ENERGY EFFICIENCY POTENTIAL IN JAMAICA:
CHALLENGES, OPPORTUNITIES AND STRATEGIES FOR IMPLEMENTATION

Ministry of Energy and Mining
Government of Jamaica

UNITED NATIONS

ECLAC

Federal Ministry
for Economic Cooperation
and Development

giz

Project document

Energy efficiency potential in Jamaica: challenges, opportunities and strategies for implementation

Al Binger

UNITED NATIONS

ECLAC

Ministry of Energy and Mining
Government of Jamaica

On behalf of
Federal Ministry
for Economic Cooperation
and Development

giz

Comisión Económica para América Latina y el Caribe (CEPAL)

This document was prepared by Al Binger who was assisted by Dr. Devon Gardner for the Economic Commission for Latin America and the Caribbean (ECLAC), in the framework of a technical cooperation programme with the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and financed by the Federal Ministry for Economic Cooperation and Development (BMZ).

The paper is in fulfillment of the work prepared by Dr. Detlef Loy under a previous cooperation action between ECLAC and the Caribbean Renewable Energy Development Project (CREDP) of GIZ.

The work was carried out under the supervision of Mr. Manlio F. Coviello, Chief of the Natural Resources and Energy Unit of ECLAC and Dr. Charmaine Gomes, Coordinator of the Sustainable Development Unit at ECLAC Office for the Caribbean.

The document preparation and related activities have been carried out under close coordination and review of the Ministry of Energy and Mining, with the direction of Mr. Fitzroy Vidal, Senior Director of Energy of Jamaica.

LC/W.394

Printed at United Nations, Santiago, Chile.

Contents

Tables

Figures

Maps

Diagrams

Ilustrations

Acronyms

ADO	Automotive Diesel Oil
AFI	Approved Financial Institution
BOE	Barrel of Oil Equivalent
BSJ	Bureau of Standards Jamaica
Btu	British thermal unit
CARICOM	Caribbean Community
CC	Combined Cycle
CDM	Clean Development Mechanism
CEM	Certified Energy Manager
CEIS	Caribbean Energy Information System
CHP	Combined Heat and Power
CI	Commercial and Industrial
CNG	Compressed Natural Gas
CO_2	Carbon Dioxide
DBJ	Development Bank of Jamaica
DG	Distributed Generation
DOE	Department of Energy (US)
DSM	Demand Side Management
EAST	Energy Audits for Sustainable Tourism
ECE	Energy Conservation and Efficiency
EER	Energy Efficiency Ratio
EEU	Energy Efficiency Unit
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GOJ	Government of Jamaica
GWh	Giga Watt hours
HFO	Heavy Fuel Oil
HOV	High Occupancy Vehicle
IDB	Inter-American Development Bank
IEA	International Energy Agency
IPP	Independent Power Producer
ITC	Investment Tax Credit
JDSMP	Jamaica Demand Side Management Programme
JEP	Jamaica Energy Partners
JIE	Jamaica Institution of Engineers
JPS	Jamaica Public Service Company
JUTA	Jamaica Union of Travellers Association
JUTC	Jamaica Urban Transit Company

KMTR	Kingston Metropolitan Transport Region
KWh	Kilo Watt hours
LCEP	Least Cost Expansion Plan
LED	Light Emitting Diode
LNG	Liquified Natural Gas
LPG	Liquid Petroleum Gas
MCPH	Marubeni Caribbean Power Holdings
MEM	Ministry of Energy and Mining
MTW	Ministry of Transport and Works
MW	Mega Watts
MWh	Mega Watt hours
NHT	National Housing Trust
NWC	National Water Commission
N_2O	Nitrous Oxide
NOx	Oxides of Nitrogen
OLADE	Latin American Energy Organization
OPEC	Organization of Petroleum Exporting Countries
OPM	Office of the Prime Minister
OTEC	Ocean Thermal Energy Conversion
OUR	Office of Utilities Regulation
PCJ	Petroleum Corporation of Jamaica
PPA	Power Purchase Agreement
REP	Rural Electrification Programme
RET	Renewable Energy Technology
SIDS	Small Island Developing States
SME	Small and Medium Enterprises
SRC	Scientific Research Council
T12	Tubular fluorescent lamp 12 × 1/8”
T8	Tubular fluorescent lamp 8 × 1/8”
UNDP	United Nations Development Programme
UN ECLAC	Economic Commission for Latin America and the Caribbean of the UN
UWI	University of the West Indies

Summary

The Barbados Programme of Action (BPoA) for Small Island Developing States (SIDS) identifies energy management as a critical issue in achieving sustainability. Like many of the small islands states, Jamaica is economically vulnerable to external factors such as fluctuations in energy prices, a consequence of an over dependence on imported oil. Securing supplies of affordable and reliable energy is an essential element of economic and social development. In Jamaica however, energy systems and energy use are inefficient and expensive and add to national economic vulnerability.

Jamaica is endowed with significant renewable energy resources that provide a base for reducing their dependence on high-cost, environmentally damaging fossil fuels. The benefits of using renewable energy are at least fivefold: a clean, green, dynamic image and marketing tool for the country; the preservation of natural and tourism resources; economic benefits via the reduction of imports (of which oil is a major component), thus saving scarce foreign exchange; creating employment and generating new income; and providing cheaper and more reliable energy for businesses and individuals.

The problems associated with such heavy reliance on fossil fuels have promulgated an energy policy that promote energy conservation and efficiency in the energy conversion (electricity generation and petroleum refining) and end use (industrial, commercial, household and transport) sectors. Energy efficiency initiatives are most promising activities for reducing GHG emissions and energy costs of sustained growth as well as increasing energy security in Jamaica, within the short to medium term; Jamaica "wastes more than half the available energy" in the imported fuels and has a comparatively high energy per unit of GDP as a consequence. The Government of Jamaica must be commended for efforts towards mainstreaming energy efficiency into the energy and development policies via the National Energy Policy (2009 2030); the Addendum on Energy Conservation and Efficiency (2008-2022), now updated to the draft National Energy Conservation and Efficiency Policy 2010-2030; and the Vision 2030 Jamaica (National Development Plan).

With respect to over two decades of discussions aimed at giving energy efficiency and renewable energy more prominent positions in the energy economy however, Jamaica has been lagging. A major factor underlying this state of affairs has to do with the behaviour of the society as a whole. Jamaica is a high consumption society in which choices in home design; household appliances; motor vehicle, and other personal commodities are hardly driven by efficiency considerations. In fact, the perception is that the Jamaican public has a relatively low awareness of the important connections between lifestyle and energy use and the mechanisms through which they can make responsible

choices to improve energy efficiency; there is a somewhat inherent belief that savings in energy cost will primarily result from renewable energy options.

Integrating regulatory instruments and the national energy policy should be part of a more comprehensive approach. A regulatory framework or law cannot be effective unless they are firmly grounded in the country's energy policy and are backed up by an institutional structure, which serves their purposes. Together with a range of targets and incentives for energy efficiency investments, the Government of Jamaica can provide a "balanced mix" of "push and pull" factors to encourage broad based participation that includes the household and commercial sectors —both, when combined, are significant users of electricity and transport fuels. Pronounced energy efficiency uptake in Jamaica requires a paradigm shift in the energy economy— away from the traditional approach that focuses exclusively on individual behaviour and technological advances to one that utilizes a range of possible measures to pursue "energy security and efficiency". There is societal acceptance that there is an almost desperate need to improve efficiency in:

- Electricity generation by the public utility, Jamaica Public Service Company and the self generators in the bauxite/alumina and sugar industries;
- Transmission and distribution of electricity by the public utility; and
- Energy use for water services provision by the National Water Commission.

While pursuing these efforts however, care must be taken not to have an over reliance on the mass intervention strategies highlighted above and there must be complimentary activities at the individual level in the household and commercial sectors. These activities should address traditional demand side measures as well as introduce and promote efficient micro generation activities to reduce reliance on the utility provider. In return, the utility should be "encouraged" to increase participation in activities "on the other side of the meter", such as demand side management schemes. Likewise, efficient uptake in transport fuels must be promoted through the broadening the role of motor vehicle and transport fuel sales and service providers to include energy issues. Government must set, evaluate and rationalize efficiency targets and "facilitate" achievement of same.

I. Pre-amble

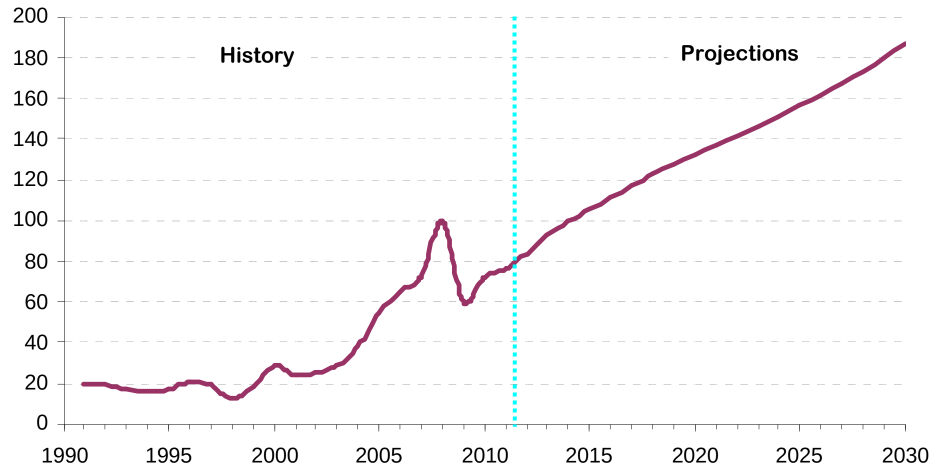
"A comprehensive program of efficiency improvement and energy diversification is urgently required for Jamaica to provide high-quality, affordable, environmentally-friendly energy and to reduce the country's dependence on high-cost imported oil."[1]

A critical and important fact is that like most Small Island Developing States (SIDS), Jamaica is almost completely dependent on oil for its energy needs but is not a producer of oil. Imported oil provides approximately 95 per cent of the nation's primary energy services. Jamaica's dependence on imported petroleum renders the country vulnerable to disruptions in its energy supply as well as to increases in the price of oil, such as took place in 1973 and more recently in the period since 2002 when the annual average spot peak price of crude oil on the international market increased by 220 per cent from USD 25 per barrel in 2002 to USD 80 in 2010. In 2008, Jamaica imported around 29 million barrels of oil approximately at a higher cost of USD 2.9 billion. Although Jamaica's oil demand has dropped due to efficiency efforts and alternative energy projects developed, the oil price fluctuations have led to increasing costs.

Crude oil prices were as high as USD 147 per barrel during 2008. Though eventually falling to USD 35 per barrel by year end as a consequence of the global economic recession, prices have since climbed steadily to above USD 90 per barrel and the volatility in supplies as well as inconsistencies in the world economy are expected to fuel future increases in the price of oil (see Figure 1). This is attributed in part to continuing political instabilities in many of the world's oil producing regions and further competition from China and India, which will continue to diminish our ability to lever access to affordable, secure hydrocarbon supplies. Further, wholesale recognition of the fast approaching oil production peak (which is a signal of the tail-end of the oil economy) is expected to continue adding fresh burdens in the future. The nations that are most vulnerable to volatile oil prices are poor countries with high levels of oil imports compared to their GDP, high current accounts and external debts, and whose access to global capital markets is limited. This is partly because economic dependency on oil (i.e. the GDP/energy ratio) in such countries has not declined to the same extent as it has in developed nations and the "more progressive" developing countries (see Figure 2).

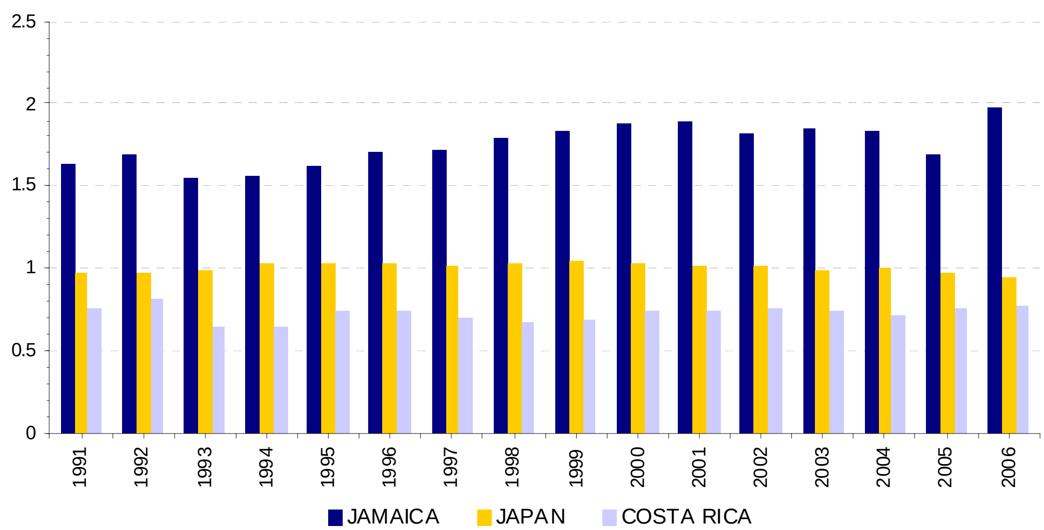
[1] National Energy Policy 2009–2030, Ministry of Energy and Mining, October 2009.

FIGURE 1
GLOBAL OIL PRICE TREND AND PROJECTIONS, 1991 – 2030



Source: EIA Annual Energy Outlook 2010, DOE/EIA 0383 (2010).

FIGURE 2
ENERGY USE IN BARREL OF OIL EQUIVALENT PER USD 1000 OF GDP, 1991 – 2006



Source: Millennium Development Goals Database, UN Statistics Division.

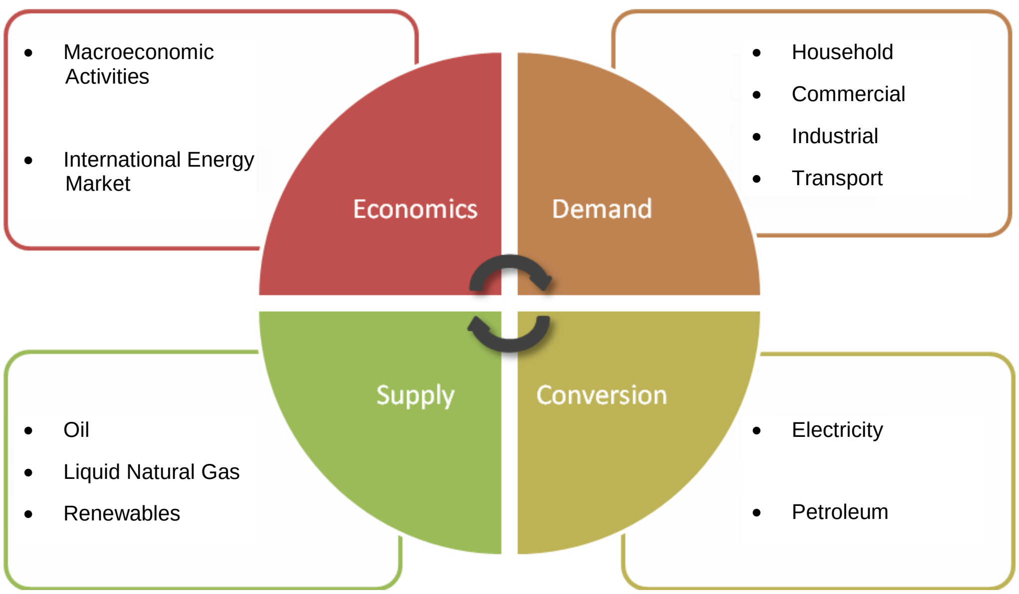
A defining characteristic of the national energy situation in Jamaica is the high inefficiency in the use of energy resources. It is estimated that the country "wastes more than half the available energy" in the imported fuels, which accounts for the comparatively high energy per unit of GDP. The multiple impacts of a rise in the price of oil have been consistently seen, especially since 2004 when oil imports exceeded USD 1 billion for the first time. More telling is the situation of 2008 when the nation's oil bill was, as a consequence of the record high oil prices, USD 2.7 billion. This sum was equivalent to the country's total export earnings of that year. Scenarios of this kind result in serious implications for the balance of payments, inflation, business competitiveness and household poverty in the country.

Further rise in the price of oil will therefore disrupt an already relatively fragile economy. Hence, the declaration of the Jamaica National Energy Policy that it is "a comprehensive program of efficiency improvement and energy diversification is urgently required for Jamaica to provide high quality, affordable, environmentally-friendly energy and to reduce the country's dependence on high-cost imported oil." The prioritization of energy efficiency has been to the extent that in 2008, the Government of Jamaica (GOJ) developed the 2008-2022 Energy Conservation and Efficiency Policy as an Addendum to the then Energy Policy Green Paper, which was intended to provide "rapid response" to Jamaica's adverse energy scenario.

While energy markets are complex, energy models are simplified representations of energy production and consumption, regulations, and producer and consumer behaviour. The likely interconnections within the energy sector may be visualized in accordance with Figure 3 below. The components of the model represent the relevant supply, demand and conversion sectors of the domestic market and also include local and international macroeconomic influences. In general, the model shows that there is direct interaction between the price of energy delivered to the consuming sector and the quantities of end use.

The fact is that the energy economics are primarily determined by global energy pricing and local macroeconomic activities, which affects the ability of the consuming sector to pay for energy services and the subsequent demand. The primary consumption groups in Jamaica are: (i) Household; (ii) Commercial, which includes service providers such as the National Water Commission and the hotel sub-sector; (iii) Industrial, which includes light manufacturing industries such as food processing and heavy industries such as Bauxite/Alumina; and (iv) Transport, which includes private and public vehicles as well as the maritime, aviation and limited rail services.

