institutional and legislative capacity, identified and created markets and the logistics to move and sell its product, exploited favourable agro-ecological conditions to expand production and finally began to integrate small-holder farmers to produce feedstock for its processing facilities. All the time, in association with South African research institutions, it improved its cane varieties, improved its land management practices, optimised the use of inputs, improved its water utilisation efficiency and improved its processing technologies.

During the formulation of the NBDS, stakeholders strongly voiced their concerns over the use of land for biofuel crops while the country is trapped in a vicious cycle of food insecurity, poverty and the increasing impacts of climate change affecting all facets of economic development. The Ministry of Agriculture was concerned that there was not enough land available to produce both food and fuel particularly at scales suggested in the NBDS (70,000 to 100,000 Ha). International development agencies operating in Swaziland also expressed a concern that the production of biofuel crops using rural farmers was inappropriate given the severe challenges the same farmers faced in producing food crops that has resulted in such agencies providing emergency food relief to hundreds of thousands of Swazis over many years.

The Ministry is also aware of the importance of a well functioning institutional and legislative environment that not only supports biofuel developments but also promotes them. A conducive institutional and legislative framework, as articulated in the NBDS, is viewed by stakeholders as being vital to ensure a sustainable and economically rewarding biofuel sector that meets the core objectives of the country's economic development plans, its environmental commitments and its commitment to poverty alleviation.

Cognisant of these concerns, the Ministry of Natural Resources and Energy, the main driver for the NBDS, took a decision to focus biofuel development on existing technologies that have a proven economic and technical viability and exploit the country's existing position of strength in sugar production.

4.1.3 UNDERSTANDING THE BIOFUEL PRODUCTION CHALLENGES

As has been described in early chapters, biofuels are derived from organic matter principally plants, that are grown and processed to extract useable oils or liquids that can be blended with petrol or diesel with little or no change in engine performance but with environmental advantages with a reduction in pollutants entering the atmosphere.

The types of crops suited for this purpose have been described in early chapters and all are considered suitable for Swaziland's agro-ecological environment. However, the NBDS identified that such crops should be grown by rural farmers on small plots feeding bigger growers and processors that in turn refine the oils to established quality standards for blending by national oil companies.

Stakeholders identified that the production of any of the identified crops would require detailed land suitability assessments, farmer capacity building, improvements in existing extension service activities, funding to secure production inputs and research on crop agronomy and husbandry to ensure consistent yields.

A review of the different production systems and scales by the Ministry identified that the discrepancies between small-sale and large-scale production in land take, yields, costs, skills and logistics is significant and that capacity to address these major challenges to uplift rural farmers to levels associated with commercialised biofuel feedstock production would take lots of time and resources.

The Ministry acknowledged that there are major differences in the ability of biofuel feedstock production to achieve significant levels of rural empowerment production whilst at the same time provide the feedstock at economic prices.

1. To address energy security through production and use of biofuels and detaching from negative developments in the market for fossil fuels.
2. To build biofuel production capacity slowly and from a position of strength and experience.
3. To enhance rural development through close and harmonious operation of the biofuel and the agricultural sectors.
4. To address environmental concerns through contributing to the overall reduction of greenhouse gas emissions and helping to reduce climate change.
5. To promote export development through providing opportunities to develop new export markets and improving the trade balance.

3.2.2.2 ACTION PLAN OBJECTIVES

The NBDAP has the following key objectives:

1. Create an enabling legislative framework
2. Create a national Biofuels Authority
3. Implement a phased development of biofuels, feedstocks and blending

3.2.2.3 ACTION PLAN OUTCOMES

Achievement of the Action Plan Objectives will lead to or will coincide with a number of outcomes and benefits:

1. A new or revised suite of laws and regulations that permit and regulate biofuel feedstock production, processing, blending and use;
2. A institution with an overall mandate to manage and coordinate all biofuel developments in the country;
3. The rapid introduction of bioethanol and its use in all petrol imported into the country;
4. A crop research and development programme that successfully introduces suitable alternative feedstock options to rural farmers;
5. Improved technical and logistical capacity to implement and manage the diverse responsibilities of biofuel production and use;
6. Sustainable financial mechanisms that satisfy private investors to develop the infrastructure required to meet national biofuel requirements; and
7. An environmentally sustainable biofuel production network that meets international standards and expectations.

