GOVERNMENT OF MAURITIUS

OUTLINE OF ENERGY POLICY 2007 - 2025

TOWARDS A COHERENT STRATEGY FOR THE DEVELOPMENT OF THE ENERGY SECTOR IN MAURITIUS

April 2007

OUTLINE OF ENERGY POLICY 2007 - 2025
CONTENTS

FOREWORD

In view of the serious challenges posed by the volatility of oil prices and the rising cost of energy, Government has reviewed the energy policy for fuelling the future as a result of a paradigm shift on the world stage caused by climate change. Previous Electricity Plans prepared prior to 2005 are now superseded. The proposed policies take into account developments in the Energy Sector.

The Presidential Address in 2005 set the tone for the future policy guidance for the electricity generation sector. The key for the CEB is its financial sustainability which is intimately linked with a diversification of the energy basket and providing affordable electricity to the customers to enable the economy to forge ahead.

Given the competitive situation on the world market, electricity prices should compare favourably with prices which investors would obtain in other countries. Thus prices must be fair and cost reflective.

In the wake of this new plan, Government will actively seek to engage into strategic partnerships which would guarantee the financial sustainability of the CEB and, in accordance with the declared policy of Government to maintain a reasonable share in the generation sector.

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Minister of Public Utilities

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1 INTRODUCTION

1.1 The General Context

1.1.1 There has been a general recognition that Man is impacting on the planet in an unprecedented manner, and the main cause thereof has until now been the non-discriminate use of fossil fuels which is causing climatic change, global warming and the rise in sea level. The recently published Stern Review as well as other data prompted the USA to at long last accept this fact. Therefore recent events and observations around the world have triggered a new awareness amongst policymakers about the need to decrease the use of fossil fuels and increase the use of sustainable energies and accordingly have caused a general shift in the energy policies in both developed and developing countries.

1.1.2 Moreover, the volatility of prices of oil, in particular the rise in the price of oil from an average of around 40 USD to 80 USD from 2003 to 2006, caused many people to fear for the long-term price of energy supplies. Accordingly, a shift towards other sources of energy is being emphasized and renewable sources have gained in importance.

1.1.3 In Mauritius, year 2005 saw a change in Government and a series of economic reforms ensued against the backdrop of democratization of the economy. In short, the principle hinges on empowering all classes of citizens in achieving their full potential. It also means opening up business to every citizen, providing them with the necessary capacity to do so in order to promote a fairer society.

1.1.4 The institutional framework for energy policy is headed by the Ministry of Public Utilities. Other stakeholders include the Ministry of Public Infrastructure, Ministry of Finance and Economic Development, Land Transport and Shipping, Ministry of Environment and National Development Unit, Ministry of Agro- Industry and Fisheries, Ministry of Industry, Small and Medium Enterprises, Commerce & Cooperatives, Meteorological Services, Central Electricity Board and the Mauritius Sugar Authority.

1.2 Concept of Energy Policy

1.2.1 Government energy policy is underpinned by the emerging economic model since 2005. The main pillars of the Mauritian economy will be tourism, with a target of 2 million tourist arrivals by year 2015, information technology, seafood hub, a restructured sugar sector and textile manufacturing.

1.2.2 The environmental dimension is integrated in the energy matrix of the country. Energy accounts generally for about 80% of all greenhouse gas emissions in Mauritius. It is known that greenhouse gas emissions are at the root of climate change and air pollution. In its position as a Small Island Developing State (SIDS), it is in the interest of Mauritius to help in the reduction of greenhouse gas emissions. Energy policies in Mauritius, which were until recently merely demand driven without any incentive to reduce demand, were unsustainable.

1.2.3 Mauritius is reliant on imported sources of energy to more than 90%. From a broader perspective, the consumption of fossil fuels by the emerging giants China and India are pushing the prices thereof to higher and higher levels, while the ongoing geopolitical situation in the Gulf States are having significant impacts on the price of oil. The high reliance on fossil fuels therefore bears economic risks for Mauritius.

1.2.4 While global energy consumption is increasing at about 1% annually, the increase in electricity consumption is at a sustained rate of 5%; there are therefore serious challenges for the country to meet electricity demand.

1.2.5 As Mauritius is an island State, it cannot have the benefit of interconnection facilities; this constraint adds to risks for security of supply in case of severe problems.

1.2.6 In the context of having to be competitive in a globalized world and economy, Mauritius has to encourage greater competitiveness in the energy sector. There is therefore a need to avoid any monopolistic situation, be it public or private. Any quasi monopoly will not go in the direction of stimulating fair and competitive energy prices, energy savings and diversified investment. The right policy mix has therefore to be provided to encourage competitiveness in the sector.

1.2.7 Greater investment in energy efficiency and renewable energy can result in economic growth and job creation. As Mauritian products need to be competitive internationally, it is important that policies are designed so as to positively impact on energy intensive sectors of the economy.

1.2.8 In devising the energy policy, the social dimension needs to be taken into account, particularly when specific measures are designed and implemented.

1.2.9 Given the diverse requirements of various stakeholders, the formulation of the energy policy is directed by the following broad parameters:

i. The new economic framework;
ii. Transportation;
iii. Sugar Industry Reform;
iv. Environment;
v. Municipal Waste Disposal;
vi. Electricity Generation Market; and
vii. Financial sustainability of the Utility.

1.3 Structure of Document

1.3.1 The document is structured as follows:

- Section 1: Introduction
- Section 2: Background
- Section 3: Objectives
- Section 4: Elements of Energy Policy
- Section 5: Action Plan
- Appendix 1 : Demand and Supply Forecasts
- Appendix 2: Draft Terms of Reference for the Preparation of the Detailed Long-Term Energy Policy
- Appendix 3: System Cost Analysis for the CEB

2 BACKGROUND

2.1 General

2.1.1 Mauritius has no known oil, natural gas or coal reserves, and is therefore heavily dependent on imported energy sources. In the 80's more than 70% of the country's electricity requirements were met from oil. This made the country's electricity supply highly vulnerable in view of the volatility of the prices of oil products, more so during times of crisis such as during the last two Gulf wars.

2.1.2 Compared to 2004, there has been a 52% increase in 2005 in total energy imports from Rs 9.7 billion to Rs 14.7 billion of which CEB Fuel oil imports accounted for about Rs 2.0 billion in 2005.

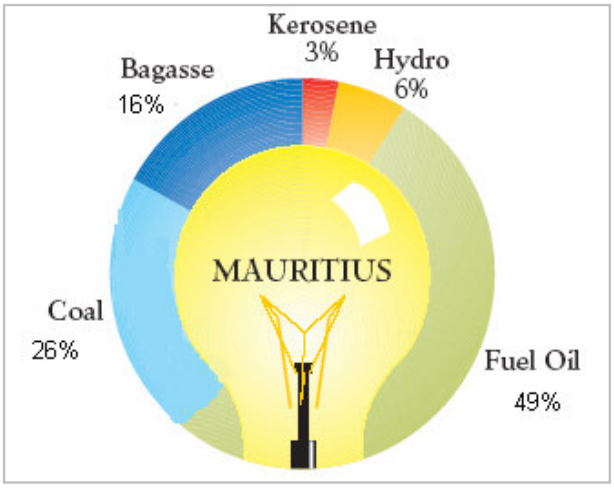
2.2 The electricity production landscape in Mauritius

2.2.1 The electricity production landscape is characterized by the CEB and the various Independent Power Producers (IPPs).

2.2.2 The Central Electricity Board is a parastatal body responsible for the production of 58% of electricity requirements of the country and is by virtue of the Electricity Act 1939, as amended, the sole agency for transmission, distribution and commercialisation of electricity. To meet the electricity requirements of the country in 2005, the CEB used some 230,000 tonnes of imported fuel oil, comprising the 380 cst and 180 cst types, and 340,000 tonnes of imported coal burned in power plants operated by IPPs. The balance was met from local and renewable sources, namely bagasse, which is a by-product of sugarcane processing, and hydro.

2.2.3 Independent Power Producers which are, for the time being, private generators from the sugar industry, produce about 42% of electricity requirements of Mauritius. The electricity production of IPPs is bagasse and coal based, imposing severe constraints on the CEB in terms of dispatching, given the technology of bagasse–coal plants which allow them to be used as base-load plants only.

The energy mix for the electricity sector in 2005 was as follows:



2.2.4 The above situation will evolve with the coming into operation a new IPP plant in the south of the country on the premises of Savannah Sugar Milling Company as from April 2007 which will impact on the energy mix in that the percentage contribution of coal will increase whilst the efficiency with which bagasse is used will also be improved.

2.2.5 From the above figure, the performance of Mauritius in terms of renewable sources of electricity i.e. 22% in 2005 already places it well above even many developed countries. It must be noted that even though the percentage contribution of bagasse in the energy mix decreases, in absolute terms, it will increase.

2.2.6 Since all bagasse currently produced in Mauritius is already used in energy production, the increase in electricity production therefrom in absolute terms will be caused mainly by gains in efficiency of boilers in the IPPs. Moreover, there are new varieties of sugar cane which can produce 25% more fibre than current ones and these would also help to increase the amount of electricity produced from bagasse.

2.2.7 It may be noted that bagasse-coal plants are less efficient in tapping the energy potential from coal. With the current technology, they are about 20% less efficient than dedicated coal plants. Hence the energy cost will be proportionately higher for coal-based energy in bagasse-coal plants.

2.2.8 Moreover, all IPPs have base load plants only, operating 24 hours a day, and therefore not providing flexibility of grid operation. The baseload electricity despatch is already constrained, and accomodating further IPPs of this nature would reduce the load despatch from CEB base load plants. The latter will then be undertutilised thereby translating into higher costs of producing electricity.

2.3 Electricity Demand

2.3.1 Total electricity generation in the island in 2005 was 2014.9 GWh. Hydro contribution was only 115 GWh, above the average hydro generation in a normal year is about 100 GWh; the remaining was thermal out of which 1008.6 GWh was from heavy fuel-oil in diesel plants, 56 GWh from kerosene in gas turbines for peak lopping principally in emergency conditions, 533.8 GWh from coal and 301.6 GWh from bagasse. The coal and bagasse-based electricity from IPPs, totaled 835.4 GWh. It may be noted that this included one coal based IPP.