FIGURE 3
LIKELY ENERGY MODEL FOR JAMAICA

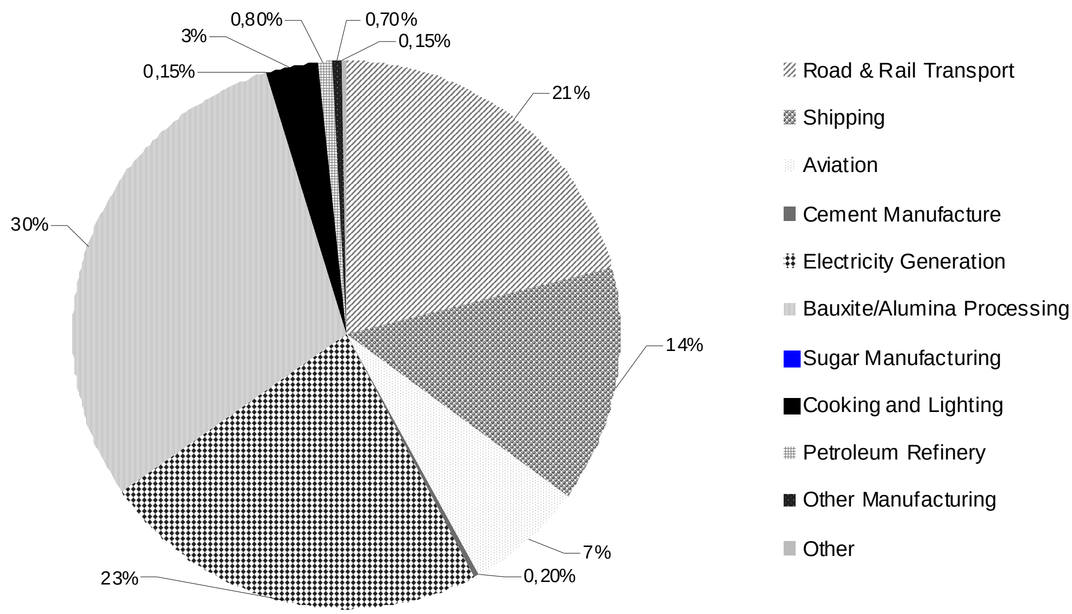


Source: Prepared by the author.

Jamaica's energy economics are primarily determined by global energy —especially oil— pricing and local macroeconomic activities. This affects the ability of the consuming sector to pay for energy services which, in turn, influences the subsequent demand. The primary consumption groups in Jamaica are: (i) Household; (ii) Commercial, which includes service providers such as the National Water Commission and the hotel industry; (iii) Industrial, which includes light manufacturing industries such as food processing and heavy industries such as Bauxite/Alumina; and (iv) Transport, which includes private and public vehicles as well as the maritime, aviation and limited rail services. Integrated into the commercial demand is energy for heat and power, feedstocks and raw materials. In the case of transport, petroleum products such as gasoline, diesel and compressed natural gas (CNG); liquid biofuels —ethanol and biodiesel— and electricity (for hybrid and electric cars) are also represented.

The transport subsector is the largest consumer of petroleum in the Jamaican economy, accounting for 42 per cent of the total quantity of petroleum consumption in 2008 (Figure 4). The Bauxite/Alumina industry follows close behind at 30 per cent, while electricity generation accounts for 23 per cent. The energy sector in Jamaica is primarily driven by these main areas and activities therein bears significant influence. Energy use is primarily in the form of electricity or petroleum products (liquid fuels) and conversion of the mostly imported fuel supply to meet local demand requires a mix of technology, legislation and investment capital.

FIGURE 4
PETROLEUM CONSUMPTION BY ACTIVITY, 2008



Source: Ministry of Energy and Mining.

The electricity subsector aptly incorporates: the stock of existing generation capacity; the menu, cost and performance of future generation capacity; expected fuel prices; expected financial parameters; expected electricity demand; and expected environmental regulations to project the "optimal mix of fuel types" for new generation capacity that should be added in future years. There is also inclusion of: the operating and maintenance costs and performance for the existing generation equipment; electricity demand; the applicable environmental regulations to determine the least cost way to meet that demand; and importantly, the transmission and pricing of electricity. The Jamaica Public Service Company (JPS) provides 70 per cent of all electricity consumed on the island; Independent Power Producers (IPPs) generate the remaining 30 per cent of electricity supply. JPS is a vertical integrated utility that is 80 per cent owned by foreign investors and is responsible for all transmission and distribution. As the sole distributor of electricity, JPS purchases power from the IPPs.

The petroleum subsector reflects: prices of petroleum products; crude oil and product import activity; domestic refinery operations (including fuel consumption), subject to the demand for petroleum products; the availability and price of imported petroleum; and the domestic production of biofuels (ethanol, biodiesel, and bio oils). It also: incorporates those refining activities specific to the production of traditional automotive fuels, such as conventional and reformulated gasoline; and includes the production of biofuels for blending in gasoline and diesel. Inherently, there will also be inclusion of the regulations that limit: the sulphur content of all non road and locomotive/marine diesel; the required renewable fuels standard; and the regulatory changes required to necessitate capacity expansion for refinery processing units. Fuel ethanol and biodiesel are included in this sub sector because their utilization is most likely as a blend with petroleum products –this is currently the case for ethanol use, which is blended into gasoline at 10 per cent by volume (E10).

In the supply sector, oil is bounded by international factors as Jamaica relies on imported crude and has no domestic supply. The availability and pricing of same tend to bear strong interrelationships among the various sources of supply, i.e. onshore, offshore, and more recently "deep-sea" that is accessed by both conventional and unconventional techniques. Further, geopolitical issues, such as instability in oil producing regions and natural disasters such as hurricanes also bear heavy influence. Liquified Natural Gas is also expected to become a significant part of the Jamaican energy supply in the near future and the transmission, distribution, and pricing of natural gas on the international market. The relevant terminal, storage and regasification infrastructure and the pipeline network that is required for delivery to end users is also part of the dynamics therein.

Jamaica has abundant potential for the development of its renewable energy resources, including wind, biomass, mini-hydro, photovoltaic and solar thermal energy. In addition, the potential for the conversion of waste to energy, ocean thermal technologies and bio-fuels is being explored and strategic analyses of renewable energy potentials on the island have identified a pipeline of projects for the electricity and transport sectors. In general, the renewable energy sub sector should reflect: renewable resource supply estimates, representing both local and regional opportunities for renewable energy development; possible positioning of Jamaica in the regional interconnection network; and the relevant legislation that facilitates the uptake of renewables by the utility company. Investment tax credits (ITCs) for renewable fuels should also be incorporated.

The energy model, in Figure 3 above, shows clearly that an important method for insulating the country against the volatile economics of oil is to shift supply to cheaper, indigenous, renewable sources. The pipeline of renewable energy projects for the electricity and transport sectors have the potential to reduce petroleum imports by increasing the renewable share in the energy matrix to 10 per cent by the year 2010, and 15 per cent by the year 2020. Nonetheless, in 2008 Jamaica's renewable share stands at 5 per cent as a result of barriers that mitigate investment in the industry.

More overwhelmingly, the model (Figure 3) shows that the required oil supply can be controlled by: increasing the efficiency of fuel conversion to energy for end use. Great potential for this exists as about 50 per cent of the island's electricity generating plants are over three decades old, has exceeded their intended useful economic life, and are considered relatively inefficient, especially when compared with more modern plants. Also, system losses in transmission and distribution represent around 23 per cent of total output. Another intervention pointed to by the model is demand side management (DSM). A matter of concern is the country's inefficiency in the use of energy with an energy intensity index that is more than four times the global average. This is largely attributed to the high energy use of the bauxite and alumina sector, an inefficient public electricity system, as well as inefficient energy technologies in manufacturing and other productive sectors.

Economics aside, the sustainable development of developing countries like Jamaica depends on making their economies less dependent on carbon intensive fuels. Traditionally, economic growth has been based on increasing fossil fuel energy consumption and consequently increasing greenhouse gas (GHG) emissions. The burning of fossil fuels is the single largest contributor to the emission of greenhouse gases such as carbon dioxide (CO_2) and nitrous oxide (N_2O) that have been identified as contributors to anthropogenic (human induced) global warming and climate change. While continued growth is desirable, the efficiency of energy consumption must be improved. This will decrease the carbon intensity of production and contribute to the reduction of GHG concentrations in the atmosphere.

Energy efficiency is among the most promising initiatives for reducing GHG emissions and energy costs for sustained growth as well as increasing energy security in developing countries such as Jamaica. Energy efficient options are not common practice due to well documented barriers such as lack of information on the part of the end user, absence of appropriate policy framework, and most importantly, the “split incentive” barrier: Frequently, those who make decisions on EE investment are not the final users who pay the energy bill. The aim of this study is to analyse the efforts of the GOJ to mainstream energy efficiency into the energy economy and energy policies in the light of different factors that include: the general policy framework; dominant paradigms and priorities; socioeconomic indicators; the institutional arrangements; demography; and political culture.

II. Background to study

A. Energy versus environment: the European experience

Economic development benefits from stable and predictable macro-economic conditions; sustainable fiscal and debt policies enable governments to finance the provision of adequate levels of public goods and services over the long-term without adversely affecting the availability of resources to fuel private sector growth. A stable macro-economy reduces risk and uncertainty in decision making by economic actors. Jamaica has significant macro economic problems that constrain its economic prospects. These include levels of public debt that are among the highest in the world, high and persistent levels of fiscal deficits, and a tax system that is complex and cumbersome; Jamaica has a history of deficit financing as a feature of fiscal policy since the 1970s.

BOX II.1
THE EUROPEAN PATH

In Europe, environmental considerations have been taking on greater and greater importance, and in some countries in Northern Europe environmental aspects and effects – such as sulphur emissions and other negative environmental impacts resulting from energy use environmental issues have gradually been gaining ground in society as a whole and have not only been included in the agendas of the more traditional political parties (and not just those of the "green" parties) but have been addressed with political programmes and specific action plans.

In the rich countries, a growing percentage of the population perceive their quality of life as a combination of economic prosperity and good environmental living conditions, and this concern with environmental issues has been the result. It can be argued that this increased concern is related to the relative decline of polluting industries and the growing importance of the service sector in the economy, in that "smokestacks" are no longer associated with economic growth and social welfare. The "new industries", by contrast, are sited in environmentally clean areas, and thus help increase social pressure for a "clean" environment.

This development contrasts with the situation in the countries of Southern Europe, where national economies still rely on less productive industries. In these countries, concern about the environment – and energy saving – is less prevalent in the population as a whole. The ability to acquire "luxury" goods that consume a lot of energy (such as cars, household electrical appliances and air conditioning and heating equipment) represents "success" in society. Consequently, in those countries where the watchword is "economic growth first, the environment second", energy saving goals are less politically feasible. Because of their institutional, political and social structures, furthermore, it is not easy to create coalitions to pursue environmental issues. Owing to their recent entry into the European Union, indeed, these countries are concerned above all with issues like economic restructuring and international competitiveness.

Source: Renewable Energy and Energy Efficiency in Latin America and the Caribbean, UN ECLAC (2002).

There has been historic cognizance on the part of the GOJ towards the role of energy in the socio economic development of the country. Nonetheless, energy efficiency and renewable energy "continues to offer great potential" for reducing the negative effects of the ever-increasing rates of energy consumption associated with economic growth and the move towards more energy intensive societal models; the uptake of sustainable energy practices and technologies into the national economy has been anaemic. Jamaica has remained tied to "luxury" goods that consume a lot of energy and continues to rely on inefficient, energy intensive industries, such as bauxite and tourism, to drive the economy.

Following the oil crisis of 1973, Jamaica adopted a programme of energy conservation and increased use of alternative energy. Since that time, energy conservation has been "promoted" in Jamaica as an official position of the GOJ. In 1995, the first "formal" energy policy was approved by Cabinet and focussed mainly on the structure and organisation in the electricity sector, while "encouraging" energy conservation and efficiency (ECE) measures, including electricity supply and demand side management.

In 2004, the Government started a new energy policy approach, this time focussing on the opening of the electricity generation market, on fuel diversification and renewable energies, as well as on energy efficiency. A discussion paper for a new Power/Electricity Policy was published which contained several proposals for demand side management measures and targets on energy efficiency. Among others, it was proposed that saving targets of 15 per cent over 5 years should be set for the public sector energy consumption. Following further inter - ministerial discussions, a Green Paper on Jamaica Energy Policy (2006-2020) was released in 2006. An Addendum on Energy Conservation and Efficiency (2008-2022) was published by the Ministry of Energy in July 2008. Both papers maintained Green Paper status as draft policies until October, 2009 when the National Energy Policy 2009 - 2030 was finalized and subsequently tabled in Parliament as a White Paper and when the draft National Energy Conservation and Efficiency Policy 2010 – 2030 was completed in September, 2010.

Parallel to those undertakings, the Government mandated the Planning Institute of Jamaica (PIOJ) during 2006 to lead the preparation of a comprehensive long term National Development Plan that would place Jamaica in a position to achieve developed country status by 2030. Development of the Plan began in January 2007 and twenty seven (27) Task Forces, including an Energy Task Force, were established thereafter. The document, Vision 2030 has since become government policy and clearly identifies "energy security and efficiency" among the requirements toward the goal of economic prosperity.

Energy efficiency has been identified in the Energy Policy as having the greatest scope for reducing emissions and dependence on imported energy. The Energy Policy includes measures to support energy efficiency and conservation including information dissemination, demand side management programmes for the power sector, and energy efficiency building code. There have been several initiatives undertaken by the Ministry with portfolio responsibility for energy (now the Ministry of Energy and Mining) to improve energy efficiency in both the public and private sectors. In instances, such have been executed through the Petroleum Corporation of Jamaica (PCJ) or the Jamaica Public Service Company (JPS).

The first of these major initiatives was the Energy Sector Assistance Project (ESAP) that was a joint programme between the GOJ and USAID between the late 1970s and the late 1980s. This project consisted of two phases: Phase One addressed the energy conservation and alternative energy requirements of the public sector, and Phase Two attempted to cater for the private sector through a revolving loan scheme. Under Phase One of ESAP, energy audits and retrofitting were carried out in several hospitals, government owned sugar factories and office buildings. Post implementation surveys in a sample of these entities revealed that energy savings between 10 and 25 per cent were actually achieved. In addition to energy efficiency improvement, several alternative energy projects were also carried out under Phase One. These included the installation of solar water heating systems in about eight hotels and ten hospitals and health centres. Phase Two of the project however, was not so successful because the private sector showed some reluctance to take up loans under the revolving loan scheme at market interest rates.

Another major energy conservation initiative was the Demand Side Management (DSM) Programme (funded by the World Bank and the Global Environment Facility, GEF) of the then state-owned JPS, which started in 1994 and was intended to demonstrate the effectiveness of conservation measures in the residential and commercial sectors.

Phase One (the pilot phase) of the residential component ran from 1994 to 1996, and its focus was to sensitize students, teachers and parents on energy conservation and efficiency measures for electricity and water use. It targeted one hundred (100) households, each of which was supplied free of cost with compact fluorescent lamps (CFL), some water saving gadgets and refrigerator door gaskets. Phase Two of this programme was from 1996 to 1998 and its aims were substantially the same as those of the previous phase, except that the target group was widened to around 30,000 households and the programme was fine tuned, using the experience gained in the pilot stage; the main achievement of the programme was a reduction of the electric load by almost 1.7 MW and electric savings of approximately 5,350 MWh per year. This level of saving exceeded the Prepared by the author. goals and the DSM is still one of the success stories of energy efficiency application in the island. However, it failed to achieve its main goal of "transforming the energy efficiency market" as consumers were still unable to finance continued energy reduction schemes in households.

The commercial component which targeted large and small commercial enterprises and included the financing of energy audits; implementation of energy audit recommendations was to be funded by the enterprises themselves. A small number of enterprises actually carried out the recommended retrofitting, and achieved energy savings of 20 to 30 per cent. In general, the retrofitting involved improvement of air conditioning systems and installation of more efficient lighting. This component of the DSM programme evolved into what is now the Energy Services Department of JPS which conducts energy audits for its commercial and industrial customers on a cost compensation basis.

In the latter part of 2003, the state owned Petroleum Corporation of Jamaica (PCJ) instituted a national Energy Efficiency Unit (EEU) for the purpose of managing national energy efficiency improvement projects. The broad objective of the energy efficiency projects was to support activities to reduce Jamaica's consumption of imported energy by 25 per cent by the year 2010, through improved energy efficiency and increased use of renewable energy. This initiative was conceived as a broad based government action which would benefit all sectors including the residential, commercial, industrial and public sectors.

The EEU is also designed to function as the coordinating agency for all project related activities undertaken by other state agencies and had oversight for evaluation and implementation of energy efficiency measures nationwide. This includes the provision of technical support for energy efficiency activities, a public education programme, and the training of personnel from energy service companies (ESCo) who are involved in conservation and efficiency activities. Under the public education programme of the EEU, a series of seminars were held in various parts of the country to educate school children and teachers about the methods of achieving energy efficiency at home and in schools. Poster competitions were organized, and energy conservation messages were disseminated via advertisement in the press, on billboards and through the electronic media. A complimentary training activity, focussing on industry professionals, was the Certified Energy Managers (CEM) course which was held in March 2005. It was sponsored by USAID through the Energy Audits for Sustainable Tourism (EAST) Project and executed by the Association of Energy Engineers of the US. A total of 22 engineers from private and public sector entities participated.