3.2.3 THE FOUR BIOFUEL PILLARS

The NBDS presented the four essential elements or building blocks around which the strategy was formulated. The NBDS referred to these as the four Biofuels Pillars:

Pillar 1: Adequate Institutional and Legal Arrangements

Important factors in this process are developing human, institutional and systemic capacity and identifying the provisions for supportive legislation.

Pillar 2: Sustainable Biofuel Feedstock Production

This pillar covers the sustainable production and marketing of feedstock, based on rational utilization of land and water, whilst minimizing adverse impacts on biological diversity and addressing land degradation. The feedstock production will involve smallholder participation.

Pillar 3: Sustainable Biofuels Production, Marketing and Trade

The principle of this pillar is to produce and trade biofuels in a sustainable manner based on sound economic and financial management.

Pillar 4: Environmental Sustainability and Social Compliance

Environmental conservation and sustainable utilization of biodiversity are key elements or conditions that need to be addressed to enable biofuels development. The mitigation of impacts on food security and social impacts is another prerequisite.

Each of these four pillars is supported by a number of strategy statements and suggested implementing activities.

4 THE NATIONAL BIOFUELS DEVELOPMENT ACTION PLAN

The NBDS provides a framework around which a viable biofuels sector can be created. The NBDS has secured political commitment and Government are beginning to put in place effective policy, institutions and regulatory frameworks that are crucial to improve the investment climate for biofuel development.

This Action Plan provides the implementing methodology that translates the NBDS into more focused and defined activities.

The NBDS remains an important reference document and should be read alongside this Action Plan. Where statements made in the Action Plan are not well understood, the Strategy should be consulted for guidance and meaning.

4.1 INTRODUCTION

Following the formulation of the NBDS and stakeholder consultation, the Government of Swaziland took a decision to formulate an action plan that would see the core objectives of the NBDS being realised but cognisant of global trends and developments since the NBDS was published:

- Oil price peaked at $149 per barrel in summer 2008, now less than half that in 2009
- Biofuels were linked to the world food-price crisis (perhaps unfairly...) and countries were advised to consider the implications on food security before embarking on large-scale biofuel projects
- Biofuels remain uneconomical in all contexts except Brazil at current oil prices
    - US overbuilt for ethanol - leading to huge industry shakeout
    - Palm oil and other food oils remain too expensive for use in biodiesel
    - Other biodiesel feedstocks failed to deliver on yields (jatropha)
    - Brazil's success comes after a deliberate 30 year effort to foster the industry
- Despite large investment, biofuels in Africa still remains a nascent industry with uncertain economic prospects and a mixed social/environmental legacy