2.3.2 As shown in Appendix 1, the forecast of the CEB shows that in 2013 about 3092 GWh of energy would have to be generated to meet demand, with a peak power demand of more than 503 MW, compared to 353.1 MW in 2005, while the maximum night load demand is expected to increase from 175 MW in 2005 to 227 MW in 2013.

2.4 Regulatory Framework

2.4.1 The current regulatory framework consists of the CEB Act and the Electricity Act 1939 as amended to be replaced by the Electricity Act 2005. Other relevant legislations pertain to the Sugar Industry, namely the Sugar Industry Efficiency Act, amended in 2007, and the Environment Protection Act 2002.

2.4.2 However, to date the energy sector has been characterized by the absence of an independent regulator. The role of regulator is effectively discharged by the parent Ministry, namely the Ministry of Public Utilities. To address this issue, the Utility Regulatory Authority Act and a new Electricity Act have been passed in 2004 and 2005 respectively. Pending few amendments, those pieces of legislation will be proclaimed as per the timetable in the Action Plan.

2.4.3 The Sugar Industry Efficiency Act of 2007 provides that where land conversion is approved for the setting up of a power station with a rated capacity of 15 megawatt or more using bagasse or other complementary combustibles for the supply of firm electrical power, no land conversion tax is payable.

2.4.4 To meet the growing energy demand, government is currently finalizing a coherent energy policy to encourage the emergence of new producers/suppliers while fully integrating the role of sugar sector and biofuels development on the basis of economic, financial and environmental analyses. The energy policy will ensure transparent decision making on a competitive basis where subsidies/incentives should be limited

to the environment only e.g. carbon credits.

2.5 Reform of the Sugar Industry

2.5.1 The economic context has been for a long time dominated by the Sugar Industry and the spin-offs thereof. However, the viability of the Sugar Industry is being threatened by the 36% reduction in the price of sugar in the context of the changes in the sugar regime in the European Union. It is therefore essential that the Sugar Industry adapts to the new context if it wants to survive. It has been agreed that the reduction in the price of sugar will be accompanied by support measures from the European Union to all ACP sugar producing countries including Mauritius, provided that such countries submit to the EU a coherent roadmap to mitigate the adverse impacts of the price reduction.

2.5.2 In this context, the Ministry of Agro Industry and Fisheries has prepared a Multi Annual Adaptation Strategy (MAAS) 2006 -2015, which provides for an increase in the annual production of electricity from bagasse from 300 to 600 GWh and the production of some 30 million litres of ethanol annually.

2.5.3 The accompanying measures are tied to certain pre-conditions, including amongst others, the submission of a coherent long-term energy policy for the period 2007 – 2025 by end of year 2007.

2.6 Environment

2.6.1 Environmental issues have come to the fore in relation to energy policy mainly as a result of global warming, caused by the emission of green house gases through the extensive, unabated, and inefficient use of fossil fuels, which can cause a rise in sea level and other climatic changes.

2.6.2 Mauritius being a Small Island Developing State (SIDS) is vulnerable to any rise in sea level, which can in turn adversely impact on its tourism industry, which is coastal-based.

2.6.3 As regards freshwater availability, a decrease of 8% in the average amount of rainfall received by the island has already been noted over the past decade, and groundwater resources may be adversely impacted by sea water intrusion.

2.6.4 Accordingly, environmental issues have a direct linkage with energy policy. It is therefore the duty and responsibility of decision makers to work towards decreasing carbon dioxide emissions. Being a signatory of the Kyoto Protocol, Mauritius as a developing country has no commitment to reduce its greenhouse gas emissions under the Protocol which provides

only for developed countries to do so. However, as a small island developing State, Mauritius is particularly vulnerable to the effects of global warming, climate change, and sea level rise. In this context, mitigation and adaptation measures which are in line with the Protocol objectives are being taken.

2.6.5 It may be noted that as per the Environmental Protection Act 2002, power projects are already subject to the requirement that an Environmental Impact Assessment report be prepared for obtaining the appropriate licence before implementation.

2.7 Renewable Energy

2.7.1 Mauritius has long recognized the need to diversify its energy mix in the electricity sector away from fossil fuels as far as possible. To date, Mauritius produces about 22 % of its electricity from renewable resources (hydro, wind and sugar cane bagasse), and as such is among one of the world leaders in renewable energy usage.

2.7.2 Mauritius has in the form of cane biomass a very potent asset, which is not yet fully tapped. Of all cash crops, sugar cane best assimilates solar energy both from the qualitative and quantitative perspectives. Per 100 tonnes of cane produced per hectare, 55 tonnes of carbon dioxide are fixed. In this way, each year 5 million tonnes of environment friendly biomass are produced in the form of sugar cane. If cane tops and leaves are considered, the biomass increases by some 20 %.

2.7.3 The dependence on oil for electricity generation (excluding transportation and industry) has been reduced to some 48% today through enhanced use of renewable energy sources such as more efficient use of bagasse and the use of coal as a complementary fuel to bagasse during the sugarcane off-crop season. The share of bagasse in total electricity generation is now about 15%, that of coal about 27%, and hydro 5%. Unfortunately, Mauritius is totally dependent on oil in the transportation sector.

2.8 Hydropower

2.8.1 Hydropower potential has been almost fully tapped in Mauritius and there are very competitive uses of the existing water resources. There are nine hydropower plants with a combined installed capacity of 59 MW. However, due to seasonal rain conditions and limited storage capacity, only three of the hydro plants can generate all year round during peak hours, whilst the other six generate as and when water is available, mostly during the period January to March. Average hydro effective capacity available is about 25MW.

2.9 Bagasse

2.9.1 Biomass used for generating electricity consists essentially of bagasse. The latter is the most plentiful primary energy resource used by the sugar industry to meet all its energy requirements in terms of heat and electricity generation. In addition, surplus power from bagasse is fed into the national grid. There is still a potential to increase bagasse-based electricity through the ongoing accelerated centralization programme of the sugar industry in the wake of the reduction of the price of sugar following the reform by the EU of its sugar regime. The programme will entail investments in more efficient energy conversion technologies and in energy conservation measures in cane processing.

Table 2.1: Amount of Electricity produced from Bagasse

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Electricity to grid (GWh)	119.0	124.6	194.3	188.5	278.5	296.5	299.1	296.1	317.9	301.6

2.9.2 Besides sugar production, energy generation from bagasse complemented by coal has been a major activity of the sugar industry since the mid-1980's. About 50% of investments in a typical sugar factory are linked to the boiler and the turbo-alternator. The IPPs in the industry have been making such investments through power generation projects for supply of electricity into the national grid. Such IPPs include CTBV, FUEL CEL and CTSav; the latter will come into operation in 2007.

2.9.3 In such an arrangement, the sugar factory obtains steam and electricity required for its operation free, and in return the power plant obtains the bagasse produced after the milling of canes for free. This has been the strategy of the sugar industry to optimize the use of bagasse for power generation complemented with coal in line with the Bagasse Energy Development Programme since 1991. At the same time the sugar factories had the opportunity to modernize their milling infrastructure, in addition to diversifying their revenue from the sale of electricity to the CEB for onward sale to consumers.

2.9.4 In environmental terms, it may be noted that one of the positive aspects of bagasse is that its ash content is less than that of coal.

2.10 Solar Energy

2.10.1 The cost of generating electricity from solar energy is still unfavourable when compared to other conventional and renewable sources despite the progressive reduction in the cost of the technology in the last decade.

2.10.2 The use of solar energy is not only achieved through its conversion to electricity but also through conversion to heat energy and use thereof such as in solar water heaters whose utilization is actively encouraged by Government.

2.10.3 The Development Bank of Mauritius provides an attractive rate of interest for loans relating to the purchase of solar water heaters. However, it is estimated that only some 15,000 households from a total of about 330,000 use solar water heaters for domestic water heating.

2.10.4 The Ministry of Public Utilities is currently conducting a household attitude survey to determine the reasons for such low penetration of solar water heaters in the market. Based on the findings from the survey, appropriate measures will be designed and put in place to further promote the use of solar water heaters in the country including for commercial and industrial uses, with attendant benefits in terms of proportionate substitution of electricity and gas.

2.10.5 Photovoltaic technology is fast evolving and its impact on the country's energy policy (2007 – 2025 timeframe) cannot be neglected. In 2005, the world production of photovoltaic modules was 1760MW from 90 MW ten years earlier. Over the same period the average module price has decreased from 5 €/Watt to 3€ / Watt. It is expected the price will fall down further to make photovoltaics a serious option in the 2020 time horizon. The average daily sunshine density of Mauritius adds to this advantage.

2.11 Wind Energy

2.11.1 Mauritius is for the major part of the year exposed to windy conditions of the South East Trade Winds, and it is therefore conducive for wind energy exploitation. The wind regime in some areas has an annual average speed of 8.1 m/s at 30 m above ground level. Pilot projects in the mid 1980's were not successful as the wind turbines were damaged by cyclones after about two years of operation.

2.11.2 The recent pilot project in Rodrigues, comprising three wind turbines each of a capacity of 60 kW, has proved to be a success. In the light of this experience and given the considerable progress in the design of turbines,

Government is seriously re-considering to use this renewable source of energy on a larger scale in Mauritius.

2.11.3 Technological progress in the wind energy has enabled a 100 fold increase in the power of wind turbines from 50kW to 5MW units in 20 years and reduced costs by 50%. With Europe adopting a green policy in energy production, one would expect major technological breakthroughs in wind energy with higher cost reductions in years to come.

2.11.4 However, given that wind energy availability is highly variable, such energy has to be provided at the marginal cost of the CEB, which is a constraint. The constraint can be overcome if wind energy projects have adequate funding, in terms of grant to meet part of the initial investment, within the framework of bilateral agreements with friendly countries.

2.11.5 Government has sought and obtained the assistance of the Government of India, which is one the few countries in the developing world that has made great strides in the use of wind power. Its assistance would be indeed very valuable to give the much-needed boost to the application of the wind technology in Mauritius.

2.11.6 To that effect, a Memorandum of Understanding has been signed with the Government of India for renewable energy development in Mauritius and under which Mauritius will, *inter-alia*, benefit from such technical assistance in terms of appropriate studies.