One of the main projects undertaken by the EEU was the Programme of Environmental Management in Hospitals and Schools, which started in 2006 and was jointly funded by the UNDP and the Government of Jamaica. It involved the energy auditing of 23 hospitals, 10 health centres and 8 educational institutions and the eventual implementation of energy efficiency and water conservation measures in four public hospitals. This project was based on the background of a cabinet decision that the public sector should reduce its energy consumption by 15 per cent and the concept that public buildings requiring hot water should be mandated to install solar water heaters. Public hospitals were seen as a prime target, as they were responsible for 9 per cent of the public electricity bill and regarded as highly inefficient in terms of their energy use. These energy audits were carried out with the assistance of the United Nations Development Programme (UNDP) and showed potential annual savings of about USD 1.8 million at investment costs of roughly USD 3.6 million; some of the measures demonstrate payback times of less than one year. To date, many of the measures recommended have not been implemented due to lack of public funds and/or the requisite policies to support private investment funding.

More recently, the Inter-American Development Bank (IDB) approved Technical Assistance in the form of a grant of USD 350,000 to compliment GOJ's contribution of USD87,500, making a total of USD437,500 to provide support to the GOJ's efforts to "improve energy efficiency in the public sector". A key component of this Technical Assistance is the preparation of an Investment Plan/Programme for implementation of the recommendations. Financing for the Investment Plan/Programme is likely to be by an energy efficiency loan programme and grant financing where, possible. It is envisioned that the IDB study will provide some answers towards the implementation strategies for Energy Conservation and Efficiency strategies within the Public Sector.

Several initiatives are underway to assist the private sector. The Energy Fund was launched on May 1, 2008 with the Development Bank of Jamaica committing JMD 1 billion to the Small Microenterprises (SME) Energy Line of Credit and was being lent through Authorized Financial Institutions (AFI) such as Commercial Banks, Merchant Banks, National People's Cooperative Banks, Credit Unions and Micro Financing Institutions. Funds are being disbursed at an interest rate of 10 per cent per annum fixed for the life of the loan with a repayment period of up to 7 years. The fund, which is designed to finance energy efficiency and renewable energy measures by the private sector, has had significantly less penetration than anticipated. The reasons for the limited uptake have been analyzed and some corrective measures being implemented.

This somewhat parallel study of the energy efficiency potential is been sponsored by the UN Economic Commission on Latin America and the Caribbean (UN ECLAC) and is intended to complement the previously mentioned IDB study by providing strategies for the Commercial, Transport and Household Sectors. In support of the GOJ's energy directive, UN-ECLAC has previously facilitated studies on Renewable Energy Opportunities (2005). This current study is a furtherance of this commitment to this support and the findings herein will hopefully assist the GOJ in its effort towards "making energy savings and efficiency an integral part of the Jamaican lifestyle".

III. Situation analysis

Jamaica is still in a “transition and adjustment phase” of development —the Vision 2030 document outlines the projected path for attaining developed status. To navigate this path, the country must find creative ways of reducing its heavy debt burden which currently stands at around 125 per cent of GDP. As the cost of fossil fuels —especially oil— continues to rise, so does the cost of electricity in Jamaica. This situation has implications for the competitiveness of the manufacturing sector and poverty in the household sector as Jamaica’s electricity rates are already not considered to be competitive when compared with the rates in many other Caribbean countries (Table 1). Nonetheless, as the country continues to make political and socio economic progress, Jamaica’s energy demand has continued to increase over the years.

TABLE 1
ELECTRICITY PRICING IN SELECT CARIBBEAN COUNTRIES

	Household						Industrial					
Country	1996	1997	2003	2004	2007	2008	1996	1997	2003	2004	2007	2008
Barbados	0.151	0.167	0.188	0.188			0.157	0.174	0.197	0.197		
Cuba	0.126	0.128	0.137	0.138			0.079	0.072	0.081	0.078		
Dominican Republic	0.084	0.082	0.107	0.150			0.101	0.098	0.106	0.120		
Grenada	0.193	0.193	0.221	0.221			0.163	0.163	0.188	0.188		
Guyana	0.079	0.078	0.059	0.059			0.105	0.104	0.078	0.078		
Haiti	0.102	0.096	0.060	0.060			0.098	0.103	0.085	0.085		
Jamaica	0.139	0.135	0.169	0.187	0.258	0.215	0.106	0.105	0.115	0.130	0.331	0.280
Suriname	0.171	0.171	0.171	0.129			0.131	0.131	0.131	0.123		
Trinidad and Tobago	0.029	0.028	0.036	0.036			0.024	0.023	0.035	0.037		

Source: Prepared by the author.

Since 1970, Jamaica’s energy consumption has doubled and is estimated to continue growing at around 3-4 per cent annually. Jamaica has provided almost all its citizens with access to electricity and approximately 90 per cent of households have connection to the grid. Consequently, Jamaica has one of the highest per capita energy consumption in the Caribbean (approximately 12 BOE per annum); this is complicated by the fact that energy use in Jamaica is inefficient and the energy intensity is also high (approximately 2 BOE per USD 1,000 of GDP). Jamaica produces very little energy from indigenous resources and is instead, almost entirely dependent on imported energy sources; petroleum currently accounts for approximately 95 per cent of the country’s total energy consumption and indigenous sources (wind, biomass and hydropower) provides the remaining 5 per cent. The problems associated with such heavy reliance on fossil fuels have promulgated an energy policy that promote energy conservation and efficiency in the energy conversion (electricity generation and petroleum refinery) and end use (industrial, commercial, household and transport) sectors.

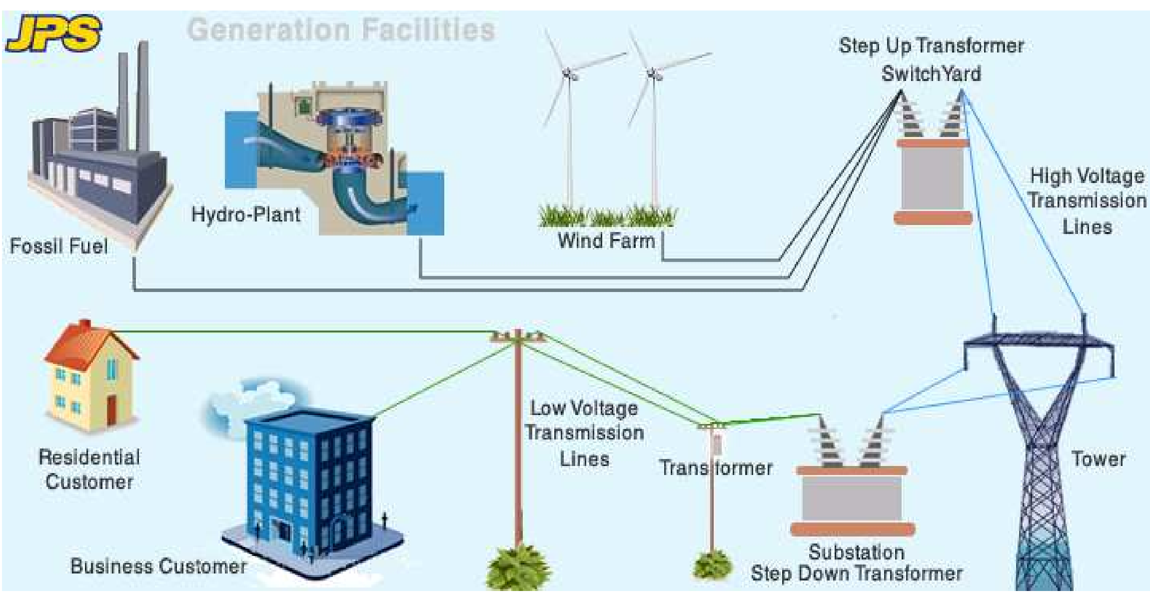
A. Electricity sector

Electricity was introduced to Jamaica in 1892 —13 years after Thomas Edison invented the first successful electric lamp—. Then, the Jamaica Electric Light Company started to supply electricity from a small coal-burning steam generating plant on Gold Street in Kingston. Thirty-one years later, on May 25, 1923, the Jamaica Public Service Company (JPS) came into being as a legal entity, providing electricity services to 3,928 customers. Currently, JPS has a customer base of over 585,000. JPS was granted an all island franchise in 1966, and today remains the sole public supplier of electricity.

The nature of the ownership of JPS has changed several times throughout its history. The company started out as a private company, owned by foreign shareholders. In 1970, the Government of Jamaica acquired controlling interest. In 2001, ownership of JPS returned to private hands when Mirant Corporation, a US based energy service provider acquired 80 per cent of the company, with the Government retaining almost 20 per cent. The remainder, amounting to less than 1 per cent, is owned by a small group of shareholders.

In 2007, Mirant sold its majority shares to Marubeni Caribbean Power Holdings (MCPH) Inc, a subsidiary of Marubeni Corporation of Japan. In early 2009, Abu Dhabi National Energy Company (TAQA) of the United Arab Emirates joined Marubeni as co owners of the JPS with majority shares are therefore jointly held by Marubeni TAQA Caribbean. The Jamaica Public Service Company provides 67 per cent of all electricity consumed on the island; Independent Power Producers (IPP's) generate the remaining electricity supply: JPS is a vertical integrated utility and is responsible for all transmission and distribution. As the sole distributor of electricity, JPS purchases power from the IPP's. JPS owns a number of fossil fuel plants that use Heavy Diesel Oil (HDO) and Automotive Diesel Oil (ADO), as well as eight hydro plants.

DIAGRAM 1
ELECTRICITY GENERATION, TRANSMISSION AND DISTRIBUTION



Source: Jamaica Public Service Company Limited, http://www.myJPS.com/about_us/how_we_deliver.php.

The supply and distribution of electricity in Jamaica is regulated by the Office of Utilities Regulation (OUR), and the sector is characterized by a lack of an appropriate and dynamic regulatory framework to address the range of issues and challenges faced. These include: pricing of electricity and petroleum products; old generation plants; tax and pricing structure for road users; system losses; and the development of renewable generation capacity. The All Island Electric Licence (2001) establishes the framework for the planning and implementation of incremental addition of generation capacity to the national electricity grid. While JPS has the exclusive right under the Licence to transmit, distribute and supply electricity throughout Jamaica until 2021, the Licence provides for the addition of generating capacity through a competitive process, starting in 2004.

1. Generation

The Jamaica Public Service Company produces electricity using steam (oil-fired), combustion gas turbines, combined cycle, diesel, hydroelectric, and wind. There are four main power plants: Rockfort and Hunts Bay in Kingston, Old Harbour Bay in St. Catherine, and Bogue in St. James. In general, there is approximately 820 megawatts (MW) of total installed generation capacity – this includes around 197 MW from the following Independent Power Producers (IPPs): Jamaica Energy Partners (JEP); Jamaica Private Power Company (JPPC); Jamalco; and Wigton Wind Farm. Formerly, the Jamaica Public Service Company Limited uses the approach of the Least Cost Expansion Plan (LCEP) methodology, which is in accordance with the terms of its licence, to determine the extent to which IPPs may provide electricity for sale to the grid – this is supposedly based on the provision of a reliable supply of electricity to consumers at the least possible cost and is subject to oversight by the OUR, which since 2007, carries out the LCEP function and the procurement for the addition of new generating capacity. In addition to JPS, there is around 200 MW of "self generation" by the bauxite/alumina and sugar sectors.

MAP 1
JPS ELECTRICITY GENERATION SITES

Source: Jamaica Public Service Company Limited, http://www.myJPS.com/about_us/power_plants.php.
Note: The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations.

Steam Generation

The steam generating units are the foundation units of the JPS generating system, and are often referred to as the "base load" units (See Map 1). These units are fairly old and are characterized by extremely low generation efficiency of around 29 per cent (See Table 2).

Hydro power

There are eight hydroelectric plants among the mix of generating units, which contribute approximately 24 MW to the grid. The hydro plants are: Upper White River, Lower White River and Roaring River in St. Ann, Rio Bueno A and Rio Bueno B in Trelawny, Maggotty in St. Elizabeth, and Rams Horn and Constant Spring in St. Andrew (Map 1). Most of the plants, however, are fairly old and are at present undergoing rehabilitation; the oldest having been commissioned in 1945. Further, the effectiveness of hydro units depends largely on the availability of water and the quality of the stream flow.

Wind Power

Since 2004, JPS signed a Power Purchase Agreement (PPA) with Wigton Wind Farm Limited through which electricity is purchased from the wind farm, located at Wigton, Manchester. The wind farm consists of twenty-three 900 kW wind turbine, with an estimated overall capacity of 20.7 MW. The generation efficiency of the turbines is estimated at around 70 per cent. In 2008, the expansion of the Wigton wind farm was approved for an additional 18 MW. Construction of the expanded plant is underway and plant commissioning is scheduled for end of 2010. Further, the effectiveness of these units depends on the consistency of the wind flow.

Gas Turbines

JPS also produces energy through the use of gas turbine engines. These gas turbines, which utilize relatively expensive oil (diesel) to produce electricity, are used primarily at those times in the day when energy demand is at its peak. The proportion of diesel oil based generation capacity in the total generation capacity mix (34 per cent) is high and is too expensive to support a “price competitive” electricity sector.

Combined Cycle Technology

The newest addition to the JPS generating fleet is the 120 MW combined cycle plant at the Bogue Power Station in Montego Bay. The Bogue plant consists of three individual units: two combustion turbine generating units with a total capacity of 80 MW and one 40 MW steam generating unit. The two combustion turbines operate on diesel fuel but are capable of converting to natural gas at any point in the future. Heat from the exhaust of both these combustion turbines is harnessed to produce steam by way of two heat recovery steam generators that are used to drive a steam turbine capable of producing an additional 40 MW. Combined cycle technology is recognized internationally as one of the most advanced and efficient means of generating electricity. This technology allows for greater efficiency of conversion than is usual through regular generation methods.

Biomass Energy

Many of the sugar factories use most of the bagasse they produce in the juice extraction process for electricity generation. Over the past several years, the Mercado Mayorista de Energía (MME) has reported in its Annual Report that the use of bagasse in Jamaica is consistently in the region of 1.2 million BOE.

TABLE 2
AGE DISTRIBUTION OF ELECTRICITY GENERATING PLANTS

Age	Operator	Capacity/ MW	Percentage
Less than 5 years	JPS	184.7	28.1
5 – 15 years	JPS	220.5	25.4
16 – 30 years	JPS	64	7.4
Older than 30 years	JPS	355.4	39.1
	JAMALCO	11	
	Sugar Company of Jamaica	23.5	
		859.1	

Source: Jamaica Public Service Company Limited.

TABLE 3
OPERATING EFFICIENCY OF POWER PLANTS SERVING THE JPS TRANSMISSION GRID

	Efficiency	
	BTU/kWh	Percentage of Energy Input
Oil-fired Steam	12 723	26.8
Combined Cycle	8 390	40.7
Gas Turbines	13 972	24.4
JPS Low-speed Diesels	9 122	37.4
JPPC Low-speed Diesels	7 937	43.0
JEP Medium-speed Diesels	8 135	41.9

Source: Preparation for a National Integrated Electricity Expansion Plan and Efficiency Study for Jamaica, March 2007.

2. Transmission and distribution

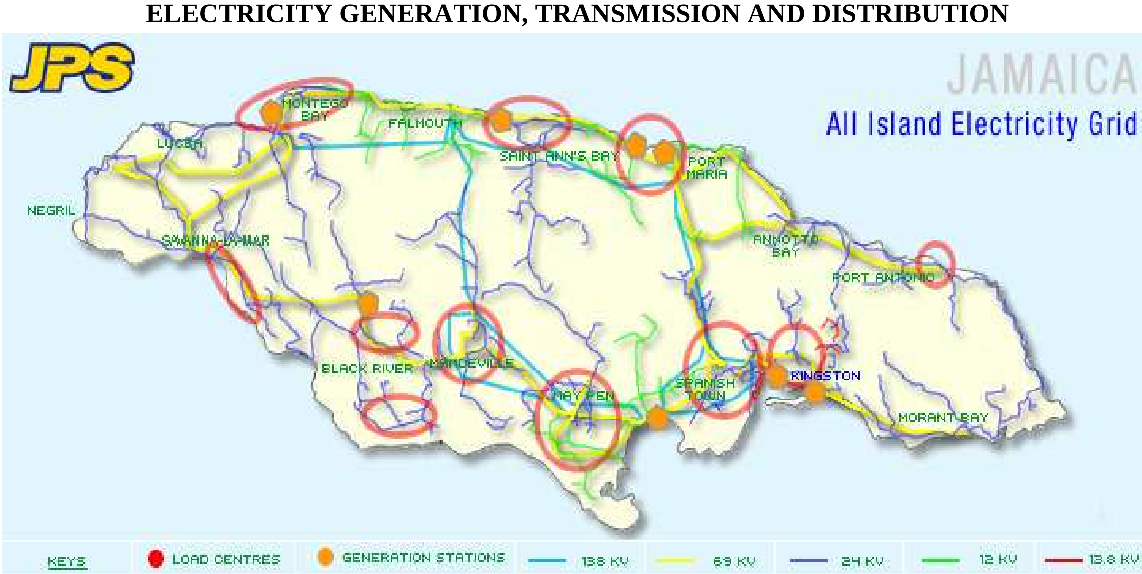
The JPS "grid" constitutes: the various generation stations where electricity is generated; load centres, which is a combination of meters and breaker sets; as well as transmission and distribution lines (Map 2). The transmission and distribution lines cover of 1,200 km.

The transmission and distribution lines are high voltage lines and medium voltage lines. The high voltage lines are: (i) 138 kV, which is the backbone of the transmission system that carries power from the plants to substations around the island; and (ii) 69 kV, for the distribution of electricity to the major load centres. The medium voltage lines are: (i) 24 kV, forms part of the distribution network and takes the power from substations, to the major towns, via transformers; (ii) 12 kV and 13.8 kV, which also forms part of the distribution network and takes the power from substations, to customers, via transformers (See Map 2).