4.1.1 FACING THE REALITIES

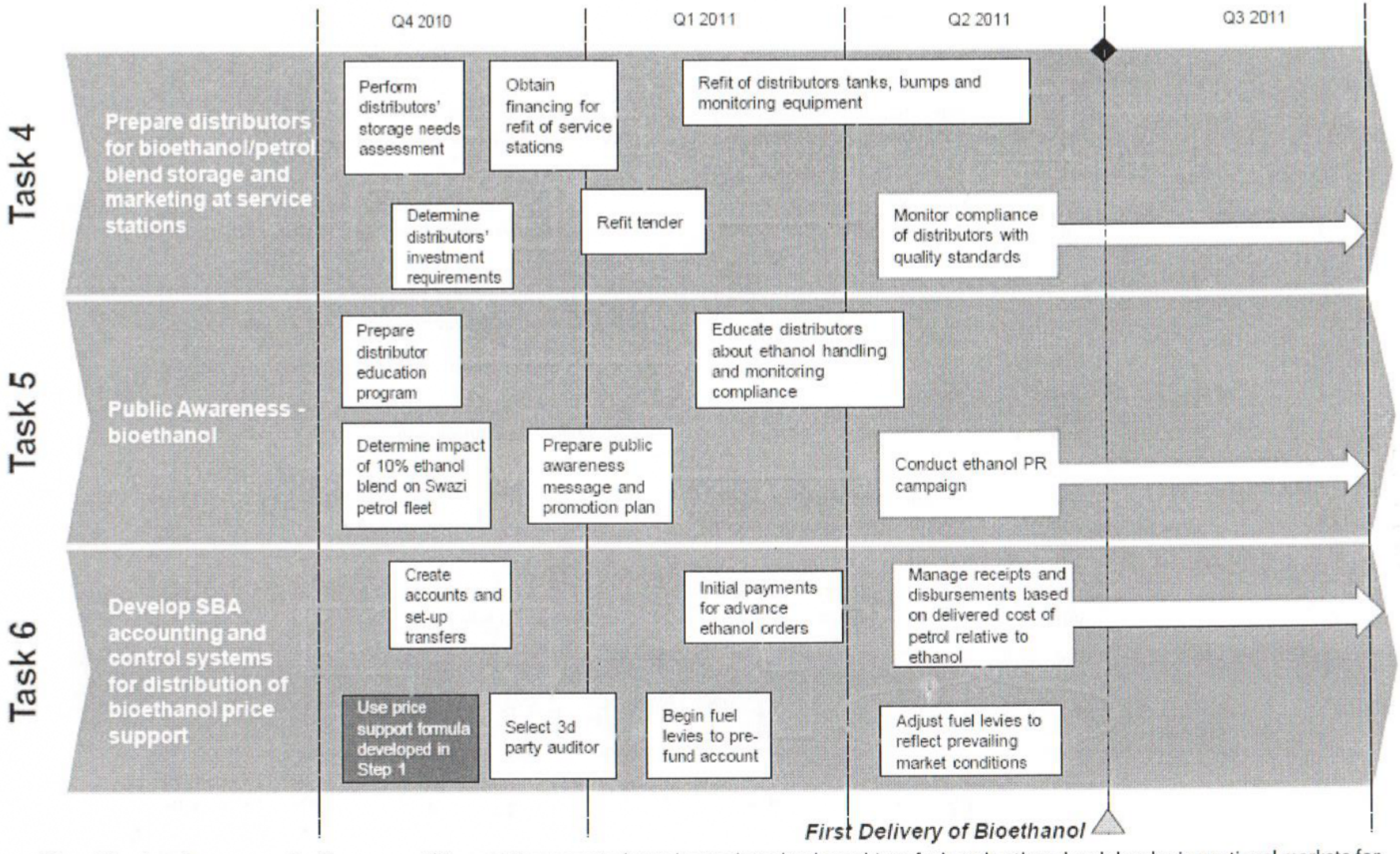
The Ministry of Natural Resources and Energy, hereinafter referred to as the Ministry, acknowledges that the global biofuels "boom" has since retreated to a phase of cautious and informed development. There are still opportunities, but the winners will be the countries/companies that go slow, build from strength, and adopt technologies and feedstocks that are proven to be appropriate to the local conditions.

Consultations and discussions with stakeholders identified that the NBDS was too far-reaching, too all-encompassing and too costly to implement particularly in a global environment that has seen many biofuel initiatives fail. In particular the following were identified as reasons to be cautious:

- **Too broad**: The strategy encompasses both bioethanol and biodiesel - two very different fuels, crops and production processes with few commonalities