2.11.7 Such initiatives are expected to shape up with ongoing discussions between the CEB and a private Indian company within the framework of the MOU. The discussions relate to the setting up of a wind farm of 25 MW in the region of Bigara. It is expected that about 2.5% of electricity requirements could be met from this project.

2.12 Energy from Waste

2.12.1 The waste-to-energy generation is part of the solid waste management policy of Government to relieve the Mare Chicose landfill. Solid waste policy management policy was guided by the Feasibility Study prepared by external consultants until 2005. With the issuance of the letters of intent to a promoter for Incineration of waste to energy, and for a composting facility, there has been a shift in policy.

2.12.2 While the cost of producing electricity from waste will be higher, it has to be noted that such costs take into account externalities in waste treatment such as environmental costs which are not accounted for in landfills. Accordingly, Government has decided that the necessary effort to meet its environmental commitments towards the population will be made, while

enabling the CEB to purchase electricity at a competitive price as compared to its own production cost and those of IPPs.

2.12.3 The proposed waste to energy plant at La Chaumiere in the West of the island will have a capacity of 20MW.

2.13 Energy Used in Transportation Sector

2.13.1 In 2005, the transportation sector consumed 100 087 tonnes of gasoline, 212 082 tonnes of diesel and 143 062 tonnes of aviation fuel. It may be noted that 49% of primary energy consumption is attributable to the transport sector. Mauritius is heavily dependent on oil in the transportation sector, though some vehicles use LPG as well.

2.13.2 The port masterplan 2002-2025 estimated the long term importations of fossil fuels as follows:

PROJECTION MASTER PLAN 2002-25 (Medium Case):

Fuel	Year			
	2005	2010	2015	2025
Mogas (unleaded)	105,457	122,230	141,698	188,909
Gas Oil (diesel)	435,752	583,135	709,472	1035,817
Fuel Oil (180)	163,692	174,073	211,786	302,761
Fuel Oil (380)	140,000	140,000	140,000	140,000
DPK/JFT	275,121	351,132	448,143	714,946
LPG	50,153	55,373	61,136	70,257

2.14 Biofuels

2.14.1 In Mauritius biofuels under consideration are of two types, namely ethanol, which can be locally produced from molasses, and biodiesel made from palm oil which has to be imported.

2.14.2 Biofuels have attracted attention since the country has embarked on the production of ethanol from molasses on a large scale. Until now, ethanol has been produced either for export or for use in manufacture of rum. With the flaring up of oil prices over the period 2004 to 2006, ethanol is becoming a viable alternative to gasoline for use in cars as evidenced by the successful experience of countries such as Brazil.

2.14.3 Ethanol production with molasses as feedstock is currently carried out by three entities in Mauritius, namely Beau Plan, Alcodis and Medine. So far 8 million litres of hydrous ethanol have been produced and exported over the period 2004 to 2006. It may also be noted that an Indian firm is currently

setting up of a new ethanol manufacturing factory at Roche Bois. The facility would use latest technology to dispose by-products from fermentation of molasses.

2.14.4 In 2006, a Monitoring Committee was set up by Government to look into the cost effectiveness of using E10 in Mauritius following the initiative of a private promoter who proposed to test E10 in 25 cars. Experiments have been carried out using imported anhydrous ethanol to test the possibility of introducing a 10% mix of ethanol with gasoline instead of 100% gasoline in cars. This would effectively reduce the import of gasoline by about 10 000 tonnes annually. The Committee would submit its recommendations by end 2007 and decision taken by mid 2008.

2.14.5 It may be noted that a Strategic Environmental Assessment (SEA) is being undertaken for the Multi Annual Adaptation Strategy (MAAS). It is expected that recommendations will be made concerning the disposal of wastes arising out of ethanol production, especially vinasse and CMS (concentrated molasses solution), taking into consideration environmental implications.

2.14.6 In terms of diesel, the possibility of introducing bio-diesel is being explored. The higher consumption of diesel allows for a greater potential for the replacement of diesel by bio-diesel, and potentially a greater impact than the E10 programme.

2.14.7 Moreover, various promoters have approached Government to secure an agreement for Government to purchase biodiesel made from palm oil. Government has agreed to the introduction of biodiesel to be used on the local market and a pilot project for testing it in diesel engines. However, unlike for E10, no testing of biodiesel use in vehicles has been effected.

2.15 Energy Efficiency and Conservation

2.15.1 Energy efficiency has recently been an integrated component of the energy policy of the country. Preparatory work on an Energy Efficiency Bill is ongoing. The energy efficiency bill will look into energy efficiency standards for appliances, buildings, vehicles etc. Moreover, an energy savings campaign was launched in 2005 by Government in the wake of the sustained high price of oil. It is the vision of Government that Mauritius evolves into an energy efficient economy.

2.16 Summary

2.16.1 The energy sector is characterized by a number of historical players. Some efforts have been made as regards renewable energy and because of the use

of bagasse, we have been able to achieve a high proportion of electricity being generated from renewables. However, there are a number of challenges lying ahead in the design and implementation of key strategies to achieve the desired policy aims and objectives, particularly with regard to the setting up of the appropriate regulatory framework, further improving the contribution of renewable energy in the electricity sector, introducing biofuels in the transportation sector and implementing energy efficiency and conservation measures in all economic sectors, particularly where energy usage is intensive.

3 OBJECTIVES OF THE ENERGY POLICY

3.1 Principles of policy formulation

3.1.1 The key objectives of the Mauritian energy policy are to:

- Limit the vulnerability of Mauritius to imported fossil fuels and their volatile prices
- Promote economic growth and job creation
- Democratize energy supply
- Secure affordable energy to consumers
- Ensure the financial sustainability of the Utility

3.1.2 These objectives must be underpinned by real targets in terms of reduction in the use of fossil fuels and in the emission of green house gases arising from energy consumption.

3.1.3 Given the uncertainty about the ready availability of oil beyond the next five decades, it is important to chart out an energy policy and strategy for the short-to-medium and long-term that would reduce as far as possible the reliance of the country on oil for electricity production and transportation.

3.1.4 In this regard, it is considered that the policy framework should be multi-pronged, in keeping with the constraints that the country has in terms of its geographical location, availability of other less volatile and better distributed reserves of fossil fuel such as coal, energy resources available locally and the availability and competitiveness of technologies in the marketplace for their conversion into electricity and for use in transportation and industry.

3.1.5 In addition, in formulating the energy policy the following essential criteria have to be taken into account:-

i. demand for electricity;
ii. economic reforms;
iii. the imperative to attract foreign investment into the country including the energy sector;
iv. environmental considerations;
v. sugar sector reforms and linkage to electricity generation; and
vi. transportation and industrial development policies and linkage to energy use

3.2 Vision Statement

3.2.1 During his visit in 2006, the Indian President APJ Abdul Kalam clearly stated that Mauritius should aim to be an energy independent nation given its tropical location.

3.2.2 The vision of the Government of Mauritius is in-keeping with the above statement of self sufficiency in energy supply in the long term, where individual houses would have the possibility and capacity to fully tap renewable resources such as wind, solar, biogas in decentralized system, which would allow energy supply to continue to be affordable to all citizens.

3.3 Targets

3.3.1 Accordingly, the target is that over the next 50 years Mauritius should be able to achieve about 70% self-sufficiency in terms of energy supply through a progressive increase in the use of renewable energies. At the end of that period, Mauritius would be able to thus reduce its greenhouse gas emissions by some 70% of its current level. Over the next 25 years, the emissions of greenhouse gases would be reduced by about 30%.

3.3.2 The above targets are ambitious and will pose a number of challenges to decision makers in their future choices, which would have to be bold daring and innovative.

3.3.3 In terms electricity, the objective is to meet demand in a consistent manner, assuring security and reliability of supply at affordable prices. The emerging economic pillars, in particular the ICT and tourism sectors would require a constant and high quality supply of electricity.

3.3.4 To this end, the energy mix for the electricity sector (which excludes transportation and industry) will have to be further diversified and more emphasis laid on renewable sources which can be sustainable over the long term. Table 1 below shows the possible targets up to the year 2025

Table 3.1: Percentage Contribution of Electricity Requirements 2007 - 2025

Source of Electricity		Percentage Contribution in Year			
		2007	2013	2020	2025
Renewable	Solar	0%	1%	5%	10%
	Wind	0%	1.5%	5%	10%
	Hydro	5%	3.4%	3%	2.6%
	Bagasse	15%	15%	15%	15%
	Waste	0%	4.7%	5%	6%
Non-Renewable	Coal	42%	53.6%	46%	35.5%
	Kerosene	1.2%	0.8%	1%	1%
	Fuel Oil	36.8%	20%	20%	20%

3.3.5 As regards the transportation and industrial sectors, specific targets will be elaborated in the long-term energy policy document.

3.3.6 The objective with respect to biofuels is to integrate its use in the energy mix for the transportation sector in the medium-to-long-term. This would provide the opportunity to reduce emissions of carbon dioxide in the transportation sector through the use of renewable fuels.

3.3.7 For the time being, the only target which has been established is the completion of appropriate studies into the use of bio-fuels by mid 2008.

3.4 Summary

3.4.1 A dynamic generation market is essential to meet the long-term energy supply challenges, whilst minimizing social costs in meeting the following aims:

- Competitiveness
- Affordability
- Sustainability
- Security of Supply

3.4.2 In this respect, the objective of Government in the electricity sector is to allow more competition in the generation market through the creation of a level playing field with historical players. In the future market, the competition would be overseen by the independent Regulator.

4 ELEMENTS OF THE ENERGY POLICY

4.1 General Framework

4.1.1 The policies and strategies of Government for the next twenty years are outlined in this section. Existing measures have achieved some results but more needs to be done to fulfil the objectives of security of supply, affordable energy, competitiveness and energy independence in the long term. Given the linkage of energy use with various sectors of the economy and the environment, any set of policies have to respond to such multi-faceted characteristics and needs.

4.1.2 The outlines that will be discussed hereunder will be supplemented by an in-depth policy and strategy document to be prepared by end 2007 as per the draft Terms of Reference at Appendix 2.

4.2 Government Policy

4.2.1 In the Presidential Address of 29 July 2005, it is ,*inter-alia*, stated that "in view of the constantly growing needs of the country, Government will take action for the timely commissioning of additional power generating plants. The CEB would be encouraged to increase its own production capacity and to ensure security and reliability of supply, at the lowest possible costs".