The transmission and distribution network in Jamaica is characterized by line losses of up to 23 per cent – this is attributed in part to technical losses due to load increases as well as an apparent increase in non technical losses, which are estimated to be approximately 10 per cent of the energy supplied by JPS. This places pressure on an already inefficient generation system and makes the existing grid very inefficient.

The Rural Electrification Program (REP) aims to extend electricity to rural Jamaica as part of the Government of Jamaica's commitment to provide the entire island with access to electricity; over 90 per cent of Jamaicans have access to electricity.

MAP 2
ELECTRICITY GENERATION, TRANSMISSION AND DISTRIBUTION



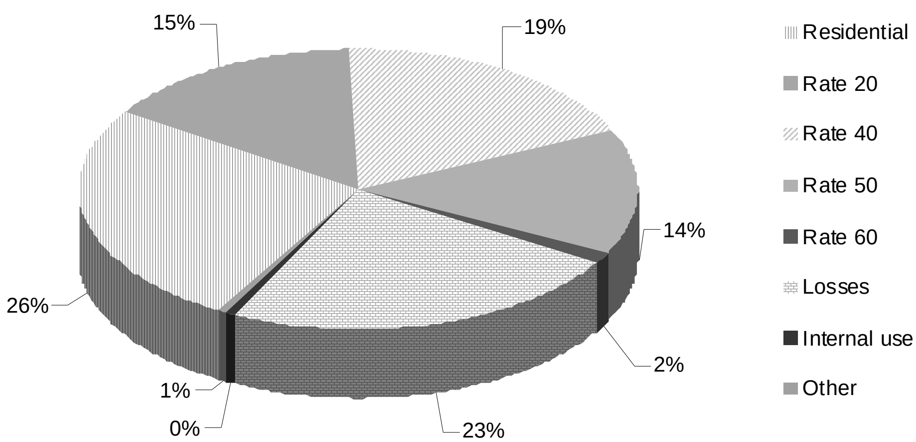
Source: Jamaica Public Service Company Limited, http://www.myJPS.com/about_us/the_grid.php.
Note: The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations.

3. Trends in electricity use

The main industries in Jamaica are: tourism; bauxite/alumina; agro processing; light manufacturing; rum; cement; metal; paper; chemical products; and telecommunications. The electricity demand module reflects the end use in these sectors, as well as the household (residential sector). These branches are typically arranged according to JPS customer rate classes; disaggregation of electricity use (by percentage), according to JPS customer rate classes is shown in Map 5.

In 2008, the consumption of electricity distributed by the public utility (JPS) may be represented as follows: (i) small commercial/public/industrial costumers (1.4 billion KWh); (ii) domestic sector (1.1 billion KWh); and (iii) larger industry (0.56 billion KWh). Residential use (rate 10) accounted for approximately 34 per cent of annual consumption, while large scale users (rates 40 and 50) accounted for 18 per cent; the cement sector alone accounted for about 3 per cent. It needs to be noted however that with self generation, the mining is by far the largest consumer of electricity in Jamaica and used over 3 billion KWh of electricity in 2008 (almost 80 per cent of all other sectors combined).

FIGURE 5
ELECTRICITY END USE DISTRIBUTION, ACCORDING TO CUSTOMER CLASS (2008)

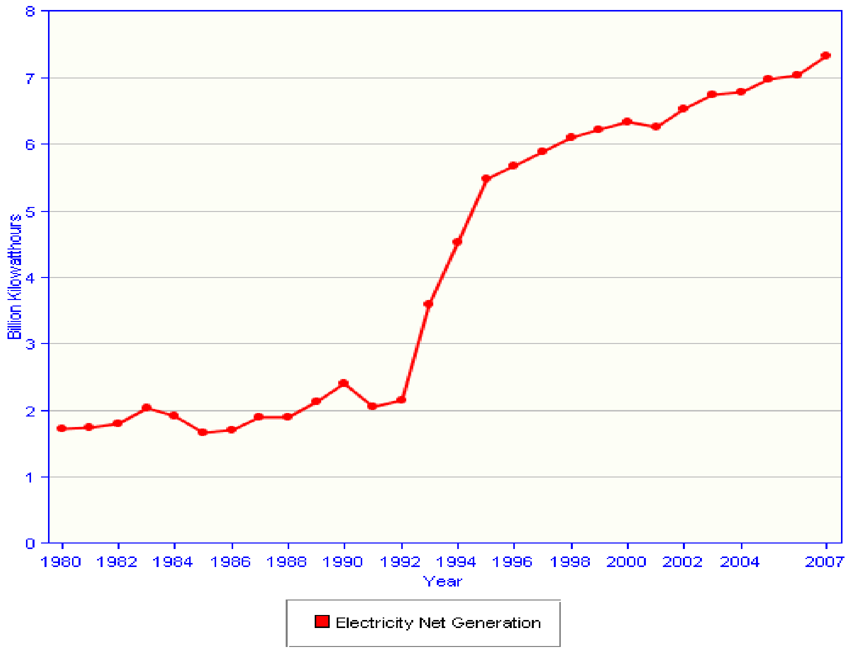


Source: JPS Annual Report, 2008.

Over the past thirty years, there has been a monotonic increase in electricity generation and use in Jamaica (Map 1); electricity generation was 1.75 billion KWh and 7.4 billion KWh in 1980 and 2007 respectively. This trend follows a similar increasing pattern in the per capita GDP (Figure 7) —a feature that represents the increased affordability and accessibility of electricity services—. In 2008, 7.41 billion KWh of electricity was generated. Of this quantity, 4.12 billion KWh was generated by JPS, which is an increase of 1.2 per cent over 2007. Despite this increase in generation however, total electricity sales to customers was reduced by 1.1 per cent —an indication of the inefficiencies in the JPS transmission and distribution system.

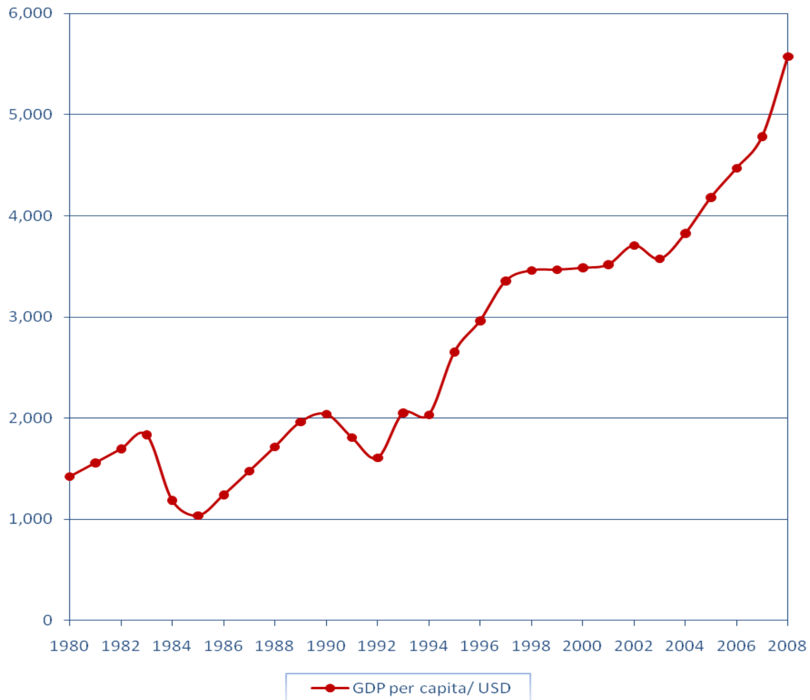
Consumer use accounted for 75.9 per cent of total electricity generated in 2008 while line losses and "unaccounted net generation" stood at 23.7 per cent —the remainder was for internal company use. Sales to large power increased to 590.6 million KWh while sales to residential consumers declined to 1.03 billion KWh. The JPS customer base stood at 586,138 in 2008, an increase of 1.6 per cent over the previous year. The number of residential customers was 523,728; general service was 60,530 and 126 were in the category large power.

FIGURE 6
NET ELECTRICITY GENERATION (1980-2007)



Source: Ministry of Energy and Mining.

FIGURE 7
PER CAPITA GDP (1980-2007)



Source: CEPALSTAT.

4. Bauxite and Alumina subsector

Bauxite and alumina, which are raw materials used in the production of aluminium, are the country's main exports. During the 1960s Jamaica was the world's largest producer of bauxite; a position held until the 1980s. Today, Jamaica is the number five exporter of bauxite in the world, falling short to the much larger Australia, China, Brazil and Guinea, and has estimated reserves of more than 1.9 billion metric tons. The majority of the bauxite exported from Jamaica is first converted into alumina, though roughly 30 per cent of bauxite is exported in its raw form. Bauxite is taken from mines to processing plants by truck and rail but, because the island lacks sources of cheap energy, the final and most profitable conversion process that turns bauxite/alumina into aluminium must take place overseas. Bauxite mining, kiln drying and lime production are linked to alumina production.

Bauxite companies operate power plants for self generation; the bauxite/alumina sector is the largest end user of energy in Jamaica accounting for over 30 per cent of the energy demand or 8.7 million barrel of oil equivalent. In 2010, the sector has one operational alumina refinery —Jamaica Alumina Company (JAMALCO)— and another company that mines and exports bauxite (Jamaica Bauxite Partners). Three alumina refineries were closed in early 2009 following the global economic downturn in 2008, which drastically reduced the price of many global commodities (including aluminium). These plants were: Aluminium Partners (ALPART) in Nain and the West Indies Alumina Company (WINDALCO) plants in Kirkvine and Ewarton. In general, the plant closures resulted in an approximately 50 per cent fall in bauxite production —from 16 to around 8 million tons. Recently, there have been announcement that the ALPART plant will re open in 2011.

TABLE 4
ALUMINA REFINERY PLANTS IN JAMAICA

Plant	Location	Capacity/ kilotons	Status
ALPART	Nain, St. Elizabeth	1 700	Closed, 2009
JAMALCO	Halse Hall, Clarendon	1 400	In operation
WINDALCO	Kirkvine, Manchester	625	Closed, 2009 -
WINDALCO	Ewarton, St. Catherine	675	Closed, 2009 -

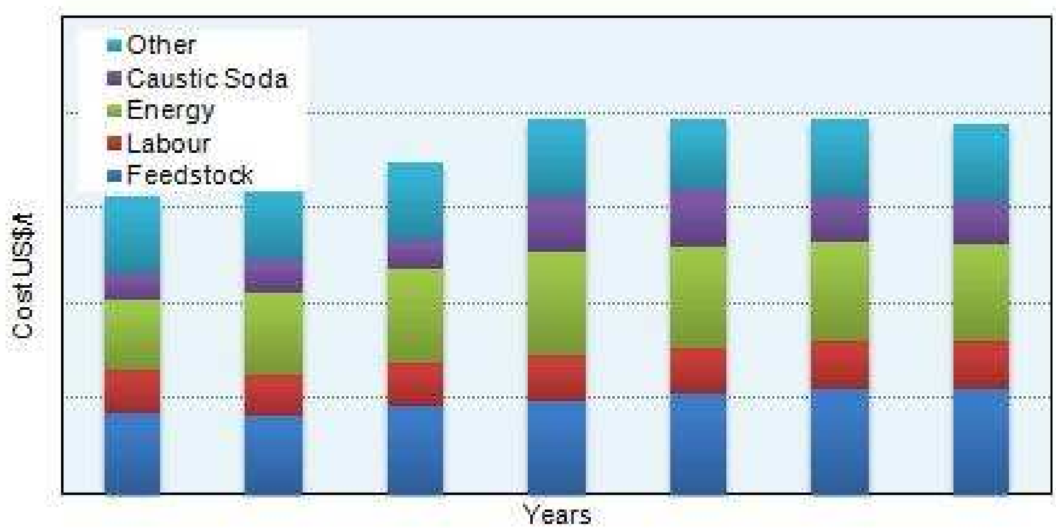
Source: Ministry of Energy and Mining.

ILUSTRATION 1
JAMAICA BAUXITE PARTNERS PLANT AT PORT RHODES IN ST. ANN

Source: http://www.worldpress.org/images/20090403-jamaica.jpg

On average, feedstock (bauxite) represents approximately 27 per cent of industry cash costs (see Figure 8). However, this contribution can vary widely for individual refineries, highlighting the advantage of access to low cost bauxite supplies.

FIGURE 8
ALUMINA REFINERY COST BREAKDOWN

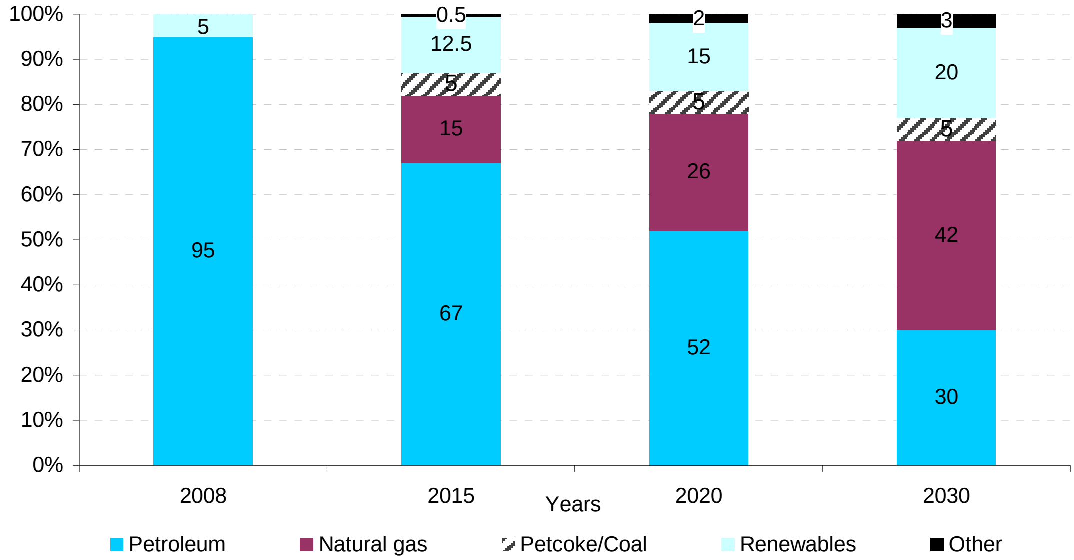


Source: http://www.ame.com.au/Refineries/Ala/Pavlodar+Alumina.htm.

In the case of Jamaica, there is already an inherent disadvantage in the fact that its alumina content is lower than average: 6 tons of Jamaican bauxite is required to make 1 ton of aluminum, compared with only 4 tons of the ore mined in Guyana. High electricity costs of around 20 US cents per kWh and low efficiencies of around 40 per cent —a loss of over 5 million BOE— result in high energy costs. The combination of these and other factors drove the closure of the Jamaican refineries as they are among the least efficient alumina plants in the world.

The anticipated long term trend is for certain costs (labour and energy) to fall with improving productivity and refinery efficiency, achieved through economies of scale, better management and some technical advances —including energy efficiency technologies and electricity generation from cheaper energy sources. Consequently, Jamaica has embarked on a consistent effort to include natural gas as a substantial portion of the island's energy matrix —to replace oil— on account of a perceived price advantage (see Figure 9). There is an abundant reserve of natural gas and Liquified Natural Gas (LNG) is expected to form 12.5 per cent of the island's electricity fuel mix by 2015, increasing to 15 and 20 per cent in 2020 and 2030 respectively. The LNG Project Steering Committee operates out of the Office of the Prime Minister and is focused on a four (4) pronged approach to deliver natural gas to the burners of new and retrofitted power generators by late 2013 to early, 2014.The approach seeks to ensure an efficient, cost effective and sustainable commercial structure that address the Policy Legal and Regulatory Framework, the Marine, Regasification and Pipeline infrastructure, the Supply of Gas and the Off-takers.

FIGURE 9
JAMAICA ENERGY SUPPLY MATRIX, 2010 – 2030



Source: Government of Jamaica, National Energy Policy, 2010 – 2030.

5. Commercial and industrial subsectors

The Jamaican industrial sub-sector may be delineated as follows:

- Primary Industries: (i) Agriculture; (ii) Animal Husbandry; (iii) Fishing; (iv) Forestry; and (v) Mining.
- Secondary Industries: (i) Oil Refining; (ii) Food Processing; (iii) Alcohol Production (Breweries); (iv) Construction; (v) Cement; and (vi) Other Manufacturers.
- Tertiary Industries: (i) Tourism; (ii) Financial Services; (iii) Telecommunication and Information Technology Services; (iv) Retail; and (iv) Other Service and Trade Industries.

In general, the bauxite/alumina subsector (see section 3.1.4), which is a part of the mining industry, has been given particular focus. Also, the Water Utility (National Water Commission) and hotel/tourism subsectors (see section 3.1.6 and 3.1.7. respectively), which are represented within the tertiary industries, are highlighted in their own right. This is due to the historic significance of these subsectors to the Jamaican economy, as well as the energy intensity of their operations.

Implicit in the process of modernization in the productive sector is the increased use of automation and sophisticated electronic equipment, which translates into increased energy intensity. The high electricity costs in Jamaica, coupled with inefficiencies in generation, as well as in transmission and distribution, impose serious operational constraints on the sector. The fact is that Jamaica uses just about 2 BOE to produce USD 1,000 of GDP —the more energy efficient countries such as Costa Rica and Japan uses around 0.75 and 0.9 BOE respectively—. As oil prices increase therefore, energy costs become a more significant portion of GDP earnings and the profitability of the sector is extremely uncertain.

A recent study by the Jamaica Manufacturers' Association (Table 5) showed that the cost of electricity was the single largest disadvantage to the local productive sector when compared with other countries within the region (Costa Rica and Trinidad and Tobago) – the cost of electricity to the Jamaican manufacturing sector is over two and a half times that of its competitors. Of significant note is also the fact that wages in Jamaica are also typically higher as a consequence of this "knock on effect" – employees must be compensated sufficiently to meet their own cost of living, which is heavily influenced by electricity and other energy costs.