Tier 0 activities	Tier 1 Activities	Tier 2 & 3 Activities	Key stakeholders	Estimated cost to completion (E 2009)
	facilities construction			
	1.4 Bioethanol blending tender		• SBA	
	1.5 Construction of bioethanol blending equipment	• Select and empower a third party to perform checks on equipment	• SBA	E8,500,000
3 - Develop bioethanol dehydration Infrastructure	3.1 Perform biofuels dehydration needs assessment	• Develop bioethanol dehydration and water-content compliance methodology	• SBA	E100,000
	3.2 Determine dehydration investment requirements	• Extract financing assumptions from Step 1 financial model and validate	• SBA	E100,000
	3.3 Obtain financing for dehydration facilities construction		• SBA	E80,000
	3.4 Bioethanol dehydration tender		• SBA	
	3.5 Construction of bioethanol dehydration equipment	• Select and empower a third party to perform checks on equipment	• SBA	E10,000,000
4 - Prepare distributors for bioethanol/petrol blend storage and marketing at service stations	4.1 Perform distributors' storage needs assessment	• Convene gathering of al service station owners and identify current storage infrastructure	• SBA	E80,000
	4.2 Determine distributors' investment requirements	• Extract financing assumptions from Step 1 financial model and validate	• SBA	E80,000
	4.3 Obtain financing for refit of service stations		• SBA	E80,000

Tier 0 activities	Tier 1 Activities	Tier 2 & 3 Activities	Key stakeholders	Estimated cost to completion (E 2009)
	4.4 Refit tender		• SBA	
	4.5 Refit of distributors tanks, bumps and monitoring equipment	• Select and empower a third party to perform checks on equipment	• SBA	E12,000,000
5 - Prepare for bioethanol/petrol public awareness	5.1 Prepare distributor education program		• SBA • Biofuels Producers Association	E500,000
	5.2 Educate distributors about ethanol handling and monitoring compliance		• SBA • Biofuels Producers Association	E100,000
	5.3 Determine impact of 10% ethanol blend on Swazi petrol fleet		• SBA • Biofuels Producers Association	E80,000
	5.4 Prepare public awareness message and promotion plan		• SBA	E100,000
6 - Develop SBA accounting and control systems for distribution of bioethanol price support	6.1 Create accounts and set-up transfers	• Determine signatory approvals and check with auditors	• SBA	E200,000
	6.2 Select 3d party auditor	• Empower auditor to discuss irregularities directly with SBA board	• SBA	
	6.3 Begin fuel levies to pre-fund account	• Based on working capital requirement established in the analysis on Step 1	• SBA	
	6.4 Initial payments for advance ethanol orders		• SBA	



Phase 2 is primarily concerned with commercializing existing sugar-industry by-products (molasses) into fuel-grade ethanol and developing national markets for purchase and use of the fuel

Critical goals for Phase 2 are:

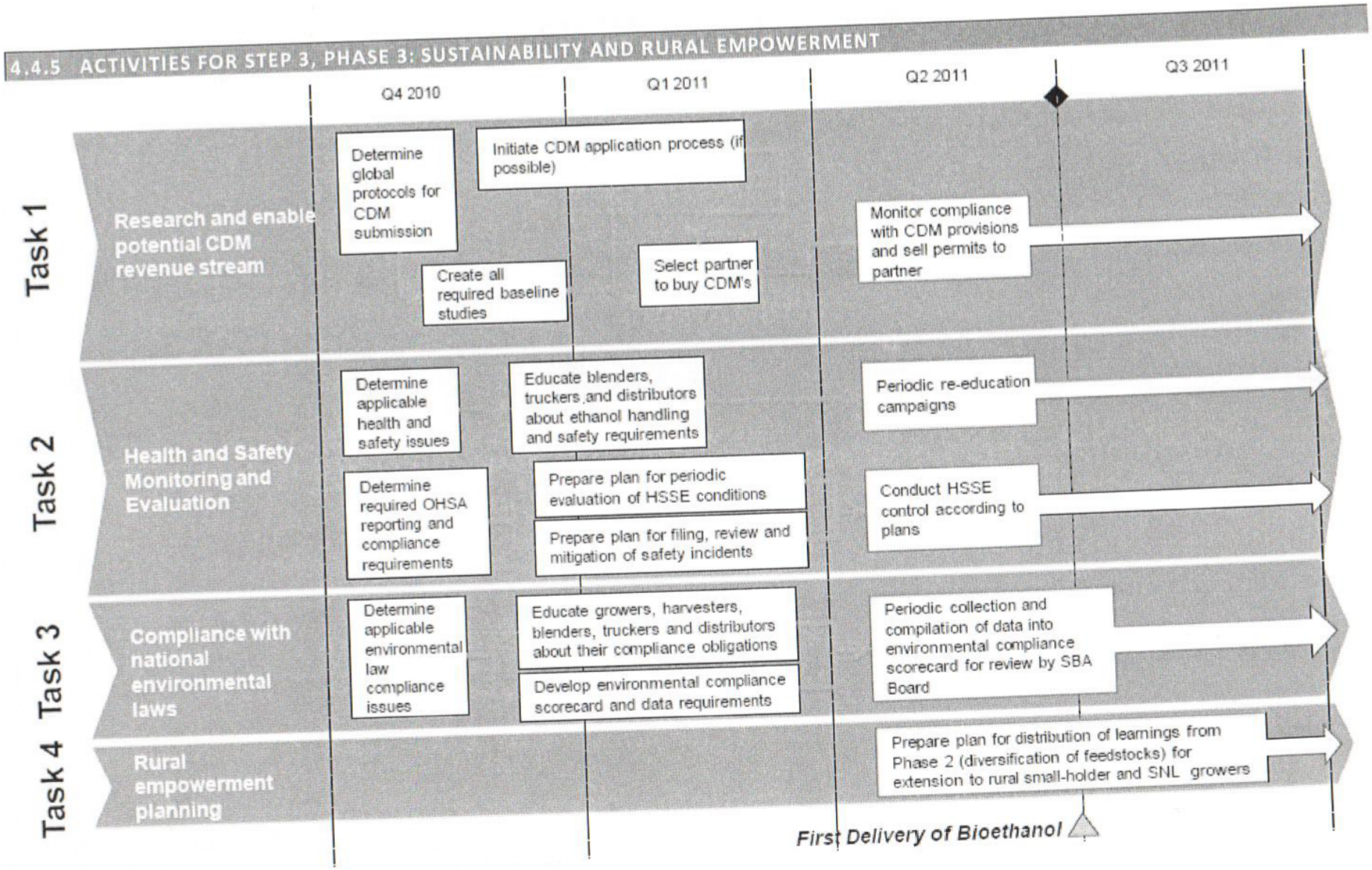
- Development of required downstream infrastructure financed privately but backed by SBA's ability to implement a levy on the price of petrol to fund biofuels development
- Creation of required financial channels, transfers and controls to enable SBA to fund ethanol purchases when cost (ethanol) + Producer margin > cost (petrol)

Key risks for Step 3, Phase 2 are:

- Setting "hard" price floors and fuel levies - the SBA needs flexibility to adjust (or eliminate) the biofuels fuel levy based on the global price of oil and ethanol producers' costs and margins
- Accounting irregularities within the SBA that could jeopardize public willingness to pay the levy in support for the biofuels industry

Tier 0 activities	Tier 1 Activities	Tier 2 & 3 Activities	Key stakeholders	Estimated cost to completion (E 2009)
1 - Develop Bioethanol Bulk Storage Infrastructure	1.1 Perform biofuels storage needs assessment	• Develop bioethanol storage and water-content compliance methodology	• SBA • MNRE	E300,000
	1.2 Determine storage investment requirements	• Extract financing assumptions from Step 1 financial model and validate	• SBA • MNRE	E80,000
	1.3 Obtain financing for storage facilities construction		• SBA	E80,000
	1.4 Bioethanol storage tender		• SBA	
	1.5 Construction of bioethanol storage equipment	• Select and empower a third party to perform checks on equipment	• SBA	E12,500,000
2 - Develop Blending Infrastructure	1.1 Perform biofuels blending needs assessment	• Develop bioethanol blending and water-content compliance methodology	• SBA	E80,000
	1.2 Determine blending investment requirements	• Extract financing assumptions from Step 1 financial model and validate	• SBA	E80,000
	1.3 Obtain financing for blending		• SBA	E80,000