4.2.2 Three key principles underpin Government policy in electricity generation and supply. Firstly, availability, security and diversity of supply are of topmost priority with particular focus on renewable energy; secondly, affordability is the key to ensuring socio-economic development of the country taking into account the financial sustainability of the utility and the economic soundness of decisions taken. Thirdly, energy conservation is another central plank of the energy policy, the more so as the prices of fossil fuels, in particular oil, keep on rising. Thus the triple bottom line i.e. the financial, environmental and social sustainability of the sector is the framework within which the policy aims and objectives have to be achieved.

4.2.3 It is estimated that over the next 25 years Mauritius will need to invest about Rs 80 billion on new electricity generation plants. The overriding priority will be to secure adequate investment in a properly functional market by providing the right investment climate. The close monitoring of the demand and supply balance will be required to identify any shortfall. Moreover, prior to any decision being taken, a financial and economic analysis will be required so as to gauge the impact of options being chosen.

4.3 Electricity Market Structure

4.3.1 Complete unbundling is not considered as being an option so that the criterion of affordability can always be met and IPPs, whilst being accommodated, would not be allowed to have total control of the electricity sector. For strategic reasons, the CEB will continue to generate electricity in line with the policy outlined in the Presidential Address. The role of the CEB as a player in generation of electricity and the sole agency for transmission and distribution will be maintained.

4.3.2 However, for effective regulation, it is essential that the Utility Regulator become operational. To that effect, Government will provide the necessary means to have the regulator in place by the end of 2008. This will allow the responsibility for market regulation and tariff setting to be effectively segregated from the CEB and the Ministry of Public Utilities.

4.3.3 Government will provide the necessary infrastructure for the proper development of the energy sector, whether by enlisting private sector participation or on its own.

4.3.4 Moreover, Government will examine how best to facilitate the integration of renewable electricity from individuals to the grid and in the medium-to long-term to allow households to generate electricity from home-based systems and sell any excess to the grid.

4.3.5 Safety nets are being removed on the international front and this applies to local industries as well, which as a result have to become efficient and competitive in the global market. Accordingly, the policy is to prevent the CEB to in turn become a safety net for other industries so as to ensure that the financial sustainability of the CEB does not suffer any prejudice.

4.3.6 Government is committed to provide electricity to all consumers, irrespective of their social status. In this regard, the regulatory framework makes provision for consideration of electricity tariffs for vulnerable groups so that their affordability is least affected.

4.4 Electricity Pricing for IPPs

4.4.1 The policy has been to discontinue with the use of the principle of avoided-cost to determine the purchase price of electricity from IPPs using a combination of bagasse and coal since year 2004. The price of electricity that the CEB would pay to IPPs, including bagasse-coal plants, has to be cost-reflective and competitive with any other alternative supply options. To that end and to ensure transparency, the Regulator should have unfettered

access to all relevant information on projects of all future IPPs, and this would be a *sine-qua-non* condition for the start of discussions regarding any Power Purchase Agreement (PPA).

4.4.2 As the sugar industry have significant requirements of electricity and steam for its own use for milling cane, processing sugar, including special sugar, and any ethanol production, the policy is to henceforth apportion the investment in common equipment to be used for such purposes and for the purpose of generating electricity for sale to the CEB, taking into account factors considered to be relevant by the parties concerned, so that there is no investment subsidy by the CEB.

4.4.3 However, in order to provide an incentive for bagasse-derived electricity, mechanisms to price bagasse appropriately, in competition with other alternatives, will be devised. Such mechanisms will not be based on the defunct rule of avoided cost.

4.4.4 While establishing the power sector capacity expansion plan, the policy is to give due consideration to the size and technology of power plants, the need for further diversification of the country's energy mix and other strategic issues such as the need to avoid any monopolistic situation, public or private.

4.5 Electricity from Bagasse

4.5.1 In order to accommodate extra electricity from IPPs, the CEB is obliged to shut down its power stations while its own high investment costs still have to be amortized.

4.5.2 However, while the policy of further use of bagasse for power generation is essential from the sugar sector standpoint, it is important that the use of coal in future power plants from the sugar industry is minimised. This is because any reduction in the medium-to-long term of bagasse availability may cause the substitution of the ensuing shortfall of bagasse by coal, which would be burnt at low efficiency. In this respect, it is noted that research and development in the sector is being accelerated at ACP level where Mauritius is playing a leading role to develop new varieties of sugar cane with higher biomass production.

4.5.3 Such a situation can have adverse macro-economic implications in terms of burning coal in-lieu of bagasse in bagasse-coal plants, which by virtue of their technology and design have low efficiency when using coal.

4.5.4 Moreover, environmental consequences would result from increased CO_2 emissions due to the low conversion efficiency of bagasse-coal plants when fired with coal only, as opposed to dedicated coal plants of better technology and design which have higher efficiencies.

4.5.5 Wherever bagasse-coal power generation configurations are envisaged, the new strategy is geared to increasing the amount of energy generated from whatever bagasse is available, while minimising the use of coal.

4.6 Deemed Energy/Deemed Price

4.6.1 In order to avoid situations where bagasse coal plants become purely coal fired, the policy of pricing is to consider any bagasse-energy substitution with coal as energy deemed to have been generated from bagasse. The price of such deemed energy would be the price that would have been paid for bagasse-derived energy. Accordingly, provisions would have to be contractually binding in any PPA to be entered by the CEB with any IPP.

4.7 Electricity from Coal

4.7.1 As stated earlier, coal is the only other fossil fuel available with proven reserves that can last much longer than oil, in addition to its even distribution around the globe, making it less prone to geopolitical and other associated risks and therefore less volatile in terms of prices.

4.7.2 To further diversify the country's electricity base away from oil and, given that the other alternative and reliable source is coal with proven reserves that can last at least a century and a range of technologies already available in the marketplace for its efficient conversion into electricity, the preferred strategy is to increase the share of coal in the country's energy mix.

4.7.3 In the medium term, coal would substitute oil to a great extent thereby reducing the country's dependence on oil.

4.7.4 However, to limit carbon dioxide emissions Mauritius would resort to clean coal technology. Coal fired power stations must strive to use new technologies benefiting from improved efficiency. Modern installations are capable of running at up to 40 to 45% efficiency.

4.7.5 Coal utilization in dedicated boilers with improved technology and design, already available in the marketplace, would have to substitute oil as much as possible in the country's energy mix to ensure security and diversity of supply.

4.7.6 Such a strategy would allow diversification away from oil with least uncertainty and would improve security of electricity supply in the country at lower cost than oil. The higher efficiency of dedicated coal plants would also allow the cost of electricity generation from coal to be less than from bagasse-coal plants. However, the issue of ash disposal is pertinent and would have to be addressed.

4.8 Renewable Energy in General

4.8.1 Prior to setting out the policy for renewable energy, it important to discuss the context in which it is being made. First, the gap between renewable and non-renewable energy prices is gradually decreasing as prices of hydrocarbons increase. Moreover, the use of renewable energy improves security of supply as it is locally produced, and finally tapping of renewable sources generates little or no greenhouse gases thereby bringing benefits in terms of air quality and carbon credits to the country.

4.8.2 However, investments in renewable energy are considerably higher than in conventional fossil fuel power stations. Therefore Government will prepare a long-term renewable energy Masterplan, which would be available by the end of 2008. The plan would provide the framework for further development of the renewable energy sector.

4.9 Electricity from Wind

4.9.1 In the quest to substitute as far as possible imported oil for power generation, wind power development is considered a priority. The policy is, therefore, to encourage the development of wind power in Mauritius, including Rodrigues.

4.9.2 Although wind energy technology is evolving rapidly, it must be borne in mind that for any development of wind-based power stations, only equipment which have established record on their ability to resist cyclonic winds or have survived cyclonic weather will be allowed in Mauritius. The preferred option for the installation of wind power stations will be Build Operate Own (BOO) so that risks to the country are minimized.

4.9.3 In addition, in the context of the implementation of any wind energy projects, efforts would be made to secure carbon credits so as to reduce the cost of generation, and therefore the cost to consumers.

4.10 Solar Energy

4.10.1 Mauritius is situated in the tropics and as such benefits from more than 2900 hours of sunlight per year. In order to encourage use of solar energy whether for water heating or electricity production, incentive schemes will

have to be devised so as to enable long-term goals to be achieved. The Renewable Energy Masterplan will address this issue thoroughly.

4.11 Transport

4.11.1 The main options currently being considered as per a package of eighteen measures by the Ministry of Public Infrastructure include: Improving further the attraction of public buses; Implementing the Mass Transit system; Improving significantly pedestrian and cycling facilities; Encouraging the use of small economic private cars instead of larger cc vehicles; Encouraging the use of a mix of petrol and Ethanol; Coordinating further the functions of Land Transport and Land Planning into the larger sector of Urbanism.

4.12 Ethanol

4.12.1 The MAAS has proposed that sugar factories would be centralized, coupled with the production of a minimum of 30 million litres of ethanol annually.

4.12.2 One local ethanol manufacturer is currently exporting ethanol on a regular basis to foreign markets. Export of ethanol has the added advantage of bringing foreign currency to the country and would be encouraged.

4.12.3 In this context, the establishment of an ethanol spot market similar to OPEC has been agreed during the recent US Brazil summit. This market will initially concern the Americas and Caribbean region but will eventually spread worldwide.

4.12.4 The policy of Government on biofuels is that in the current macro-economic reform context whereby subsidies on a variety of items are being re-targeted or removed, any direct subsidy on production or use of ethanol would not be warranted except in the environmental context. Biofuels would therefore have to compete with other fuels on a level playing field, with a minimum of price incentives. Their success would depend wholly on their quality, acceptance by consumers and their competitiveness.

4.12.5 It is recognized that any switch to E10 will only occur through price incentives which can only be environmental as outlined above. The price of E10 must also reflect its mileage performance and excise duties would ultimately reflect the overall competitive advantage which a shift to E10 would represent.

4.12.6 Moreover, as regards the effective implementation of any E10 programme, all petrol stations should be required to install pumps servicing E10 gasohol so that the proposed blend can be effectively delivered to consumers in future.