TABLE 5
COMPARATIVE COSTS OF KEY INPUTS INTO MANUFACTURING

Input	Unit	Cost/USD			Jamaica Comparative Index
		Jamaica	Costa Rica	Trinidad and Tobago	
Middle Manager	Per annum	35 000	39 348	24 000	1.11
Professional Personnel	Per annum	20 000	14 700	12 750	1.46
Supervisor	Per annum	12 000	10 152	8 900	1.26
Skilled Labour	Per annum	5 200	2 787	4 524	1.42
Unskilled Labour	Per annum	2 500	2 028	2 100	1.22
Electricity	Per KWh	0.12	0.06	0.03	2.67
Factory-space Rental	Per Sq. Ft.	4.25	4.0	4.75	0.97
Telephone Call to US	Per Minute	1.14	0.80	0.90	1.34

Source: JMA Competitiveness Study (2003).

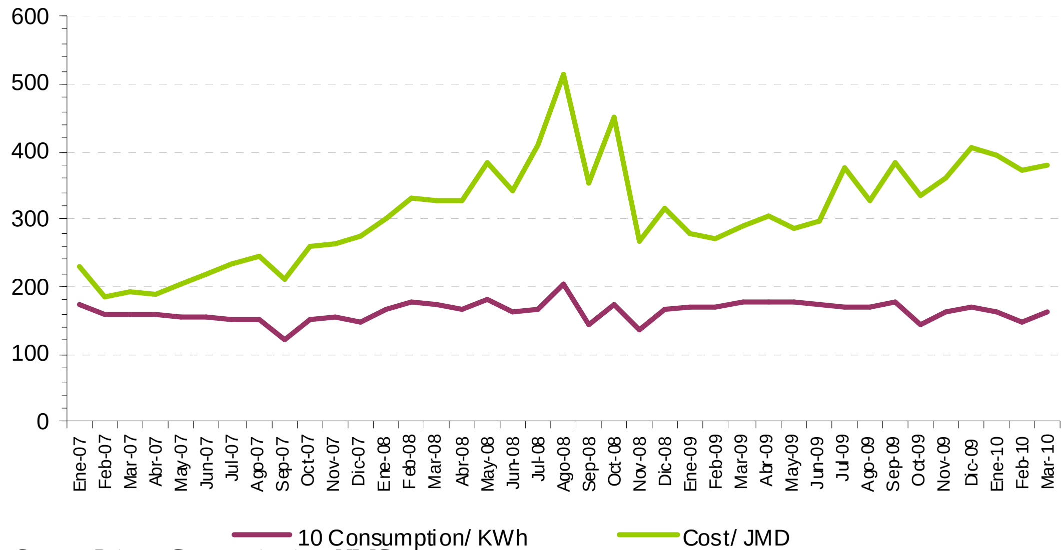
6. National Water Commission (NWC)

The National Water Commission (NWC) was established in 1980 as a government agency and is charged with providing potable water and wastewater treatment services. The Office of Utilities Regulation (OUR) approves tariffs and establishes targets for efficiency increases. Overall, access to the municipal water supply in Jamaica stands at 93 per cent and access to sanitation (sewerage) is currently at around 80 per cent.

The National Water Commission (NWC), which produces more than 90 per cent of Jamaica's total potable water supply, operates a network of more than 160 wells, over 116 river sources (via water treatment plants) and 147 springs; Parish Councils and a small number of private water companies supply the rest of the potable water . NWC operates more than 1,000 water supply facilities and over 100 sewerage facilities island wide. These vary from large raw water storage reservoirs at Hermitage and Mona in St. Andrew and the Great River treatment plant in St. James, to medium sized and small diesel driven pumping installations serving rural towns and villages across Jamaica. The NWC facilities also include over 4,000 kilometres of pipelines and more than 500 kilometres of sewer mains across the island and the company supplies some 190 million gallons of potable water each day.

Over the last three years (2007 – 2010), average monthly electricity consumption by the NWC has been around 16 million KWh (see Figure 10); NWC consumed 184.4 million KWh in 2007, 202 million KWh in 2008; and 204.5 million KWh in 2009 and is the single largest customer of JPS – NWC uses around 5 per cent of the electricity generated by JPS. This has been at significant cost, reaching as high as JMD 514 million or just over USD 7 million in August 2008 (following the July 2008 oil-price spike of USD 147 per barrel).

FIGURE 10
MONTHLY ELECTRICITY CONSUMPTION, NATIONAL WATER COMMISSION, 2007 – 2010



Source: Private Communication, NWC.

The “energy water nexus” is a critical one. These two critical resources are inextricably and reciprocally linked; the production of energy requires large volumes of water while the treatment and distribution of water is equally dependent upon readily available, low-cost energy. The fact is that the NWC water and sanitation infrastructure is inadequate and inefficiently operated, as the level of “non revenue water” for the NWC is typically around 66 per cent; in 2008, the service providers produced 277 million cubic metres of water, but only 103 million cubic metres were consumed.

The inefficient provision of water (66 per cent “non revenue” loss) via power provided from inefficient electricity generation (71 per cent process loss) and transmission/distribution loss (23 per cent) leads to very little of the energy used eventually reaching customers through commodity delivery. In fact, only about 7.5 per cent of the energy content from each barrel of oil used towards water and sewerage services is manifested through commodity delivery to the end user.

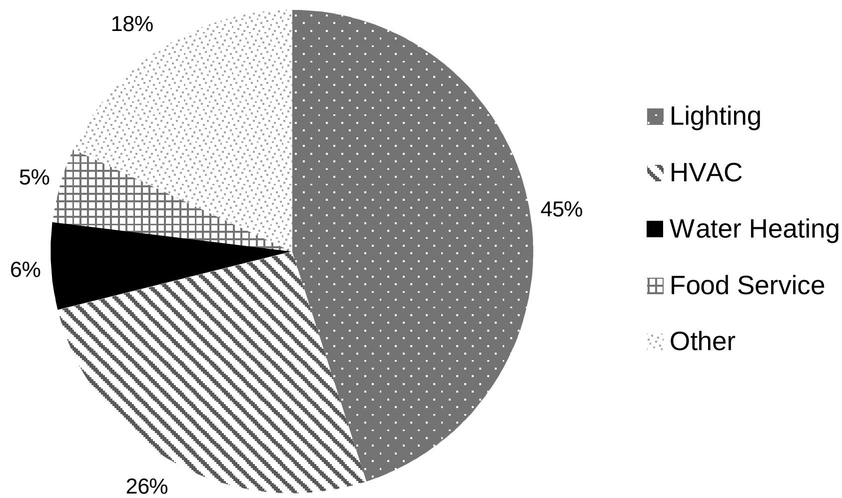
7. Hotel and tourism subsector

The hotel industry is one of the most energy intensive subsectors of the tourism industry, with much of the overall energy consumption due to lighting and air conditioning services; the thermal comfort standards applied in defining the required levels of thermal comfort in hotels have a substantial effect on the overall energy use in this sector. Hotels are designed to provide multi facetted comfort and services to guests frequently accustomed to, and willing to pay for exclusive amenities, treatment and entertainment. Comfortable indoor environments, safety and reliability are some of the amenities valued by guests. State of the art technical infrastructure is typically utilised in hotels to provide high levels of comfort, including thermal comfort.

Many of the services provided to hotel guests are highly resource intensive, whether it concerns energy, water or raw materials; he energy expenses of some hotels are believed to be as high as 10 per cent of their gross revenue. Typically, lighting consumes as much as half of the total energy used in hotel facilities and over 25 per cent of the total energy used in hotel facilities is consumed by systems and processes responsible for space conditioning, i.e. heating, ventilation and air conditioning (HVAC). Activities that target lighting, HVAC and water heating services are desirable as together, these services account for 77 per cent of electricity end use (Figure 11).

There is little available data that specifically tracks electricity and other forms of energy use in the Jamaican hotel subsector – this tend to be aggregated with the rest of the commercial subsector (rate 20/40 customers).

FIGURE 11
HOTEL ELECTRICITY CONSUMPTION BY END USE



Source: Hotels' Power Quality and Utilization Guide, European Copper Institute (2008).

Unfortunately, hotel managements are not always as appreciative of adopting methods and technologies promoting energy conservation as they seem to be susceptible to new trends in accounting or security systems; technologies, such solar and ocean cooling, have the potential to significantly reduce air conditioning costs. The mistaken perception that energy saving is inherently complicated and prohibitively expensive, is still widely prevalent. On the contrary, it has been shown that modest capital expenditure and good housekeeping can result in around 20 – 30 per cent savings on energy bills.

Actions put in place as a result of the implementation of environmental management systems at five Jamaican hotels, through the EAST Project that was implemented between 1997 and 2002, reduced energy use per guest night by 12 per cent. These actions also reduced water consumption by 50 million gallons and energy use by over 1.6 million KWh. The dollar value of the efficiency gains for the five hotels was USD 616,555 and was derived from total investments of USD 175,000.

8. Household subsector

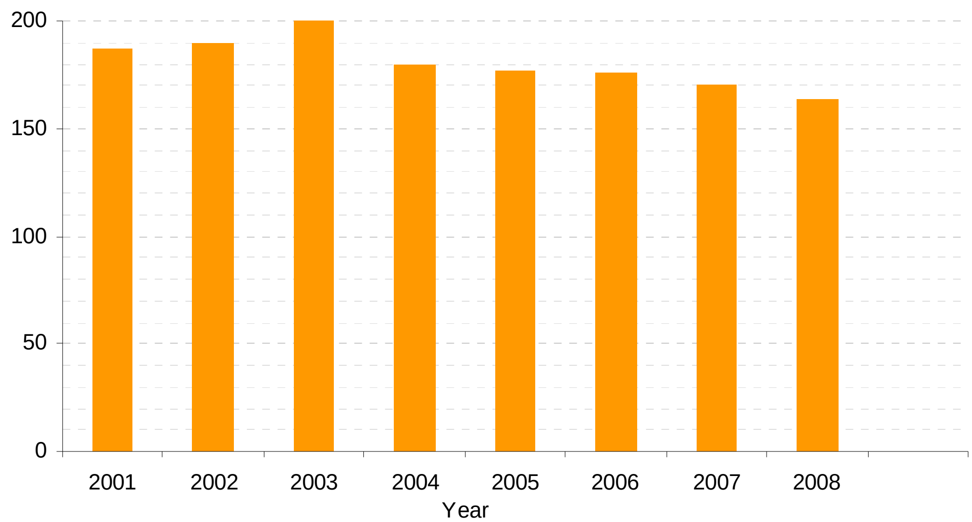
Electricity is the main source of lighting for Jamaican households, with approximately 90 per cent of the population having access to electricity. Residential customers comprise the largest group of customers to the electric utility company (JPS) and averaged 523,728 in 2008, consuming a total 1.08 billion kWh of electricity which is 25 per cent of the electricity generated. In 2006, Jamaican household consumers paid US 25.6 cents per KWh (for the electricity purchased from the utility).

The GOJ had promulgated an energy policy in 1995, and sought to development of a new energy policy in 2004, with a Green Paper being tabled in Parliament in March 2006 to promote discussion. As a consequence, a household energy end use survey was commissioned in June 2006 by the Petroleum Corporation of Jamaica (PCJ) with funding from the United Nations Development Program (UNDP). It was conducted by the Statistical Institute of Jamaica (STATIN) and the Planning Institute of Jamaica (PIOJ). Data generated from the survey was to assist in the formulation of strategies to enhance the achievement of the policy objectives and further address the needs of the sector.

The findings of the 2006 survey complemented those of an earlier 1997 energy survey and indicated that lighting was predominantly by electricity, though some households (mainly in the rural areas) still used kerosene and a few used candles. Cooking was mainly with Liquid Petroleum Gas (LPG), though some rural households used firewood or charcoal. Water heating was mostly by electricity, though some in rural areas used firewood; there were also some solar water heaters. Comparison with the 1997 survey revealed an increase in the use of electricity for lighting in 2006 and an increase in the use of LPG for cooking, which coincided with a reduction in kerosene for these purposes and a reduction in the use of firewood and charcoal for cooking. This was attributed to an increase in the standard of living and may be validated by the fact that per capita GDP increased from USD 3,356 in 1997 to USD 4,469 in 2006 —an increase of 33 per cent.

Average electricity consumption of Jamaican households, as depicted in Figure 12 below was 164 KWh per month in 2008, gradually decreasing from 200 KWh per month in 2003. This reduction was due largely a response by citizens to some amount of energy efficiency programmes in the household and more particularly to increasing electricity rates, which culminated with record high electricity costs following the 2008 "oil price spike".

FIGURE 12
AVERAGE MONTHLY HOUSEHOLD ELECTRICITY CONSUMPTION (IN KWH), 2001 – 2008



Source: Energy Policy 2009 – 2030, Ministry of Energy and Mining, October 2009.

Between the 1997 and 2006 energy surveys, an increasing trend in the proportion of households having electricity was identified. Many households (35, 38 per cent) consumed 301 – 500 KWh of electricity; 30 per cent of those in urban areas consumed above 500 KWh. Heads of household seemingly gave limited consideration to energy efficiency in their decisions to purchase electrical appliances, more so urban than rural heads of households.

Energy consumption is determined not so much by individual consumer behaviour as by lifestyle patterns that are more collective in nature. It is believed that individual choice in industrial societies is limited by the way these have been shaped: cities, water and energy supply systems, building and product design, etc. While individuals influence what happens at the end of the chain, the scope for major changes in energy use is constrained by the primary systems in which individual lives are led.

A consequence of changing lifestyles is an increasing demand for household electrical equipment, homes, cars, etc., both in quantitative and qualitative terms. Qualitative changes are typically manifested in increased scale: refrigerators with a larger volumetric capacity, widescreen televisions, faster, more powerful computers, etc. All this suggests a basic premise: that these items convert energy into services, and it is the services in which individuals are interested, not the energy.

The 2006 Study showed that the most common appliances for entertainment were television sets in 93 per cent of households, while about 74 per cent had radios and 40 per cent had component sets/stereos. DVD players and recorders were in nearly 39 per cent of homes. For kitchen appliances, 82 per cent of households had a refrigerator and nearly 35 per cent had a microwave oven; the latter were almost twice as prevalent in urban households. Other high electricity use appliances (in addition to microwave ovens) were not common; electric water heaters were only in 6 per cent of households, deep freezers in 11 per cent, electric stove in 4 per cent and air conditioners in 3 per cent of households. The exception was the electric clothes iron in 88 per cent of households. It was found that 16 per cent had two or more televisions and over 19 per cent had two or more fans.

Comparison of the percentage of households having various appliances in 1997 and 2006 showed little change for radios, or for some of the high electricity users, such as electric stoves, water heaters and air conditioners. Others showed large increases over the decade, particularly microwave ovens, televisions and washing machines. There was also some increase in refrigerators and electric clothes irons.

In the 2006 Survey, about 79 per cent of households suggested that they routinely performed energy saving practices. The most identified measure by 73.1 per cent of respondents was the turning off of electric lights and appliances when not in use. Interestingly however, only 26.6 per cent stated that their households used energy saving bulbs.

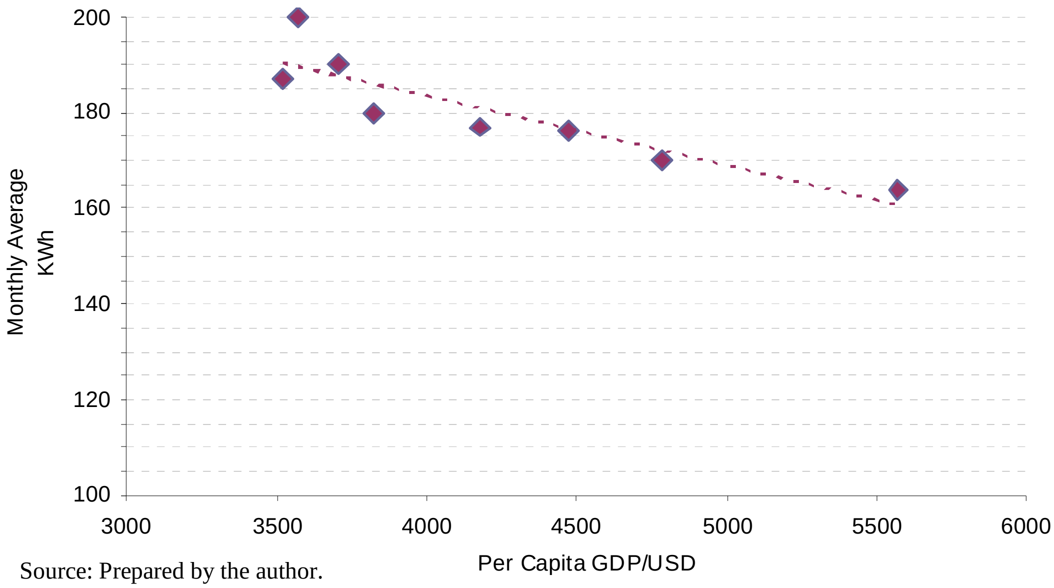
An early energy conservation initiative that targeted the household sector was the Demand Side Management (DSM) Programme. This project created a DSM program unit within the JPS and that was aimed at demonstrating a broad-based utility DSM program. As part of this program, the utility gave free CFLs to 100 homes (about 300 lamps) in a pilot established the technical criteria regarding equipment performance, customer response, and installation problems. Subsequently (in Phase Two), the utility sold around 100,000 CFLs to approximately 30,000 households at discounted prices; the utility sold CFLs to consumers as part of an overall energy savings package along with combinations of other equipment like low flow showerheads and outdoor lighting controls. Consumers were offered up front cash or 12 month financing options and involved a substantial public education and information campaign through utility mailings, offices, and the media.