4.4.5 ACTIVITIES FOR STEP 3, PHASE 3: SUSTAINABILITY AND RURAL EMPOWERMENT



Phase 3 is primarily concerned with commercializing existing sugar-industry by-products (molasses) into fuel-grade ethanol and developing national markets for purchase and use of the fuel

- Critical goals for Phase 3 are:
  - Setting up key baseline data collection BEFORE E10 hits the market to capitalize on any CDM or other GHG abatement credits which may be available
  - Set the standard for health and safety controls and compliance
  - Initiate consultation with rural growers and agricultural extension services for eventual expansion of biofuels feedstock production to small holder and SNL farmers in Phase 3
  - Develop and maintain strict compliance reporting for national and global environmental, social and food-security standards
- Key risks for Step 3, Phase 3 are:
  - CDM projects fail to materialize
  - Sustainability criteria fails to provide expected levels of protection
  - Research of alternative feedstocks suited to local conditions fail to be proven and viable

Tier 0 activities	Tier 1 Activities	Tier 2 & 3 Activities	Key stakeholders	Estimated cost to completion (E 2009)
1 - Research and enable potential CDM revenue stream	1.1 Determine global protocols for CDM submission		• SBA • MTEA (MET)	E80,000
	1.2 Create all required baseline studies		• SBA • MTEA (MET)	E200,000
	1.3 Initiate CDM application process (if possible)		• SBA • MTEA (MET)	E100,000
	1.4 Select partner to buy CDM's		• SBA • MTEA (MET)	
2- Health and	2.1 Determine applicable	• Create and implement ISO compliance monitoring plan	• SBA	E200,000

Tier 0 activities	Tier 1 Activities	Tier 2 & 3 Activities	Key stakeholders	Estimated cost to completion (E 2009)
Safety Monitoring and Evaluation	health and safety issues			
	2.2 Determine required OHSA reporting and compliance requirements	• Develop road-safety and transport standards and monitoring plan to ensure compliance	• SBA	E100,000
	2.3 Educate blenders, truckers and distributors about ethanol handling and safety requirements	• Develop safety regulations and method for monitoring them	• SBA	E100,000
	2.4 Prepare plan for periodic evaluation of HSSE conditions		• SBA	E100,000
	2.5 Prepare plan for filing, review and mitigation of safety incidents		• SBA	E80,000
3 - Compliance with national environmental laws	3.1 Determine applicable environmental law compliance issues	• Assess adverse environmental impacts • Set protocol for implementing Biodiversity Conservation and Management Policy and Act in site selection process	• SBA • SEA	E250,000
	3.2 Educate growers, harvesters, blenders, truckers and distributors about their compliance obligations	• Define plan for periodic environmental surveys	• SBA • SEA	E50,000
	3.3 Develop environmental compliance scorecard and data requirements	• Set sustainability gateway requirements for go-no-go decision making • Create environmental monitoring mechanism to evaluate impact	• SBA • SEA	E150,000
4 - Rural	4.1 Prepare plan for		• SBA	E100,000

Tier 0 activities	Tier 1 Activities	Tier 2 & 3 Activities	Key stakeholders	Estimated cost to completion (E 2009)
empowerment planning	distribution of experiences from Phase 2 (diversification of feedstocks) for extension to rural small-holder and SNL growers		• SEA	

5 IMPLEMENTATION COSTS

The cost of implementing this Action Plan is presented in the table below.

Step	Year of cost	Fixed Cost	Recurrent Costs	Total
Step 1: Create the Legislative Framework	2010	E650,000.00	-	E650,000.00
Step 2: Establish and run the Swaziland Biofuels Authority	2011	E2,860,000.00	E2,470,000.00	E5,330,000.00
Step 3, Phase 1: Feedstocks (upstream)	2012-2015	E1,430,000.00		E1,430,000.00
Step 3, Phase 2: Production & Markets (downstream)	2013-2015	E45,200,000.00		E45,200,000.00
Step 3, Phase 3: Sustainability and Rural Empowerment	2014-	E1,510,000.00		E1,510,000.00
TOTAL		E51,650,000.00	E2,470,000.00	

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