4.12.7 In respect of carbon credits, the revenues accruing from the sale of any possible Emission Reduction Units from biofuels use would accrue to governmental bodies which would be used to provide incentives, if any, to promote biofuels.

4.12.8 Participation by both strategic partners and sugar industry stakeholders in the equity of ethanol companies will be a hallmark of the new set up to democratize the economy. The level of participation of the various parties in the equity of ethanol companies will be the subject of mutual agreement on terms and conditions that may be shaped by the specificities of molasses production. Equity participation in ethanol companies is also part of a global strategy which aims at establishing "an organic link between two key stakeholders of the industry" and that would "ensure enhanced revenue and security to all stakeholders" as mentioned in the MAAS.

4.13 Electricity from Solid (Municipal) Waste

4.13.1 The policy with regard to the generation of electricity as a by-product of incineration of waste is that the CEB would purchase electricity from such facilities at rates which are competitive and comparable to other sources so as not to adversely impact on the financial sustainability of the CEB.

4.14 Environment

4.14.1 Environmental considerations are an integral part of the energy policy. Two main environmental aspects are of importance: first the reduction of greenhouse gases and secondly emissions to air, soil, and water from electricity generation facilities.

4.14.2 In addition, the need to address the issue of climate change is becoming more and more pressing. Therefore in future years, in order to meet targets set in the document, Mauritius will have to step up efforts in the direction of further use of renewable energies.

4.14.3 The long-term commitment to the reduction of greenhouse gases remains unchanged. Government will seek to increase revenues from carbon credits from all renewable energy projects, so that such funds may be used to realise projects which until recently were not feasible. It is implied herein that all carbon credits from renewable energy projects, including bagasse, would accrue to governmental bodies.

4.14.4 Emissions to air, soil and water from electricity generating facilities have to be minimized either by resorting to renewable sources or by applying pollution control measures. The Environmental Protection Act 2002 already covers such aspects but wherever gaps are noted in legislation, stricter European norms will be used as reference.

4.14.5 As regards the capacity expansion plan of the country, the policy is also to take into account the overall environmental impact of power project proposals, including those of IPPs. Only those proposals which comply with environmental norms would be entertained.

4.15 Demand Side Management and Energy Efficiency

4.15.1 The improvement of energy efficiency at all levels can potentially help to achieve the objectives of the energy policy of the country. However, implementing energy efficiency measures will require significant efforts in terms of investment and behavioural change. Demand side measures would be implemented as regards:

- standards for appliances,
- energy performance of buildings,
- time–of-use tariffs,
- electricity generation,
- losses in transmission and distribution systems.

4.15.2 In terms of time of use tariffs, the introduction of differential tariffs is being considered as they could flatten peak demand and reduce costs to the CEB whilst at the same time reducing the electricity bills of households.

4.15.3 As for the transportation sector, Government will look into the need to implement measures to promote the use of fuel efficient vehicles, including cars, and buses. A new mass transit system is being considered as well.

4.16 Summary

4.16.1 The policies outlined in this section concern the following topics:

- Government Policy
- Electricity Market Structure
- Electricity Pricing for IPPs
- Electricity from Bagasse
- Deemed Energy/Deemed Price
- Electricity from Coal
- Renewable Energy in General
- Electricity from Wind
- Solar Energy
- Ethanol
- Electricity from Solid (Municipal) Waste
- Environment
- Demand Side Management and Energy Efficiency

4.16.2 The next section provides a timetable for implementing measures to support the outlined policies.

5 ACTION PLAN

5.1 General

5.1.1 In this Action Plan, measures for the short-to-medium term are outlined. The long-term energy policy, which would be prepared as per the draft terms of reference at Appendix 2, will provide greater details. The Action Plan, which supports the energy policy of Government, is classified into four main sectors, namely electricity generation, regulation, policy development and transportation. Measures to promote more players in the electricity generation market are also contained in the Action Plan. In addition, a timetable is also put forward for the coming into operation of the Utility Regulatory Authority.

5.2 Electricity generation over the period 2007 – 2011

5.2.1 Following discussions with stakeholders, a timetable has been approved by Government for the coming into operation of new bagasse-coal facilities. It may be noted that letters of intent would be issued provided the projects of IPPs are in line with the policies of Government, taking into account that commissioning of a power plant takes at least 24 months.

5.2.2 It may be borne in mind that prior to reaching the timetable, the CEB carried out an in-house system cost analysis to ensure that reasonable and informed choices were made. This analysis is included at Appendix 3.

5.2.3 Table 5.1 below provides the timing of the Sugar IPPs as approved by Government.

Table 5.1 : Time Table for Sugar IPPs as per Government Decision

Year	Power Station
2007	CTSav 1&2 will be commissioned as scheduled with 74MW off crop and 65.5 MW crop season.
Mid 2008	A third and new Unit for CT SAV to come online in mid 2008 and export 15 MW of power to the CEB.
Late 2009	Fuel to add a new plant of between 20MW (crop) to 22 MW (intercrop) while keeping the existing 27 MW plant. Deep River Beau Champ to close down by then.
Late 2011	Subject to demand, Medine to come on line with of 15 MW (crop)/21 MW (intercrop).

5.2.4 Moreover, there are other projects which have been agreed by Government and in line with its policy, the timetable is shown in Table 5.2 below.

Table 5.2: Timetable for coming into operation of other power stations

Year	Power Station
2009	CT Power to come into operation with 50 MW
	Waste to Energy Plant 20 MW to be in operation at La Chaumiere *
	Wind farm to come on grid by 2009 *
2010	CT Power to come into operation with second 50 MW

* These IPPs will provide non firm power and therefore will be treated on an avoided cost basis by the CEB.

5.2.5 The report of the Monitoring committee set up to look into the cost effectiveness of using E10 will be submitted by end 2007. Recommendations regarding the use of bio-fuels in the transportation sector would be examined for implementation in mid 2008. Moreover, in the context of the introduction of the use of biofuels in the transportation sector, Government will put in place a mechanism for obtaining carbon credits which would go towards making the use of biofuels more attractive. Tentatively, it is targeted to replace at least 5% of oil used in the transportation sector by fuels derived from renewables over the period 2010-2015.

5.3 Legislation

5.3.1 The Utility Regulatory Authority Act will be proclaimed at latest by the end of 2008. Appropriate measures would be taken to set up the Authority so that it is operational when the Act is proclaimed. To that effect technical assistance would be sought so as to establish the provisions which will have to be made so that human, technical and financial resources are in place at the time of proclamation of the Act and the coming into operation of the Regulator.

5.3.2 Once established the regulatory body will proceed in its duties using this plan as a starting point. Hence the plan which has been set forth by Government will be maintained.

5.3.3 The Electricity Act will also be proclaimed in the wake of the setting up of the Regulator, i.e. within the same timeframe. It may be noted that the Regulator would also oversee the water and the wastewater sectors.

5.3.4 The Energy Efficiency Bill will be prepared with appropriate technical assistance for enactment some time in mid 2008. It may be noted that work has already started on the labeling of certain electrical appliances which would eventually be linked to the Energy Efficiency Bill.

5.4 Detailed Energy Policy and Masterplan for Renewable Energy up to 2025

5.4.1 The draft terms of reference of the detailed energy policy are annexed at Appendix 2. Discussions with the EU for financial assistance to prepare the document are underway, and it is expected that the terms of reference would be finalized by end April 2007; the study is targeted for completion by end 2007.

5.4.2 The same consultant will be entrusted with the task of preparing the Renewable Energy Masterplan. The long-term energy policy document and the Renewable Energy Masterplan are scheduled for completion by the end of 2007 and mid 2008 respectively.

5.4.3 It may be noted that a new system cost analysis will be performed as part of the preparation of the detailed energy policy document.

5.5 Summary & Conclusion

5.5.1 Measures that would support Government Energy Policy are contained in the Action Plan. Targets for the setting up of various power stations and the necessary legal framework for the regulation of the energy sector have been established. These targets are coherent with the timetable established by Government in October 2006.

5.5.2 The milestones are as follows:

- Terms of reference for long-term Energy Policy – April 2007
- Coming into operation of power stations as per Tables 5.1 and 5.2
- Proclamation of URA and Electricity Acts – end 2008
- Passing of the Energy Efficiency Bill – mid 2008
- Preparation of Detailed Energy Policy – end 2007
- Renewable Energy Masterplan – mid 2008
- Use of biofuels for transportation in Mauritius – 2010-2015

5.5.3 It may be noted that the Action Plan will pave the way for the implementation of proposed policies and is coherent with the strategy of Government for the development of the energy sector for the short-to-medium term.

5.5.4 All stakeholders should realize that no single policy, which has direct linkage to the overall energy policy should be taken on its own in isolation so as to avoid any conflict with the overall objective of the direction which has been charted. The set of policies in this document represent a paradigm shift that would allow the country to meet daunting challenges in the energy sector.

5.5.5 All the stakeholders in the energy industry have to bear in mind that there are always competing interests and that the best type of market is the open one, so that consumers can benefit from best prices. The targets for renewables have been set in an ambitious manner with sufficient lead time for them to be achieved. The policymakers are confident that in the coming years the appropriate technology will become available at affordable prices.

5.5.6 As a concluding note, it must be said that the energy policy of the country has the root objective of making Mauritius energy efficient, where for each unit of GDP produced, minimum energy is used and accordingly minimum carbon dioxide emitted to the atmosphere.