The main achievement of the programme was a reduction of the electric load by almost 1.7 MW and electric savings of approximately 5,350 MWh per year. Despite its numerical success, the project failed to achieve its main goal of “transforming the energy efficiency market” as consumers were still unable to finance continued energy reduction schemes in households. To address the issue of affordability, the GOJ developed a programme for the free distribution of 4 million CFLs (that were provided as a gift by the Republic of Cuba) to households in 2006. Though plagued with “administrative inefficiencies”, the project resulted in an estimated load reduction in 80 MW of demand or 48,500 MWh of electricity. The most successful feature of the “Cuban CFL Project” was the large scale acceptance of the product and its benefits by the general public.

In general, the poorest households tend to have lower electricity bills on average than do the richest. In some countries the difference is quite small, but in most cases the richest households spend, on average, three to six times as much on electricity each month. Although rich households have higher bills, the households in the poorest quintile devote on average a larger share of household consumption to electricity. Further, households typically spend more on energy than on water, if they pay for water at all.

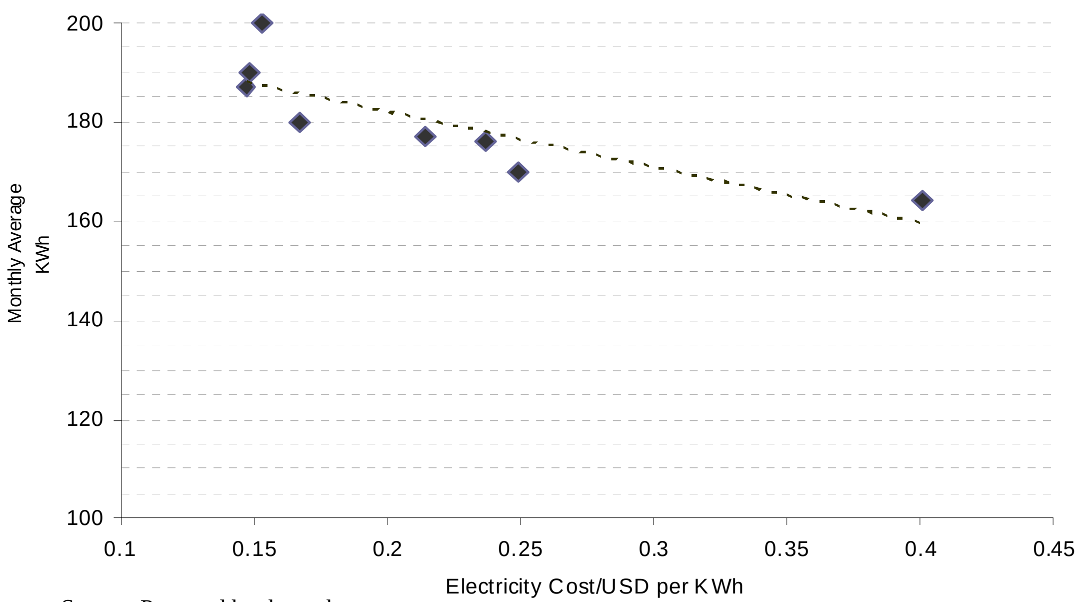
Though more analysis may be required however to link the dynamics between electricity use and household economics, it seems (at a glance) that electricity use decreases as per capita GDP increases for the greater part of the last decade (2001-2008) – Figure 13. This could be either a consequence of efficiency measures, such as CFLs, becoming more affordable or that the economic gains of the household were simply eroded by the increasing cost of electricity over the same period. Figure 14 indicates the trend in electricity use with price and shows that as electricity costs rose above US 20 cents per KWh, households responded by reducing their consumption – this was most likely achieved through more stringent conservation methods.

FIGURE 13
RELATIONSHIP BETWEEN ELECTRICITY USE AND PER CAPITA GDP
2001 - 2008



Source: Prepared by the author.

FIGURE 14
RELATIONSHIP BETWEEN ELECTRICITY USE AND COST PER KWH
2001 - 2008



Source: Prepared by the author.

B. Transport sector

The transport sector – land, air and maritime - represents a critical component of any country in its impact on national development. One of the most fundamental attributes of the sector is the ability to move persons, goods and services between spatial locations at the local, regional and international levels. Jamaica transport infrastructure includes: (i) a total of 15,394 km of road network (844 km of arterial roads; 717 km of secondary roads, 3,225 km of tertiary roads; 282 km of urban roads; 10,326 km of parochial roads; and 800 bridges on the main roads); (ii) an airport infrastructure of two international airports and four domestic aerodromes; (iii) a railway network covering approximately 331 km of track as well as six privately owned mining railways lines; and (iv) a maritime transport infrastructure of fourteen major seaports. Jamaica has one of the densest road networks in the world, with a total of 15,394 kilometers of road. The length of the road network in Jamaica has incurred some changes due to developments such as the realignment of main roads. There was also the addition of thirty-three kilometers (33 km) to the road network due to the construction of Highway 2000. The transport sector in Jamaica may be considered to include road and rail transportation, air and maritime transportation.

1. General consumption

The transport subsector (including shipping and aviation) used about 12 million barrels of petroleum or 42 per cent of the nation's oil imports in 2008, i.e. more than one third of total petroleum consumption. Of this, land (road and rail) transport accounted for 6 million barrels or around 21 per cent of total consumption. The amount of petroleum used for road and rail transport alone is in the range of the volume used for electricity generation by JPS for the public grid, without self generation of the bauxite and sugar industries.

The demand for petroleum is rising steadily, with a particular steep increase of almost 1.5 million barrels between 2004 and 2005. Almost two thirds of the total amount was spent for road and rail transportation, with the latter being of minor importance. The remaining is evenly split between air and marine traffic. If we concentrate on the road sector, we find that there is an almost equal share of consumption for unleaded gasoline with Octane 87, unleaded gasoline with Octane 90 and Automotive Diesel Oil (ADO), which is mainly used by buses and trucks, as passenger cars operating on diesel are not very common.

There is no secure statistical information available yet, which would demonstrate, how the transport sector and fuel consumption was affected by the steep increase of petroleum prices in the first half of 2008 and before. Preliminary data suggest that there was a fall in petroleum consumption by about 10 per cent. It can be assumed that drivers reacted by reduced mileage as it happened in most industrialized countries. In the last quarter of 2008, ex refinery prices dropped from more than JMD 70 per litre (Octane 90 gasoline) to only JMD 50. In a drive to reduce prices, E10 was introduced in Jamaica on a phased basis on November 1, 2008 and by May 2009 all motorists across the island were receiving E10 fuel in both Octane 87 and 90 fuels, as their only option. The economic benefits of the project are however yet to be analyzed.

2. Private motor vehicle fleet

By March 2006 about 537,000 motor vehicles of all types were registered, of which 374,000 were motor cars and 128,000 were trucks. In the year 2005 alone, more than 74,000 vehicles had been registered for the first time. Only one quarter of all cars and light commercial vehicles (as pickups and sports utility vehicles) were new on the road, the rest was imported as second-hand vehicles, mainly from Asia. Figures for the import of used vehicles dropped significantly in the late 1990s as new regulations restricted the shipping of older cars and import duties were raised. A revised import policy, in effect since July 2004, restricts the age of imported vehicles even further to a maximum of three years for cars and four years for light commercial vehicles.

Despite high import duties related to cylinder volume, Jamaican vehicle buyers do not necessarily opt for smaller cars. Apparently other features have more importance than motor size and fuel consumption. The annual license fee is also dependent on cylinder capacity of the engine and does not take into account fuel consumption. Compact cars, with a specific average consumption of less than 6 litres per 100 km, are exceptionally rare. We estimate that the medium consumption of all passenger cars is 10 litres per 100 km, or above.

3. Public motor vehicle fleet

Under the rationalisation of the public passenger transport system in the Kingston Metropolitan Region (KMTR), the Metropolitan Management Transport Holdings Ltd. (MMTH) was established in 1995 with responsibility for purchasing buses and building depots and terminal facilities, while the Jamaica Urban Transit Company (JUTC) was established in 1998 to operate the public passenger transportation system that had previously been provided by private operators.

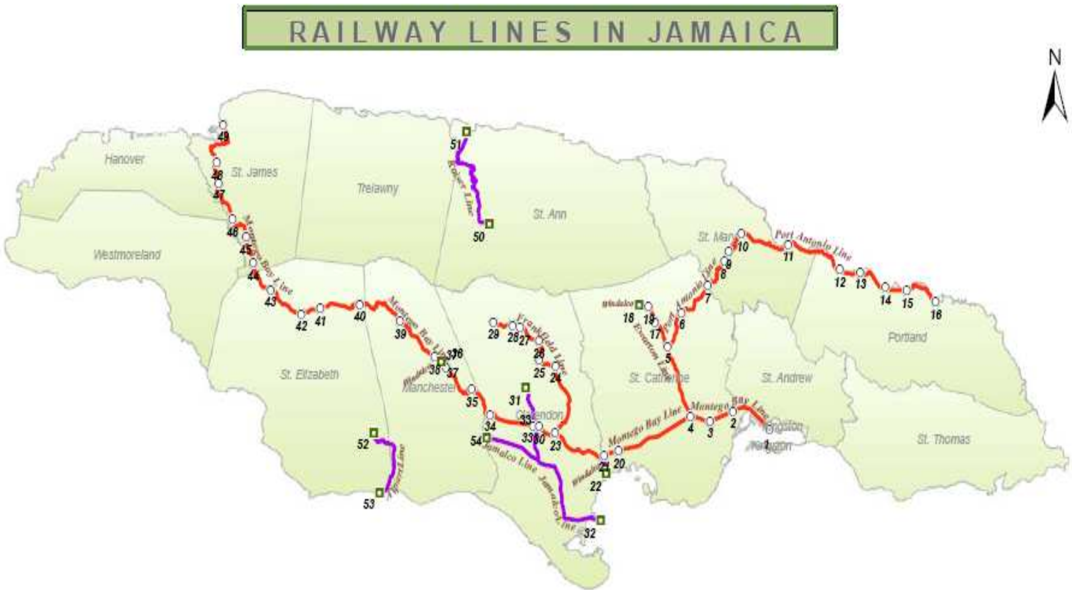
In 2008, there were a total of 1,648 buses licensed to operate in or from the KMTR with a total seating capacity of 39,457. In addition, the Montego Bay Metro provides service on three routes with eight buses. There were a total of 19,075 taxis licensed by the Transport Authority to provide public passenger service island wide. The importance of the public transport system to road transport in Jamaica is highlighted by the finding of a recent survey that nearly 75 per cent of households do not own a motor vehicle.

4. Railway transport

Jamaica used to have a public railway track system of 334 km run by Jamaica Railway Corporation (JRC), of which currently only 92 km are in operation for the bauxite industry. There is currently no passenger traffic. In total 292 km would be available for reuse with the longest distance connection between Kingston and Montego Bay (181 km). The second major line between Spanish Town and Port Antonio would need major rehabilitation or even reconstruction between Bog Walk Junction and Port Antonio (87 km) before reopening could take place. Apart from the public rail system, different bauxite companies own and operate own tracks with a total length of about 100 km.

Since the closure of the public passenger and freight transport services of the Jamaica Railway Corporation (JRC) in 1992, passenger rail transport has remained dormant and railway operations in Jamaica are currently limited to the activities of bauxite companies in the island.

MAP 3
RAILWAY LINES IN JAMAICA



Source: Jamaica Railway Corporation.
Note: The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations.

It may neither be economically viable nor reasonable to rehabilitate the railway system at full length to take up regular passenger traffic. Under Jamaican conditions with relatively short distances, a modern bus transport system can be as efficient and speedy as trains and offer more flexibility.

5. Maritime and air transport

Jamaica is ideally located along strategic north-south shipping lanes and air routes with a major port facility and other potential port facilities on the south coast. Jamaica's water-based transport subsector is almost entirely represented by deep-sea maritime transport, as inland waterways and short-sea coastal shipping play insignificant roles in the island's transport sector. In 2008, sea and air transport accounted for 21 per cent of the nation's energy use —the same as that used by land (road and rail)—. There is significant aggregation of the diesel fuel used by land vehicles and marine craft. It is a well known fact that the local fishing industry is primarily dependent on diesel and the energy use scenario within this group is worth examining with a view to identifying the scope for efficiency activities.

C. Policy and regulatory framework

1. Government policies on energy efficiency and energy conservation

Vision 2030: National Development Plan

This document provides the overarching context within which Jamaica's sustainable strategy will be pursued. Vision 2030 identifies "energy security and efficiency" among the key requirements toward the goal of economic prosperity.

National Energy Policy 2009 - 2030

This policy is intended to support the implementation of the Vision 2030 – National Development Plan, particularly National Outcome Number 10 – Energy Security and Efficiency – and is therefore consistent with, and part of the vision for achieving developed country status by 2030. The policy highlights the Jamaican energy vision as: “a modern, efficient, diversified and environmentally sustainable energy sector providing affordable and accessible energy supplies with long term energy security and supported by informed public behaviour on energy issues and an appropriate policy, regulatory and institutional framework”.

Energy Conservation and Efficiency Policy 2010 - 2030

The areas of focus in the draftEnergy Conservation and Efficiency Policy 2010 – 2030 include: public sector; private sector (households, industrial, commercial, and tourism); electricity; transport; codes and standards; energy conservation and efficiency market; renewable energy technologies; environment; institutional framework and technical capacity development. This policy supports the National Energy Policy in which Goal 1 is that: “Jamaicans use energy wisely and aggressively pursue opportunities for conservation and efficiency”. Further, the eighth fundamental principle on which the strategic elements of the National Energy Policy is built describes: “An energy sector that reflects a sustained improvement in the ways in which energy is used, through greater energy efficiency, reduced energy intensity and better energy conservation and management”.

Energy Efficiency Building Code, 1996

The current legally enforced building code in use in Jamaica was produced in 1908. Nonetheless, the current code that is being advocated by the GOJ and civil society is the Energy Efficiency Building Code that was spearheaded by the Bureau of Standards (BSJ) and the Jamaica Institute of Engineers (JIE). This code will require the passing of the new Building Act into legislation in order for it to become a legally enforceable document and adherence to same is now on a voluntary basis. The National Energy Policy has stated an intention to: “update, apply and enforce the Energy Efficiency Building Codes to support efficient use of energy in buildings”.

Carbon CreditTrading Policy 2010 - 2030

The draft Carbon Credit Trading Policy 2010 – 2030 was developed in 2009 and, as outlined, sets out a framework for Jamaica’s participation in the carbon trading market. The overarching objective is to position Jamaica to capitalize further on opportunities for partnerships with developed countries through the Clean Development Mechanism (CDM) and other related tools. The vision of the policy described as: “A competitive, diversified, efficient and investment-conducive carbon emission trading sector that fosters sustainable development and induces a less carbon intensive and non renewable energy dependent economy”.

2. Electricity regulations

Regulatory Policy for Addition of New Generating Capacity to the Public Electric System, 2006

This policy sets out the regulatory framework, which will provide the rules for the addition of capacity. These rules are required to facilitate the long term expansion of generation at the least economic cost and must give due regard to the relevant government policies and all applicable legislation. It sets out several modalities by which capacity can be added to the system and will be important in the provision of renewable energy generation to the grid. The Least Cost Expansion Plan (LCEP) is the starting point for the addition of new capacity, above 15MW.

Net Billing Regulation, 2009

The regulatory policy allows for the addition of small power producers of 100 KW capacity and less to be made to the system by way of a Standard Offer Contract issued by JPS. This contract, among other things, addresses: (i) the tariff structure; (ii) the rights and responsibilities of the parties; (iii) safety; (iv) the technical requirements of the facility; and (v) the assignment of interconnection costs.

The regulatory policy specifies net billing which utilizes a two meter system, as opposed to net metering which requires only one meter as the method of interface to the grid. Both mechanisms involve selling excess generating capacity to the grid; however, in the simplest terms, the difference would be the price at which JPS buys the excess. In net billing, JPS would buy excess power from its customers at the "generation avoided cost", plus a premium (currently set at up to 15 per cent) if the source is renewable energy. In the case of net metering, JPS would buy excess power from its customers at the same rate at which it retails to customers. Net billing is currently supported under the Addition of New Generating Capacity to the Public Electric System agreement.

All Island Electric License, 2001

The All Island Electric License (2001) establishes the framework for the planning and implementation of incremental addition of generation capacity to the national electricity grid. While the Jamaica Public Service Company (JPS) has the exclusive right to, under the License, transmit, distribute and supply electricity throughout Jamaica until 2021, the License provides for the addition of generating capacity through a competitive process since April 2004.

3. Transport sector regulations

The National Transport Policy, 2007

The National Transport Policy is designed to encourage energy conservation measures in the transport sector. The suggested mechanism for same is the prioritization of the following related activities: (i) efficient traffic management; (ii) car pooling; (iii) park and ride; (iv) clean fuel development; (iv) "flexi" work hours and "telecommunicating" work arrangements; (v) efficient public urban mass transit systems; (vi) promotion of vehicle and road maintenance programmes; and (vii) assessment of more efficient transport modes —such as barging and rail— for bulky cargo. In addition, supporting legislation for biofuel use and studies related to the uptake of compressed natural gas (CNG) as a transport fuel are being explored.

Petroleum Quality Act, 1992

The Petroleum Quality Act defines the cursory characteristics of the various classes of liquid fuels used in Jamaica; these are identified as petroleum, motor gasoline, diesel oil, kerosene (whether domestic kerosene or Turbo Jet A1 Fuel) and such other categories of petroleum as may be prescribed by the Minister —this includes biofuel blends—, such as E10, and biodiesels, etc.

4. Water regulations

Jamaica Water Sector Policy (Draft)

The Jamaica Water Sector Policy, Strategies and Action Plans were formulated by the GOJ in 2002 to facilitate the structured development of the water sector; the policy suggests an intention by the GOJ to increase the efficiency in the provision and consumption of water services. It will, therefore encourage the implementation of measures to ensure conservation by providers and consumers of water. The "unaccounted losses" by the NWC is featured as a main priority.

5. Other related policies and regulations

Office of Utilities Regulations Act, 1995 (Amended, 2000)

The Office of Utilities Regulations Act establishes and outlines the roles, responsibilities and functions of the Office of Utilities Regulations (OUR). The OUR is primarily responsible for regulating the utility companies in Jamaica. This includes companies that provide Electricity, Telecommunications, Water Supply, Sewerage, as well as Public Passenger Transport by road, rail and ferry. These companies include the Jamaica Public Service Company (JPS) and the National Water Commission (NWC).

Standards Act, 1968

The Standards Act of 1968 establishes the Bureau of Standards Jamaica (BSJ). “The Bureau” has responsibility for formulating, promoting and implementing standards for goods, services and processes; its role is especially critical to the development and enforcement of technical regulations for commodities, including fuels, machine and equipment, household appliances, etc.

National Resources Conservation Authority (Air Quality) Regulations, 2006

The National Resources Conservation Authority (NRCA) Air Quality Act of 2006 sets out the criteria for determining the facilities that require license to discharge listed air pollutants and the associated fees for same. The regulation also requires licensees to submit annual emissions reports, to include the quantity and individual components of their air discharge. This is especially important in the electricity generation sector where large quantities of greenhouse gases (GHGs) and other pollutants are discharged.

National Science and Technology Policy

This policy seeks to promote the development of science and technology to enhance national development and foster international competitiveness. This policy may be utilized to influence R&D activity in energy efficiency and renewable energy technology development.

Housing Public Private Partnership Policy, 2008 (formerly Joint Venture Policy)

The HPPPP is intended to provide the GOJ, through the Ministry of Housing, with direction on developments being undertaken either on government lands or on lands that are privately owned, with development facilitated by the ministry or government agencies. The policy may be used to promote energy efficient housing solutions, especially for low and middle income Jamaicans.

Tourism Master Plan for Sustainable Development

The Master Plan is intended to provide guidance on issues related to the greater diversification of the Jamaican tourism product and a primary goal of same is the integration of environmental management and protection of natural resources into tourism services. Given the significant energy use of the hotel/tourism sector and the “nexus between energy and the environment”, the policy may play a role in promoting sustainable energy use within the industry.

D. Activities and projects

TABLE 6
ENERGY EFFICIENCY-RELATED INITIATIVES IN JAMAICA IN THE LAST 3 DECADES

Programme	Financed by	Period	Main Priorities	Achievements
Project for Energy Conservation and Efficiency in the Public Sector	IDB and GOJ	2010 - 2011	To evaluate energy consumption in the public sector and develop plans to implement corrective measures	Assessment of energy costs and patterns are in progress
Programme of Environmental Management in Hospitals and Schools	UNDP and GOJ	2006	To "kick-start" energy conservation activities in the public sector, particularly hospitals and schools	Energy audits showed potential annual savings of about USD 1.8 million at investment costs of roughly USD 3.6 million
Household CFL Distribution Programme	Republic of Cuba and GOJ	2006 - 2007	Providing "state-led" intervention in energy efficiency measures at the household level	Estimated load reduction in 80 MW of demand or 48,500 MWh of electricity, as well as large-scale acceptance of the product and its benefits by the general public
Jamaica Demand Side Management Programme, JDSMP	World Bank/ GEF and GOJ	1994 - 1998	Demonstrating a broad-based utility DSM program	Reduction of the electric load by almost 1.7 MW and electric savings of approximately 5,350 MWh per year
Least Cost (Electricity) Expansion Plans, LCEP	JPS OUR	2004 2007	Establishes a balance between capital investments that flow into the electricity sector and the price to the consumer	
Energy Audits for Sustainable Tourism, EAST	USAID and GOJ	1997 - 2002	Demonstrating the benefits of environmental management systems to the hotel sector	Reduction in water consumption by 50 million gallons and energy use by over 1.6 million KWh
Energy Sector Management Assistance Programme, ESMAP	UNDP/ World Bank and GOJ	1990 - 1991	To ensure that proposed investments in the energy sector represented the most efficient use of domestic and external resources	Energy Efficiency Building Code (EEBC); Appliance Testing and Labeling (ATL) programme; and other technical assistance
Energy Sector Assistance Programme, ESAP	USAID and GOJ	Late 70s – late 80s	To provide technical assistance and funding for energy conservation and alternative energy requirements of the public and private sectors	Energy audits and retrofitting that resulted in energy savings between 10 and 25 per cent

Source: Data gathered by the Author.

E. Financing and incentives

The Energy Fund

The fund was set up in May 2008 to act as a wholesaling window for energy, particularly energy efficiency, projects and targeted primarily: (i) commercial and industrial energy users; (ii) energy service companies (ESCos); and (iii) manufacturers of energy efficiency equipment and devices. The funds are being retailed by approved financial institutions (AFIs) at an annual interest rate of 12.5 per cent. Oversight for the fund is provided by the Development Bank of Jamaica (DBJ). The intention is that the Fund will seek to raise USD 25 million over the next five (5) years for energy efficiency measures and small scale renewable energy projects. The National Housing trust (NHT) and PCJ provided JMD 5 million and JMD 15 million respectively towards start-up financing, which was added to a loan of USD 5.75 million from the PetroCaribe Development Fund; This resulted in a net initial value of JMD 500 million or USD 6 million. In March 2010, only around JMD 70 million (ca. USD 0.8 million) – or 14 per cent of the available funds – had been accessed.

The PetroCaribe Development Fund

The PetroCaribe Development Fund was established as a result of the 2005 PetroCaribe Corporation Agreement that started between Venezuela and thirteen Caribbean countries, including Jamaica. The Fund is an initiative of the Government of Jamaica that was created to manage deferred payment proceeds owed to Venezuela from oil supplied under the Petrocaribe Corporation Agreement. The Fund was established in December, 2006 through an Amendment to the Petroleum Act, which provides for the following:

- Upgrading of the physical and social infrastructure of Jamaica.
- Support the development of human resources.
- Support projects designed to stimulate economic expansion.
- Support projects which promote the use of alternate energy sources.
- Refinancing of domestic public sector debt.

Under the initiative, Jamaica was initially allowed to access 21,000 barrels of oil per day from Venezuela, (a volume, which was increased to 23,500 barrels per day) through a deferred payment scheme —the amount of which is determined by the per barrel cost of oil. Under the Prepared by the author. PetroCaribe arrangement, once the price of oil exceeds USD 100 per barrel, 50 per cent of the cost of these imports is deferred for a period of 20 years at a concessionary rate of two per cent; this was adjusted to 60 per cent following the “oil price spike” of 2008. In 2006, Jamaica passed legislation to make provisions for the formal establishment and operation of the fund.

An essential feature of the objective of PetroCaribe Corporation agreement was the addition of energy saving and renewable energy programs to help reduce the imported oil dependency of the Caribbean countries. In this regard, PetroCaribe may arrange credits and exchange technologies to enable beneficiary countries, such as Jamaica, to develop highly functional energy efficient programs and systems, as well as other measures making it possible for the reduction of their oil consumption and to provide a wider range of energy services. Contributions to the fund were typically drawn from the financed portion of oil invoicing and any resulting savings from direct trade. The Energy Fund (outlined previously) was supported by a loan of USD 5.75 million from the PetroCaribe Fund. The Refinery Upgrade Project (RUP) at Petrojam, Jamaica’s only oil refinery is also expected to be financed through PetroCaribe Development Fund. The expansion of the 20.7 MW Wigton Wind Farm Project to 38.7MW is also being financed from the PetroCaribe Development Fund. In general, it has been estimated that as much as USD 156 million has so far been allocated to 68 projects in 10 member nations under the agreement. Jamaica has so far accessed around USD 65 million for energy related programmes —for the Energy Fund, Refinery Upgrade Project and Wind farm Expansion projects.

The ALBA CARIBE Fund

The ALBA CARIBE FUND for Social and Economic Development was established in order to help foster the social and economic development of the countries of the Caribbean. Under the ALBA-CARIBE Fund, participating countries can access financial support for financing social and economic programmes. The Fund was activated by a contribution of United States Fifty Million Dollars (US$50.00M) by the Bolivarian Republic of Venezuela. In December 2007, Jamaica in support of the objectives of the FUND, made a donation of United States Five Million Dollars (US$5.00M) to the Fund. Other member countries are expected to make voluntary contributions to support its expansion as there is an estimated savings of ca. USD 14 per barrel for countries that received the oil supply under the PetroCaribe Corporation Agreement. These resources are expected to be used for the implementation of development projects. Venezuela pays a further USD 0.50 for every barrel of oil exported annually —a sum estimated to be around USD 760 million per annum.

Incentives

The factors typically considered for Government incentives in the current paradigm within the energy sector are:

- Growth in electricity generating capacity using renewable resources;
- Growth in electricity generation by renewable resources;
- Growth in the production of ethanol fuels;
- Reduction in cost of the renewable technology; and
- Market sustainability of the renewable technologies.

The types of incentives that have thus far been promulgated are:

1. Financial incentives

- Personal Income Tax credits and deductions for the purchase of various renewable technologies or alternative fuel vehicles;
- Corporate Income Tax credits, exemptions, and deductions for investments in renewable technologies;
- Sales Tax (or GCT) exemptions on renewable equipment purchases;
- Variable Property Tax exemptions on the value added by the renewable systems;
- Grants for renewable energy technology demonstration projects;
- Special Loan Programmes for renewable energy investments; and
- Production Tax credits.

2. Fiscal incentives

- Direct taxing;
- Full (100 per cent) depreciation in the first year of installation of a project;
- Exemption/reduction in Exercise Duty;
- Exemption from Sales Tax (GCT); and
- Custom Duty concessions on the import of material, parts and equipment;
- Tax subsidies for the production and use of alcohol transportation fuels under the following: (i) Excise Tax exemption; (ii) Ethanol Excise Tax exemption; (iii) Blenders' Tax credit; (iv) Ethanol Production Tax credit; or (v) Alternative Fuels Production Tax.

Also, the following services are eligible for Tax Credit consideration:

- Energy audits;
- Implementation of Energy Conservation Opportunities (ECOs);
- Net metering applications services;
- Waste recycling production; and

- Research and development in energy related processes and technologies: (i) Basic research (original investigation in some area but with no specific commercial objective); (ii) Applied research (investigation with a specific commercial objective in mind); (iii) Developmental research (translation of scientific discovery into commercial products or processes).

In general, there is a raft of GOJ incentives that are available for the pursuit of renewable energy and energy efficiency activities. Questions have been frequently raised however, regarding the suitability and accessibility of incentives – especially tax credits and duty exemptions – to interested parties. There has been, thus far, neither qualitative nor quantitative assessment to determine the degree to which government financing and incentive schemes support the mechanism that are required for the "relative success" in integrating increased energy efficiency activities in the energy sector.

IV. Strategies for implementation

The future pattern of traditional, fossil energy supply and demand points to a growing mismatch between the regions in which energy is needed and those in which natural resources are located. As a result, we can expect to see increasing trade in fossil fuels between regions of the world. Longer supply lines, will increase the risk and impact of disruptions to energy supplies. As world energy demand continues to grow, significant amounts will be met by fossil fuels for some time to come and the development of energy sector policies and strategies must be a mix of energy efficiency strategies and renewable options that on the one hand, lower energy consumption and on the other hand shift energy provision from fossil to more indigenous (renewable) sources. Further, there is a need for sustainable energy policies to be consistent with the Government of Jamaica's overall macroeconomic policies.

As a cornerstone of its policy, the GOJ seems committed to the broad objective of relying on market forces to achieve the efficient allocation of resources. However, it must be cautioned that "the market will deliver" philosophy is wishful thinking and there is need for some direct government activities to drive some energy efficiency and renewable energy options. This chapter of the Report attempts to delineate some intervention points that may assist the GOJ in the pursuit towards: "energy security and efficiency".

The Report will consider primarily whether there is any scope for influencing the pattern of demand and, if so, how and with what policies and instruments. The second approach will look at political agenda setting and design, i.e., consideration of how well the sustainable energy policies have been mainstreamed into the national energy policy framework and/or initiatives to change existing situations. The final approach will explore situations where energy efficiency and renewable energy programmes do exist, considering whether they have been implemented successfully or not and what indicators may be used to define success and failure. Energy Conservation and Efficiency (ECE) remains Jamaica's only short term response to significantly impact the adverse energy situation. Past efforts at energy conservation and improved efficiency of use have not been sustained. The Report identifies strategies to assist in overcoming barriers to the implementation of ECE initiatives, whilst simultaneously addressing the "twin towers" of energy security and GHG mitigation.

A. Electricity Sector

1. Generation

TABLE 7
IMPLEMENTATION STRATEGIES PROPOSED FOR THE GENERATION SECTOR

Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
JPS			
Generation heat loss: Low efficiency (ca. 29 %) of oil- and gas- fired plants	Increase generation efficiency in JPS oil- and gas- fired generation plant from current rate of less than 29 % to around 60 %. This is supported by the National Energy Policy, which identifies the need for: "improved efficiencies in the conversion of primary fuels to electricity" and may require incentive to JPS to induce interest.	This will require a phased introduction of combined cycle (CC) plants, in place of the existing oil- and gas- fired plants on a phased basis. There are 355.4 MW of installed JPS capacity that is already over 30 years old and another 64 MW that is between 16 – 30 years old. Targeting these plants (419 MW or 46.5 % of installed capacity) over the next 10 years would require a mix of JPS and private investments (IPPs); this would bring efficiencies to between 50 – 60 %.	Basic steam generation units have fairly low energy efficiency; typically, only 33 to 35 % of the thermal energy used to generate steam is converted into electrical energy. In CC plants, the waste heat from the oil and gas- fired plants is used in generating steam, which is then used to generate electricity much like any other steam unit.
High cost feedstock: Slow- and medium- diesel plants use very expensive diesel feedstock (ca. USD 210 per barrel)	Replace high cost imported diesel with lower, and more predictable, cost "indigenous" biodiesel.	Explore the development of a pilot facility that utilizes 4,000 acres of Arundo donax to produce around 500, 000 barrels of biodiesel from fast (flash) pyrolysis annually. This would be at a cost of ca. USD 90 million and would require a mix of multilateral and private funding – financed through a commercial Green Bond and may require government intervention on fuel sale terms to JPS.	This activity has the potential to directly replace some diesel in the JPS feedstock. At current diesel price (USD 210 per barrel), this would be an "avoided cost" of USD 105 million per year that is channeled to a local energy source. There could be savings as high as USD 60 million per year due to the cheaper biodiesel.
Hydro plants efficiency: Increasing the operating efficiency via operating conditions and schedule	Increasing the operating efficiency of the hydroelectric power plants from an estimated 40 % to around 80 %.	This requires the systematic upgrade of the ca. 23.8 MW of installed capacity, which is between 20 – 60 years old. Targeting these facilities over a 5 year period would result in increased electricity production of nearly 24 MW – cost analysis on the upgrade should be undertaken as a matter of urgency.	The conversion efficiency of a hydroelectric power plant depends mainly on the type of water turbine and can be as high as 95 % for large installations; smaller plants with output of less than 5 MW may have efficiencies between 80 and 85 %.
IPPs			
Incentives to improve efficiency of IPP plants	Implement "differential" rates for power purchase from IPPs on the basis of generation efficiency	This requires negotiation with JPS and the relevant policy, perhaps the Efficiency in Electricity Generation Policy, is required to induce investment in this direction.	The IPPs, with efficiencies of ca. 40 %, are currently among the more efficient power plants in the generation network. Nonetheless, their efficiencies may be improved to 75 % or more with CC.

(continued)

Table 7 (concluded)

Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
Self-generation			
Sugar (Bagasse): Only two sugar mills – Worthy Park and St. Thomas – use biomass (bagasse) exclusively for electricity; others use bunker "C" fuel and efficiencies are low.	Increase output to grid by increasing the amount of biomass feedstock for electricity generation and increasing generation efficiency in the sugar mills.	Following the recent divestment of the sugar industry, government should enter into discussions with the investors regarding electricity provision and facilitate PPA with JPS – a premium price per KWh for green fuel would be applicable. Options such as biomass gasification may be worth exploring.	Increasing generation feedstock and efficiency will increase the available output to the sugar companies, the excess of which would be likely made available to the grid.
Bauxite/Alumina: Increase output to grid	Increase efficiency in the generation plants used by the bauxite/alumina sector.	This may be achieved through a phased introduction of CC plant technology with combined heat and power (CHP), in place of the existing oil- and gas- fired plants, as well as the shifting of the fuel of use from fossil-based oil (HFO and Bunker 'C') to bio-oil and / or Liquefied Natural Gas (LNG)	This activity has the potential to directly replace some fossil-based fuel without the need for retrofitting and/or infrastructural changes. May provide an opportunity to compliment the LNG strategy.

Source: Elaborated by author.