Appendix 1

DEMAND AND SUPPLY FORECASTS FOR UP TO YEAR 2013

EPP Capacity balance

Year	2006	2007	2008	2009	2010	2011	2012	2013
CEB								
St. Louis (-5MW yearly as from 2008)	70,0	70,0	65,0	60,0	55,0	50,0	45,0	40,0
Fort Victoria I (-20MW 2006)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Fort Victoria II (-17MW 2017)	17,0	17,0	17,0	17,0	16,0	16,0	16,0	16,0
Fort George (-21MW 2017,-21 2018),	128,0	128,0	128,0	128,0	123,0	123,0	123,0	123,0
Nicolay (Not retired over planning period due to low run hrs expected)	74,0	74,0	74,0	74,0	74,0	74,0	74,0	74,0
New Plant addition Semibase (30 FV 2008+……..)								
New Peak plant								
Hydro (Average of 59MW installed)	25,0	25,0	25,0	25,0	25,0	25,0	25,0	25,0
Sub Total	314,0	314,0	309,0	304,0	293,0	288,0	283,0	278,0
F.U.E.L.	27,0	27,0	27,0	27,0	27,0	27,0	27,0	27,0
FUEL New 20 MW				20,0	20,0	20,0	20,0	20,0
Beau Champ	22,0	22,0	22,0	0,0	0,0	0,0	0,0	0,0
Belle Vue	62,0	62,0	62,0	62,0	62,0	62,0	62,0	62,0
CTDS	30,0	30,0	30,0	30,0	30,0	30,0	30,0	30,0
CTSav		74,0	74,0	74,0	74,0	74,0	74,0	74,0
CTSav 3 15 MW			15,0	15,0	15,0	15,0	15,0	15,0
Medine						18,0	18,0	18,0
Waste to energy				20,0	20,0	20,0	20,0	20,0
CT Power new IPP Coal				50,0	100,0	100,0	100,0	100,0
CPP retirements		-15,0	-15,0	-25,0	-25,0	-30,0	-30,0	-30,0
Sub Total	141,0	200,0	215,0	273,0	323,0	336,0	336,0	336,0
Grand Total Effective	455,0	514,0	524,0	577,0	616,0	624,0	619,0	614,0
Breakdowns	35,0	35,0	35,0	50,0	50,0	50,0	50,0	50,0
Maintenance (Scheduled)	60,0	60,0	60,0	60,0	60,0	60,0	60,0	60,0
Effective Capacity available	360,0	419,0	429,0	467,0	506,0	514,0	509,0	504,0
To date May 06 Forecast	365	382	401	420	437	456	478	503
Peak plus10% Spinning reserve	402	420	441	462	481	502	526	553
Capacity margin	-42	-1	-12	5	25	12	-17	-49

EPP ENERGY balance (GWH)

Year	2006	2007	2008	2009	2010	2011	2012
C.E.B.							
St.louis(-10 2009, -10 2011,-5 2012, -5 2013) peaking only as from 2009 retire 2014	75	90	75	20	15	15	15
New St Louis 41MW(2006)	210	190	150	125	125	110	125
F.Victoria 1(Mirrlees) peaking emergengy only 2006 retire 2009	0	0	0	0	0	0	0
F.Victoria 2(M.A.N.)	80	80	80	40	40	55	60
F.George 1	125	110	110	80	50	60	60
F.George 2	125	110	120	90	50	60	60
F.George 3	135	125	120	90	70	60	70
F.George 4	135	130	120	90	70	60	70
F.George 5	135	130	125	90	70	60	70
Nicolay	25	21	22	25	26	22	25
Hydro(normal year)	90	90	90	90	90	90	90
Sub/total CEB Generation	1135	1076	1012	740	606	592	645
Used on works CEB	45	43	40	30	24	24	26
CEB Sent Out	1090	1033	972	710	582	569	619
IPP/CPP							
CTDS 30MW	200	180	200	175	175	175	200
CTSav 74MW (2007)	0	350	400	350	300	350	400
FUEL new 20MW	0	0	0	330	300	300	330
Medine						120	120
C.E.L.	110	110	110	0	0	0	0
C.T.B.V.	375	325	350	325	325	325	325
F.U.E.L.	160	160	160	0	0	0	0
CTSav 3	0	0	110	110	110	110	110
Waste project				140	140	140	140
Proposed CT IPP (50MW 2009,50MW 2010)			0	330	660	660	660
S.E.(Continuous) (2007 -12,2011 -18,2012 -24)	140	92	76	40	40	20	20
Sub/total IPP sent out	985	1217	1406	1800	2050	2200	2305
Forecasted sent out	2075	2250	2378	2510	2632	2769	2924
Line losses	195	203	204	211	216	224	234
Sales forecast	1928	2047	2173	2299	2416	2544	2690

APPENDIX 2

DRAFT TERMS OF REFERENCE FOR THE PREPARATION

OF

THE DETAILED LONG TERM ENERGY POLICY FOR THE REPUBLIC OF MAURITIUS

Energy Policy for Mauritius, 2007-2025

Terms of Reference

1. The Mauritian Economy

The Republic of Mauritius has set an ambitious objective to move away from a 'preference based' economy to one which will be globally competitive. In order to achieve this objective, it has embarked on a major programme of reforms with the following main thrusts:

(i) the opening up of the economy to encourage and attract investment, know-how and technology;

(ii) the overhauling of the present investment environment through the Business Facilitation Act so as to place Mauritius within the top 10 countries in the Doing Business Report; and

(iii) the re-structuring of the economy through the re-engineering of existing sectors such as sugar, tourism, textile and encouraging the emergence of new cluster of activities around the Seafood Hub, Duty Free Shopping, Knowledge Hub, Information and Communication Technology, Integrated Resorts Schemes, etc.

In order to sustain the objective of becoming globally competitive, Mauritius has to upgrade its entire infrastructure facilities as well as develop a coherent energy strategy. In this respect, the outline energy policy for the horizon up to 2025 has been prepared by Government in consultation with stakeholders such as the Ministry of Finance and Economic Development, the Ministry of Agro-Industry and Fisheries and the CEB amongst others.

The background taken into account in preparing the document included the Multi Annual Adaptation Strategy for the Sugar Industry which was submitted to the EU. The proposed energy policy would have to follow the thrust of the outline and be more comprehensive in its approach.

2. Overall Objectives

The main objectives of Government in preparing a National Energy Policy are to:

(i) Broaden the energy base of the country so as to reduce dependence on imported energy carriers thereby limiting the vulnerability of the Republic of Mauritius to imported fossil fuels and their volatile prices while factoring in a reasonable tradeoff relating to the costs of such a policy relative to the risks;
(ii) Allow optimal use of local and renewable energy sources by ensuring that any alternative energy projects (e.g. ethanol) are evaluated on the basis of providing benefits to consumers
(iii) Enhance protection and preservation of the environment, in particular the reduction of the emission of greenhouse gases;
(iv) Promote energy efficiency including in the Transportation sector;
(v) Provide affordable energy to all sectors of the economy while ensuring the financial sustainability of the electricity public utility.
(vi) Provide for transparency in Independent Power Purchase agreements
(vii) Promote economic growth and job creation by ensuring reliable supply of energy at internationally competitive prices;
(viii) Democratize energy supply by opening up the provision of power to new entrants by developing a transparent and open system that encourages new entrants including SMEs to compete to offer energy products.

These objectives must be underpinned by real targets in terms of reduction in the use of fossil fuels, enhanced use of local and renewable sources, improved energy efficiency and the reduction of emission of green house gases arising from energy consumption.

Given the limited global oil reserves, it is important to chart out an energy policy and formulate strategies for the short-to-medium and long term that would reduce, as far as possible, the reliance of the country on imported oil for electricity production and transportation. However, any such policy needs to be balanced and should factor in long term fuel prices after removing volatility.

In this regard, it is considered that the policy framework should be multi-pronged, in keeping with the constraints that the country has, in terms of its geographical location, availability of other less volatile and better distributed reserves of fossil fuel such as coal, energy resources available locally and the availability and competitiveness of technologies in the marketplace for their conversion into electricity and for use in transportation and industry.

In addition, in formulating the energy policy the following essential criteria have to be taken into account:

(i) future energy demand;
(ii) economic reforms;
(iii) energy production at prices that are internationally competitive and that require no subsidy from taxpayers except for an explicitly calculated and transparent environmental and/or social benefit;
(iv) economic and financial viability of all public sector operators, particularly the CEB;
(v) the imperative to attract foreign investment into the country including the energy sector;
(vi) environmental considerations;
(vii) sugar sector reforms and linkage to electricity generation; and
(viii) transportation and industrial development policies and linkage to energy use

3. Current Regulatory Framework

The current regulatory framework consists of the CEB Act and the Electricity Act 1939 as amended to be replaced by the Electricity Act 2005. Other relevant legislations pertain to the Sugar Industry, namely the Sugar Industry Efficiency Act, as amended in 2007, and the Environment Protection Act 2002.

Relevant policy documents include:

1. Outline Energy Policy 2007-2025
2. Presidential address 2005
3. Multi Annual Adaptation Strategy 2006 – 2015
4. White Paper for Environment Policy 2007
5. National Environmental Strategy 1999
6. Port Masterplan 2002-2025
7. Integrated National Transport Strategy Study 2001
8. Consensus Paper on Transport 2006

4. 3. The Energy Policy Document

The Energy Policy is expected to cover the following:-

(i) an energy sector vision up to 2025, in line with existing strategic policy;
(ii) strategic priorities for Government to take timely decisions with a view to ensuring security of energy;
(iii) improved legal and regulatory framework to promote private sector investment in an open, competitive and transparent manner in line with best international practice;

(iv) policies to address environmental and social impacts related to the energy sector that are explicit, transparent and costed with a direct link to the green taxes required to pay for such subsidies;
(v) state-of-the-art technologies to achieve efficient energy use taking account of economic and financial viability; and
(vi) awareness about the issues/options/challenges and ensure all stakeholders participation for sustainable development.

5. Terms of Reference

The Terms of Reference are broken down into two parts. First the immediate requirement in terms of energy policy and secondly in depth studies which will be conditional upon certain conditions being met at the end of the first phase. Throughout the assignment, the Consultant is expected to refer to the document Outline Energy Policy 2007 to 2025 Towards a Coherent Strategy for the Development of the Energy Sector in Mauritius as it provides the gist of Energy policy adopted by Government in April 2007. The Consultant will be expected to consult stakeholders including the Ministries, parasatal organizations, and NGOs concerned, as directed by the Client, during the preparation of the policy document.

The issues that will need to be addressed by the Consultant in the first phase of the assignment comprising the development of an Energy Policy for the Republic of Mauritius shall include, but not be limited to, the following:

Part I: Elaboration of Energy Policy:

1. **Economic and Financial Analysis**
   (i) To assess economic and financial implications of the various options and issues discussed in sections 2 through 8 below;
   (ii) To evaluate the economic, environmental and financial costs and benefits of proposed IPPs plants relative to the plans of CEB

2. **Energy Supply**

   (i) To identify and analyse the challenges, opportunities and threats faced by Mauritius in terms of availability, reliability, transportation and prices of primary sources of energy; and
   (ii) To formulate the policy and strategic orientations for ensuring the security, reliability, diversity and quality of supply, including:

      a. options for the right energy mix and strike a balance between renewable and non-renewable sources of energy taking account of costs, balanced risk assessment and need to produce energy at internationally competitive prices;

b. the role of IPPs in the overall context and to highlight the opportunities and threats they may represent to the national interest, particularly what is required to ensure an open and transparent system for considering their offers;
c. an assessment of the sectoral energy prices as well as its implication on the country's international competitiveness; and
d. energy pricing strategies based on affordability to end-users and financial sustainability of the electricity public utility.

3. Energy Utilisation

(i) Review the demand and supply matrix and power sector capacity expansion plan for energy up to 2025 taking into account the need for green taxes and measures to induce conservation; and
(ii) Assess sectoral energy use and advise on state of the art technologies with a view to encouraging efficient use of energy so as to maintain the country's international competitiveness.
(iii) Propose policies for implementing energy efficiency in the transportation sector and in electricity including reduction of losses in transmission and distribution.
(iv) Develop a policy framework and suggest models for the development of an Energy Efficiency Bill

4. Electricity Sector

(i) Ascertain the operational and technical inefficiencies of the present generation facilities and their viability of remaining into operation;
(ii) Determine the least cost economic dispatch/load of electricity generation, transmission and distribution
(iii) Advise on the type, sequencing and timing of new generation facilities and assess the cost implications for consumers
(iv) Suggest reservation prices based on the above analysis which IPP proposals would not be considered; and
(v) Propose an investment programme for the new generation facilities based on the above analysis with due regard to protecting consumers and ensuring financial sustainability of the electricity utility.

5. Transportation

(i) Propose a biofuels policy in line with the Mauritian context and outline policy
(ii) Identify the strategic options for introducing different types of biofuels including E10, E20, biodiesel and recommend the best possible course of action taking into account the economic context

(iii) Assess the possibility in the long term for equal taxation of carbon emissions from various sources of fuel;
(iv) Review major aspects of land transport (public and private) and identify policies that would enhance efficiency and energy saving in the sector in the short term, taking into account social acceptability.
(v) To chart out a biofuels strategywhich will be an integral part of future energy policy

6. Environmental Aspects

(i) Identification of strategic priorities for availability of sustainable energy for end users based on -
- the supply of renewable sources of energy and improved energy efficiency;
- introduction and/or expansion of existing green taxes to reduce environmental impacts
- sustainable transport systems;
- public awareness campaign on efficient use of energy;

(ii) To assess the environmental impact of future energy production, distribution and use on both climate change and local environment;
(iii) To devise incentives for enhanced use of renewable energy or disincentives for fossil fuel based electricity generation;
(iv) Identify means and ways of introducing demand side management and promote research into technology appropriate for the context of Mauritius and Rodrigues.

7. Institutional and Regulatory Framework

(i) Review the present policy and institutional framework in the energy sector based on the findings of the study and make proposals for changes therein to enhance their effectiveness.
(ii) Harmonize and improve the legal and institutional framework with a view to clarifying the roles and responsibilities of the different energy agencies and to provide high degree of transparency and clarify for private sector participation and PPP projects in the energy sector.
(iii) Propose institutional and regulatory changes (and if necessary legislative action) to ensure an open, transparent and competitive process for seeking and selecting private sector involvement in the production of energy products;
(iv) To suggest how the Regulatory Body should, as and when required, carry out its due diligence to assess the viability of new projects, submitted in fulfilment of Government policy objectives, and their impact on tariffs while safeguarding the interests of all stakeholders including taxpayers and consumers.

8. Action Plan

(i) Develop a practical and coherent action plan for the ensuing years till 2025 based on economic, financial, social and environmental sustainability.

(ii) The Action plan shall provide definite specific, measurable, achievable and realistic targets for the short, medium and long term i.e. for years 2010, 2015, 2020, 2025, 2050 in relation to

a. Implementation of biofuels (including ethanol) policy
b. Promoting efficiency in the transportation sector
c. Implementing the Energy Efficiency Bill
d. Construction of power plants
e. Energy and Electricity Mix

In so doing, the Consultant shall review targets set in the Outline Energy Policy 2007 to 2025 Towards a Coherent Strategy for the Development of the Energy Sector in Mauritius and adjust them if necessary

Part II: Further Detailed Studies

Additional studies which may form a second part of the assignment subject to satisfactory completion of the first part of the consultancy services and availability of funds include:

(i) A Masterplan for Implementation of Renewable Energy Policies taking into account economic and financial analysis

(ii) Preparation of a strategic environment assessment of the Energy Policy;

(iii) Develop an Energy Efficiency Bill appropriate to the Mauritian Context

6. Time Frame

The study should be completed within a period of 6 months.

7. Reporting

A Steering Committee, chaired by the Ministry of Public Utilities and comprising amongst others, of representatives of the CEB and Ministry of Finance & Economic Development, will supervise the project. The Consultant shall report to the Committee during the study.

8. Workshop

The Consultant shall submit his recommendations, the rationale behind those recommendations and their implications to Government in a workshop.

9. Deliverables

The following documents shall be submitted by the Consultant:

Deliverables	Date due (after recruitment of the Consultant)
Draft Inception Report	3 weeks
Draft final Inception Report	6 weeks
Inception Report	8 weeks
Draft Energy Policy document and Action Plan	16 weeks
Draft Final Energy Policy document and Action Plan	20 weeks
Final Energy Policy document and Action Plan	24 weeks

All deliverables, whether draft or final, shall be submitted in three hard copies together with a soft copy in Word format on CD.

10. Expertise Required

The core team of experts required shall be as follows:

1. Energy Policy Specialist
2. Power Specialist
3. Financial/Economic Analyst
4. Environmental Economist/Specialist
5. Transport Economist/Specialist
6. Institutional and Regulatory Expert

APPENDIX 3

SYSTEM COST ANALYSIS FOR THE CEB

Methodology and rationale for the assessment of expansion scenarios for the Mauritius Power Sector in the context of the Capacity Expansion Plan 2006-2013

Prepared by

Central Electricity Board

and

Ministry of Public Utilities

April 2007

1.0 Introduction

Following the submission of the paper entitled Electricity Generation Policy and Power Sector Expansion Plan for 2006-2013, a request was received to provide further details on the approach used to analyse the proposals contained in that document. Accordingly, this paper prepared by the CEB and the Ministry of Public Utilities describes the approach and methodology used in assessing different scenarios resulting from a set of proposals received from the private power sector.

Within the present Government policy framework and constraints in the Central Electricity Board (CEB) generation dispatch system, plausible scenarios were derived and assessed. Projects proposed vary in nature and technology with their specificities.

An in-house Excel generation model has been developed for this purpose. Results produced have given very good indications of the cost impact of the scenarios. The results are comparable in this specific context under a set of reasonable assumptions at time of the study. Only pre-feasibility figures and information available at the time of this study has been used. As it is crucial to ensure the financial viability of the CEB and the country's economy at large, results provide a comparative insight to decision makers to make informed decisions.

2.0 Background

In view of the serious challenges posed by the hiking up of oil prices and the rising cost of energy, Government has reviewed the energy policy for meeting the future requirements of the country.

Consequently the previous Electricity Plans prepared prior to 2005 are now superseded. The proposed policies will be the drivers of developments in the Energy Sector.

The Presidential Address in 2005 set the tone for the future policy guidance for the electricity generation sector. The key for the CEB is its financial sustainability, which is intimately linked with a diversification of the energy basket and providing affordable electricity to the customers to enable the economy to forge ahead.

By encouraging the optimal use of bagasse as fuel and other renewable sources, this will largely benefit the country's economy in reducing the foreign exchange cost for servicing the energy bill, availing revenues from carbon credits and bringing efficiency to the sugar production activity that is so vital to Mauritius.

In the wake of this new plan, Government will actively seek to engage in strategic partnerships, which would guarantee the financial sustainability of the CEB and would be in accordance with the declared policy of Government to increase its share in the generation sector.

3.0 Methodology

3.1 Demand forecast

In many power utilities, it is common practice to derive the electricity sales forecast from available GDP forecasts because it is known that growth in the electricity demand is related to growth in the economy. However, in the present context, such an approach is not deemed appropriate because it is believed that a ten-year GDP forecast, if available, would not be reliable enough in a fast-changing economy like ours.

Therefore, the method adopted by the CEB to forecast the electricity sales (GWh) and capacity demand (MW) over the long-term does not use GDP as input. This approach is supported by the fact that energy demand has been growing faster than GDP over the past decade. While GDP has grown by 85% from 1992, electricity sales have grown by 166% over the same period. Hence GDP and Energy growth are decoupled in our economic context (Refer to Graph 1).

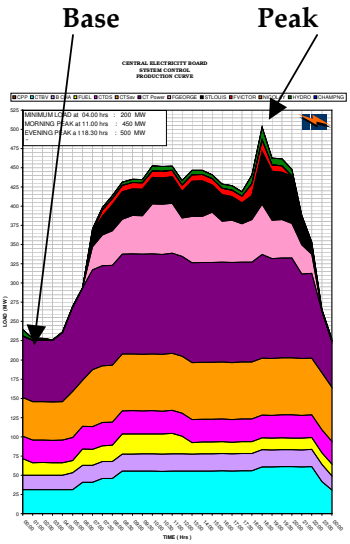
The CEB's approach consists of forecasting the energy requirement based on trends in customer numbers and specific consumption by customer category. Major development projects that have a direct or indirect incidence on electricity consumption over the short-term are also taken into account. The capacity requirement is then derived from the energy by applying an energy-to-power regression formula. The result from this technique has been validated against a secondary method that makes use of expected changes in load duration curves over the planning horizon (CEB, 2006).

Demand forecast 2006-2013

Year	2006	2007	2008	2009	2010	2011	2012	2013
Peak Power (MW)	365	382	401	420	437	456	478	503
Annual Increment (MW)		17	19	19	17	19	22	25
Energy demand (GWh)	2129	2250	2378	2510	2632	2769	2924	3092
Annual Increment (GWh)		121	128	132	122	137	155	168

Source: CEB Load forecast 2006-2013

3.2 Demand pattern



The side figure illustrates a typical daily demand curve. The highest peak is the maximum power demand and the area under the curve represents the total energy dispatched. Each colour highlights the individual contribution of each power plant. This demonstrates the uneven nature of the daily demand profile.

The daily minimum power is about 175 MW average base load and 350 MW peak -- that is, a ratio of about two between the peak and the minimum demand. This indicates that we need about 175 MW of modulable capacity which can be switched on and off daily therefore providing greater flexibility. The IPP plants run continuously and cater for the base demand only and have limited flexibility whereby their output can be reduced to 30% to 50% only.

The CEB plants cater for the partly for the semi base and wholly for the peak demand requirement and the system reserve margins required for maintenance and breakdown. By virtue of their technology, the IPP coal/bagasse plants cannot be started and stopped at leisure.

Hence they cater for the base demand, while the CEB heavy fuel diesel generators supply the semi base and peak demand. As per the forecast, some 150 MW of new capacity, both base and semi base, will be required over the period up to 2013 in order to meet demand.

3.3 Present situation

In 2006, the CEB registered a peak power demand of 367 MW and supplied some 2090 GWh of energy with some 455 MW of effective capacity available. More than 50% of generation came from fuel oil only. This justified the shift to coal/bagasse from a financial and economic standpoint. In that year, Fort George power station, the only oil base load plant provided for about 32 % of power needs alone (Figure A).

Figure B in the annex shows a typical load duration curve. Total energy demand is made up of some 50 % of base energy, 45 % semi base energy and 5 % of peak energy.

It is interesting to note that the average growth in peak demand is twice as much as the base demand (Figure C). This warrants the introduction of more semi base plants. But with the high oil price, high fixed cost coal/bagasse plants can now compete favourably with diesel plants even at load factors as low as 40 to 50 % utilization factor (Figure D).

With the prevailing high price of fuels, the marginal cost of electricity from coal is **half** that from fuel oil. Figure E shows that the evolution of our fuel mix is clearly away from fuel oil. Hence the justification to favour coal in the base load and limit fuel oil generators to semi base and peak operation. However, the

investment cost in new plants against repayment of loans and depreciation of existing asset must be carefully accounted.

At present some 140 MW are supplied by Independent Power Producer (IPPs) in the system. In all, about 340 GWh of electricity is derived annually from bagasse from the cogeneration plants of the sugar factories. There is still scope to increase the total output from bagasse to a maximum of 600GWh annually by increasing the efficiency of the IPPs. This in itself represents a potential national foreign exchange saving of some 20 Million USD in the annual energy bill. It must be highlighted that this increase in bagasse output will have to be accompanied by almost an equal amount of coal-based energy. Base and semi base energy actually derived from Fort George power plant will be thus displaced, reducing our dependency on fuel oil.

3.4 Proposals from IPPS

To meet demand, the CEB had elaborated an expansion plan where it proposed to redevelop its existing Fort Victoria medium speed diesel oil plant (30MW) along with a 2 X 50MW new coal power plant at a green field site and delay the retirement of some of its medium speed diesels. We call this the Base Case.

The sugar industry proposed to install 4 X 42MW of new coal/bagasse plants similar to those already in construction at the Savannah plant. This would be more than enough to meet demand, but would have high financial impact on the overall generation cost. This is termed Scenario 1.

After protracted discussions at various technical meetings with all stakeholders it has been concluded that the sugar industry can meet the centralization objective while raising the bagasse energy output to the 600 GWh target with only 35 MW net of new installed capacity (15MW at Savannah, 20/22 MW at FUEL and 15/21 MW at Medine with the existing 20MW at CEL Beau Champ closing down). This is termed Scenario 2 in this report.

This would allow lower capital investment and make room for higher efficiency coal dedicated plants to be pursued. Screening curve, figure D, illustrates the higher efficiency and lower cost of the dedicated coal plant. Hence a 2 X 50 MW coal plant will be set up as an IPP with the CEB as equity partner under this Scenario 2.

A waste to energy project is also under consideration for 20 MW and about 150 GWh of energy would be made available. This project is an alterative to landfill and the energy generated there from is a spin off, and therefore will be simple energy take and the capacity is not considered firm as it is largely influenced by feed rate and quality of waste. It will not be appraised in this study, as this requires a full economic analysis including the waste disposal and environmental aspects.

Similarly a 25MW wind farm project has also been proposed and will be considered according to its merit in due course.

3.5 Summary of Scenarios

The three scenarios for which the system generation cost over 2006-2013 have been calculated are: -

- Base Case Scenario

  - 30 MW of medium speed diesel at Fort Victoria in 2008
  - 50 MW of Coal fired plant at new site in 2010
  - 50 MW of Coal fired plant at new site in 2012

- Scenario 1, all sugar proposal

  - 42MW of Coal/bagasse fired plant at Savannah in 2008
  - 42MW of Coal/bagasse fired plant at FUEL in 2009
  - 42MW of Coal/bagasse fired plant at FUEL in 2010
  - 42MW of Coal/bagasse fired plant at Medine in 2011

- Scenario 2, compromise

  - 15 MW Coal/bagasse fired plant at Savannah in 2008
  - 20/22MW of Coal/bagasse fired plant at FUEL in 2009 (conditional to existing 20MW at CEL Beau Champ closing down)
  - 15/21 MW of Coal/bagasse fired plant at Medine in late 2011
  - 50MW new coal fired plant in 2009
  - 50MW new coal fired plant in 2010.

3.6 Detailed Methodology for Scenario Analysis

The methodology used for analysis comprises first an assessment from the technical angle. In this respect, the supply demand matrix is used to establish the demand/supply balance, whereby account is taken of the criteria in line with prudent electricity supply practices in terms of reserve CEB needs for programmed maintenance, unexpected breakdowns and instant fluctuations in demand, met by what is commonly called spinning reserve capacity.

After arriving at the demand supply balance, a financial exercise is undertaken to determine the cost implications for the CEB whereby the total costs of generation over the period 2006-2013 are determined for the base case and for each scenario;

Then the implications for the country in terms of the foreign exchange outflow for fuel import for the base case and for each scenario are determined. It may be noted that the foreign currency outflow for equipment purchase and transfer of return on foreign equity is not assessed for lack of sufficient information in the project proposals.

Thus the study of the costs associated with the 3 scenarios and the base case have been undertaken, with respect to:

- Generation costs;
- Possible revenue from carbon credits; and
- Forex outflow with regard to coal and fuel oil imports only.

3.6.1 Capacity balance

Table A illustrates a typical static capacity balance meeting demand. Allowance is made for retirement of old plants, 10% of spinning reserve, and about 100MW for maintenance and breakdown reserves.

3.6.2 Energy balance

Table B illustrates a typical energy balance after introducing the new plants under a specific scenario. Allowance is made for energy used on works, transmission and distribution losses and contractual requirements under the current take or pay contracts. This is worked out to match the requirement of base, semi base and peak energy as dictated by the load duration curve. Economic dispatch of plants as per their merit order is also ensured.

3.6.3 Assumptions

In analyzing the scenarios, certain essential assumptions have been made in order to be able to compare and analyse the projects. Thus all costs have been determined in constant rupees and constant US dollars, where applicable, with an exchange rate of Rs 31 to the dollar and Rs 40 to the Euro. No costs have been escalated given that the forecast of the price of commodities such as oil and coal, which have significant weightage in the cost structure, cannot be done with certainty, and any attempt to do so would be merely speculative or guess work. Furthermore, no discounting of costs has, therefore, been carried out.

Other assumptions have also been made when applying the above methodology. These are:

- A constant price model is used to compute the cumulative generation cost over the period 2006-2013 without assuming escalation and discount factors

- The annual generating cost is calculated using the fixed, variable and financial costs

- Prices used for the existing CEB and IPP plants are at 2006 economic conditions except for CTSav, which is at 2007

- Prices for coal and waste to energy proposed plants are based on pre-feasibility offers (Information submitted by the promoters are insufficient to make proper comparative analysis. Therefore more accurate analysis will have to be conducted after feasibility studies are completed)

- Financial and operating costs for the proposed plants from the sugar industry are based on CTSav submissions

- Cost for the new CEB coal units are assumed to be similar to the CT Power proposal and the proposed Fort Victoria project cost is taken from the CEB consultant's feasibility study

- CO2 emission avoided with bagasse and municipal waste electricity generation: 1.5 kg/kWh; and potential credit for CO2 avoided: 10.5 EUR/tonne of CO2 (70% of current EU rate)

- Fuel oil price used is 357 USD per tonne (equivalent to USD 71/barrel) and Coal price of 55USD per tonne

- Exchange rates: 1 Euro = Rs 40 and 1 USD = Rs31

- Growth of energy demand: 6.2% per annum

- Growth in capacity: 4.5% per annum

- Prices for all IPPs are assumed as per 2006 tariff

- Operation cost for existing plants CEB plants as at 2006 used

- Yearly finance charges and depreciation cost of CEB assets is also considered.

3.7 Generation cost simulation

For each scenario, the total generation cost has been calculated using an in-house Excel calculation model over the period 2006-2013 based on current demand forecast and prevailing economic conditions.

The methodology consisted in working out a Capacity balance table to meet power demand, then calculating the corresponding Energy dispatch and finally computing the Total cost of generation for all the years in the study.
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4.0 Results

The results of the analysis are presented in the table below. It is seen that Scenario 2 is marginally more expensive to the CEB than the base case,

Summary of estimated costs over period 2006-2013

	CEB Base	Scenario 1	Scenario 2
	Rs (billion)	Rs (billion)	Rs (billion)
Total Generation Cost	57,24	60,65	57,26

The Ranking of the proposals is as follows in terms of cost to the CEB only: -

1. CEB base case
2. Scenario 2
3. Scenario 1

5.0 Conclusion

Scenario 1 comprising all initial proposals from the Sugar Industry is the most expensive one and is therefore discarded. Scenario 2, which comprises 3 power plants from the sugar sector and two coal fired plants, is marginally more expensive than the CEB base case, and has the advantage of accommodating all the stakeholders, thereby enabling the optimal use of bagasse while reducing our dependency on fuel oil. In addition, the CEB's dire financial situation would not allow such huge investment without the private sector participation. Hence this solution is retained and recommended.