2. Transmission and distribution

TABLE 8
IMPLEMENTATION STRATEGIES PROPOSED FOR THE "T & D" SECTOR

Item	Recommendation (s)	Proposed Implementation Strategy	Rationale
Transmission and distribution (T&D) losses: System losses are ca. 23 %	Reduce T&D loss from 23 % to 15 %. Current OUR prescription is for a maximum of 15.8 % and requires an incentive formula that penalizes failure to meet target and credits target achievement.	This may be achieved by incrementally reducing non-technical losses from 13 to 8 % and technical losses from 10 to 7 % over a 3 year period; GOJ "incentive and penalty" regime would be required. Again, dialogue with public utility is required to determine same. GOJ support will be required to legitimize "non-revenue" consumers.	Transmission and distribution losses in the USA were estimated at 6.5 % in 2007 (c.f. Jamaica at 23 %). Non-technical losses in Jamaica is estimated at 13 %, and is believed to be largely attributable to electricity "theft".
Existing transmission scenario: JPS is the sole operator for the transmission and distribution of electricity in Jamaica	Develop strategies for net-metering and wheeling to promote small- and medium- private Distributed Generation (DG) facilities.	Conduct study to determine the "real costs" for JPS transmission and distribution, with an aim to formulate "wheeling" costs and to facilitate discussions around same with the utility company.	DG is attractive because it offers electricity that is more reliable, more efficient, and cheaper than purchasing power from a centralized utility. However, the success of DG projects is dependent on the ability of the investor to move the power produced either into the grid or to another point of consumption at reasonable cost.

(continued)

Table 8 (concluded)

Item	Recommendation (s)	Proposed Implementation Strategy	Rationale
Power System Frequency / Cycle: 50 Hz vs. 60 Hz The rate of oscillation of the electricity in power systems around the world is either 50 or 60 cycles per second (Hertz, Hz); "American" type systems oscillate at 60 Hz and "European" type – such as Jamaica - oscillate at 50 Hz.	Evaluate the existing power system cycle scenario to examine the cost/benefits to the electricity sector of maintaining 50 Hz vs. changing to 60 Hz.	Conduct equipment audit of the commercial and industrial sectors, as well as appliance and equipment survey for households to determine mismatch between end-use requirement and the existing cycle. Thereafter, conduct cost analysis for cycle change and energy efficiency gains.	Jamaica inherited the 50 Hz system from the UK but proximity to the US means most electrical devices have been supplied from the latter. It is a fact that frequency mismatch results in inefficient power consumption.
Distributed Generation (DG) vs. Central Generation	Government facilitation for the uptake of Distributed Generation into the energy sector; DG refers to the practice of generating electricity on-site, instead of in a large centralized power plant.	Commission a Study on the lessons learnt from past practices such as the Jamaica Broilers co-generation facility. Conduct stakeholder discussions to determine interest in operation of DG facilities, such as micro-turbines and to determine the role of JPS in same. The private generation of electricity is already allowed under the Addition of New Generating Capacity to the Public Electric System agreement. Its uptake is however discouraged by the unavailability of net-metering, Feed-in-tariffs, or wheeling policies as private facilities would be more economical if electricity may be sold to the grid at a reasonable cost.	DG allows for increased local control over the electricity supply, and cuts down on electricity losses during T&D. With DG, the heat that would normally be lost as waste energy can easily be used to perform other functions, such as powering a boiler; this is known as Combined Heat and Power (CHP) systems and is especially useful in process industries.

Source: Elaborated by author.

3. Demand Side Management

TABLE 9
IMPLEMENTATION STRATEGIES PROPOSED FOR THE "DSM"

Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
"Utility-led" DSM	Involve JPS in a commercial and household DSM functions, as a part of its "required" functions.	Implement the Energy Fund and other DSM initiatives through JPS rather than the AFIs.	The utility is centrally placed to determine and implement strategy, as well as to collect revenue for same.
"Negawatts" Initiative	Facilitate "Nega-watt Initiative" at JPS to control energy use via efficiency and conservation.	GOJ to use its influence as a stakeholder in JPS to negotiate "avoided capacity expansion" through a "Nega-watt Initiative".	The electric utility must be at the forefront of ECE programmes as they have direct contact with end-users.
Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
Net-metering	Introduce net-metering into JPS license (All Island Electric License).	Commence negotiation of net-metering clause, based on findings from T&D study. Offer "green" and "efficiency" target incentives to JPS to encourage same.	Net-metering will give economic encouragement to self-generation and allow for DG plants, which have higher generation efficiency and lower T&D loss. Micro-turbines are especially useful for this purpose.

Source: Elaborated by author.

4. Bauxite/alumina subsector

TABLE 10
IMPLEMENTATION STRATEGIES PROPOSED FOR BAUXITE/ALUMINA SECTOR

Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
"Non-competitiveness" of manufacturing sector	Assess the cost of energy input into the various commercial sector branches, esp. manufacturing, and determine strategies to increase regional "energy cost competitiveness".	Conduct study to determine how electricity pricing and energy intensity within the commercial – manufacturing and service – subsector influence the cost in consumer product; include comparative analysis with competing countries (especially within the region) and methods for remediation.	Past analyses have shown that the cost of electricity was the single largest disadvantage to the local productive sector, when compared with countries within the region; strategies must be found to optimize the energy situation within the sector.
Incentives for energy efficiency improvement	Increase government incentives for the increased "integration of energy efficiency" into commercial operations. This may require both "pull and push" factors.	Create efficiency baselines for the various industries and offer tax-incentives for achieving same, with incremental tax bonus for high efficiency performance (pull factor). Perform consistent revision of energy efficient technologies (including vehicles) that are eligible for duty concession as this will increase the chances of various industries to attain and surpass baseline (push factor).	Energy efficiency has the greatest scope for immediately reducing high energy costs and will increase the comparative advantage of the commercial sub-sector. This is especially important in the more energy intensive industries.
Self-generation	Promote micro-generation activities within the commercial sector.	Develop institutional capacity within government, via the Ministries with responsibilities for Commerce and Energy, to assist industries to identify and implement "self-generation" solutions. Again, this would be feasible if supported by net-metering regulations.	Microturbines are a type of DG systems and have the capacity to produce 25 to 500 KW of electricity. Using waste heat recovery techniques, microturbines can achieve efficiencies of up to 80 %.

Source: Elaborated by author.

5. Commercial subsector

TABLE 11
IMPLEMENTATION STRATEGIES PROPOSED FOR THE COMMERCIAL SECTOR

Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
"Non-competitiveness" of manufacturing sector	Assess the cost of energy input into the various commercial sector branches, esp. manufacturing, and determine strategies to increase regional "energy cost competitiveness".	Conduct study to determine how electricity pricing and energy intensity within the commercial – manufacturing and service – subsector influence the cost in consumer product; include comparative analysis with competing countries (especially within the region) and methods for remediation.	Past analyses have shown that the cost of electricity was the single largest disadvantage to the local productive sector, when compared with countries within the region; strategies must be found to optimize the energy situation within the sector.
Incentives for energy efficiency improvement	Increase government incentives for the increased "integration of energy efficiency" into commercial operations. This may require both "pull and push" factors.	Create efficiency baselines for the various industries and offer tax-incentives for achieving same, with incremental tax bonus for high efficiency performance (pull factor). Perform consistent revision of energy efficient technologies (including vehicles) that are eligible for duty concession as this will increase the chances of various industries to attain and surpass baseline (push factor).	Energy efficiency has the greatest scope for immediately reducing high energy costs and will increase the comparative advantage of the commercial sub-sector. This is especially important in the more energy intensive industries.

(continued)

Table 11 (concluded)

Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
Self-generation	Promote micro-generation activities within the commercial sector.	Develop institutional capacity within government, via the Ministries with responsibilities for Commerce and Energy, to assist industries to identify and implement “self-generation” solutions. Again, this would be feasible if supported by net-metering regulations.	Microturbines are a type of DG systems and have the capacity to produce 25 to 500 KW of electricity. Using waste heat recovery techniques, microturbines can achieve efficiencies of up to 80 %.
Ocean- and Solar- Air Conditioning: for Hotels and Large Commercial Building Spaces	Promote the uptake of ocean (seawater) and solar air conditioning technologies within large hotels and commercial buildings, such as airports, etc.	Conduct feasibility assessments, to include bathymetry data collection, and develop at least one “commercial scale” project supported by government.	Air conditioning costs account for between 60 - 70 % of electricity cost in the services sector and may require a “targeted approach”.
Commercial DSM Financing	Create Fast Start Fund for supporting energy efficiency and self-generation activities.	Ascribe initial funding of JMD 250 million (USD 3 million) from the existing Energy Fund to directly support initiatives to reduce energy consumption in the commercial sector.	The specific targeted activity of the Energy Fund will make it much more attractive as the Facility may be designed to meet the needs of the intended client.
		The funds may be best managed as a revolving loan through the Development Bank and interest groups such as the Jamaica Manufacturers’ Association, with implementation coordinated in conjunction with JPS.	In addition, the involvement of the interest groups (clients) and the electric utility (good provider) will influence the speed at which “best fit solutions” are found for the individual entities.
Smart-meters	Encourage “Energy Monitoring Committees” within industries, especially manufacturing, to track and report progress in energy use.	Install smart-meters in commercial facilities to support easy recording and monitoring of energy use. Provide training and support, via PCJ Energy Efficiency Unit, for committees.	The objective of this activity is to have enough relevant information available to be able to determine the design characteristics, and subsequent impact, of energy efficiency programmes.

Source: Elaborated by author.

6. National Water Commission (NWC)

TABLE 12
IMPLEMENTATION STRATEGIES PROPOSED FOR THE WATER SECTOR

Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
“Non-revenue water” (NRW) losses: NRW losses are typically at around 66 % for NWC	Reduce NRW losses from 66 to 25 % over a five (5) year period.	At NWC, the exact breakdown of NRW components is simply not known, making it difficult to decide about the best course of action to reduce NRW. Metering of water use at the level of production (wells, bulk water supply, etc.), and at key points in the distribution network is essential to same. A national water audit will then allow the level of NRW to be known, and the concomitant remediation strategy, to be determined.	NRW losses can be real losses (through leaks, etc.) or apparent losses (through theft or metering inaccuracies, etc.); high levels of NRW are detrimental to the financial viability of the water utility. The World Bank recommends that NRW should be “less than 25 %”.

(continued)

Table 12 (concluded)

Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
Efficiency of electrical pumps	Develop strategy to increase the efficiency of electrical pumps, by introducing variable speed pumps, into the existing set-up.	Conduct energy audit on NWC pumping and treatment facilities to identify energy "hot spots" and costs for remediation.	The results of current energy audit initiatives in the public sector should facilitate expedition of corrective measures
Self-generation	Examine the possibility of self-generation for some energy services provision, especially those which are most energy intensive.	Conduct pre-feasibility and feasibility determinations on the possibility for running some pumping stations and treatment facilities on DG systems, such as microturbines or small wind-diesel hybrid plants, etc.	Distributed Generation systems have been known to improve energy efficiencies in public electricity supply systems
Water conservation	Introduce Water DSM Programme.	Develop DSM programme that identifies and finance water saving options for the household and commercial sectors; programmes should be eligible for loans under the Energy Fund.	Increased reliance on DSM policies to manage the existing scenario is relevant at the commercial and household levels. It is important that creative "kick-start" financing be used to stimulate same.
Water usage charges	Remove "cross subsidies" from NWC water usage rates. This will discourage inefficient use by the consumer and also provide NWC with revenues to invest in efficiency improvement technologies and methods.	Introduce "realistic rates" that more aptly reflect water consumption cost to NWC, but with relevant social safety net to facilitate the ability of the poor to afford the service via monthly allowance towards same.	"Cross-subsidy" is where one group of customers pays more than another for a particular good and its associated services. As water usage rates are heavily subsidized by tax-payers, those using less water "subsidize" those who use more – a situation that discourages efficiency in water end-use.

Source: Elaborated by author.

7. Household subsector

TABLE 13
IMPLEMENTATION STRATEGIES PROPOSED FOR THE HOUSEHOLD SECTOR

Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
Appliance efficiency verification	Implement mandatory testing of household appliances by the BSJ to verify efficiency rating.	Provide the BSJ with relevant support to allow for the development of benchmarking standards for the verification process and implement same as mandatory under the Standards Act.	Current initiatives to strengthen the standards and labeling capability of the BSJ will be timely.
Household DSM Financing	Implement 24 month financing options for household energy efficiency kit – CFLs and energy efficient appliances.	Provide up to USD 300 (ca. JMD 26,000) per household from the Energy Fund, and administered via the electric utility, to provide CFLs, energy efficient appliances or to assist in solar water heating, etc.	The electric utility has experience and demonstrated capability to implement household energy efficiency programmes
	In addition, other energy efficiency interest – such as micro-generators, timing devices, etc. – may be evaluated on a "case by case" basis.	The re-payments will be made through the existing electricity billing and collection system.	

(continued)

Table 13 (concluded)

Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
Smart meters: A smart meter fund was created by the OUR to energy efficiency; contribution of Jamaican 4 cents per KWh of electricity sold over the next 14 years to support same.	Encourage "Energy Monitoring" within households to track progress in energy use.	Install smart-meters in residences to support easy recording and monitoring of energy use.	The objective of this activity is to provide real time impact to household consumers, on the effectiveness of energy efficiency measures undertaken.
Self-generation	Promote micro-generation activities among energy-intensive, high-income households.	Develop institutional capacity within government, via the Ministry of Energy as well as the Consumer Affairs Commission, to assist high-income households to identify and implement "self-generation" solutions. Again, this would be feasible if supported by net-metering regulations, as well as government tax and duty incentives.	National Energy Policy and draft Sub-Policies prescribe strategies to improve technical and institutional capacity within the Ministry with responsibility for Energy and the wider energy sector

Source: Elaborated by author.

B. Transport Sector

1. Private motor vehicle fleet

TABLE 14
IMPLEMENTATION STRATEGIES PROPOSED FOR THE PRIVATE TRANSPORT SECTOR

Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
Motor Vehicle Import Duty	Replace existing tariff structure with a value system based on vehicle technology (e.g. electric, hybrid, CNG, gasoline, diesel, etc.) and fuel efficiency (e.g. kilometers per 100 litres, miles per gallon, etc.)	Conduct assessment to determine the most reasonable "fuel efficiency based" classification system for vehicle tariffs. Thereafter, move to amend the provisions governing current motor vehicle import duties to reflect same.	Currently in Jamaica, motor vehicle import duties for cars and SUVs are calculated on a tiered system based on engine size. In addition, diesel vehicles are affixed a lower duty rate than gasoline-powered vehicles, except those rated at 1000 cc and below.
Vehicle Emissions Testing	Implement emission rate measurements for carbon monoxide (CO), unburnt hydrocarbons, and oxides of nitrogen (NOx).	Provide mechanism for mandatory testing, under an amendment to the National Resources Conservation Authority (NRCA) Air Quality Act of 2006, for same.	Studies indicate that as ca. 45 % of the pollutants released globally are a direct consequence of vehicle emissions. Further, vehicle emissions are closely linked with vehicle technology and the efficiency with which they use fuel.
Car-pooling or High Occupancy Vehicles (HOV)	Introduce privileges for HOVs in the Kingston Metropolitan Transport Region (KMTR).	Conduct feasibility for allowing HOVs to utilize bus lanes within the KMTR. Look at the possible integration of same under a broader Transportation Demand Management (TDM) scheme.	HOV Priority measures can increase transit service efficiency by increased ridership per vehicle-hour and reduced fuel consumption per vehicle-mile. HOV Priority improves the performance of transit and ridesharing (a direct benefit to users).

(continued)

Table 14 (concluded)

Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
Park and Ride	Examine the development of "Park and Ride" facilities, with dedicated car parks and bus services, in Kingston and Montego Bay.	Conduct feasibility studies for the development of Park and Ride facilities in Kingston and Montego. Examine the optimization of the related logistics by linking Park and Ride with HOV access lanes.	Park and Ride facilities are car parks with connections to public transport that allow commuters to travel into the city centre from a designated car park via bus transfer or carpool. The vehicle is stored in the car until the commuter returns.

Source: Elaborated by author.

2. Public motor vehicle fleet

TABLE 15
IMPLEMENTATION STRATEGIES PROPOSED FOR THE PUBLIC TRANSPORT SECTOR

Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
Jamaica Urban Transit Company (JUTC)			
Efficiency Indicators and Incentives: JUTC has introduced a number of schemes to assist in efficient driving techniques. This includes bus driver simulation programmes to encourage efficient driving practices.	Introduce efficiency benchmarks and drivers' incentive scheme to encourage fuel conservation practice among drivers.	Determine efficiency benchmark with respect to passenger miles vs. fuel consumption for rating driver efficiency and implement driver ranking system, with appended salary increment, based on driver efficiency targets.	
Route Planning and Scheduling	Introduce Transportation Demand Management (TDM) into JUTC scheduling mechanism.	Devise mechanisms to reduce the amount of "dead miles" travelled by buses, as well as utilize a peak vs. off-peak scheduling structure.	
Fuel Type and Use	Include alternate fuel vehicles (AFVs), e.g. electric, hybrid, solar and CNG, among JUTC fleet; implement policy for minimum percentage of fleet to constitute same.	Examine government vehicle procurement policies and devise strategy for determining and introducing minimum portion of "alternate fuel based" vehicles in JUTC fleet.	
Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
Fuel Production Facility	Examine the feasibility of locally produced biodiesel for JUTC fleet.	Perform feasibility study for Tyre Derived Fuel (TDF) – biodiesel from tyres – for JUTC fleet.	In general, there are around the JUTC buses use ca. 3,600 tyres per annum. Using TDF technology (such as flash pyrolysis), these tyres have the potential to produce biodiesel for use in the JUTC fleet.
Taxis and "Privately owned" buses	Implement emission rate measurements for CO, HC and NOx.	Provide mechanism for mandatory testing, under an amendment to the NRCA Air Quality Act of 2006.	Vehicle emissions are linked with the efficiency with which they use fuel.

Source: Elaborated by author.

3. Railway transport

TABLE 16
IMPLEMENTATION STRATEGIES PROPOSED FOR THE RAILWAY TRANSPORT SECTOR

Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
Freight Rail: Rail carries a range of bulk and non-bulk cargoes (including premium parcels, high value car components and food stuffs) and may become the preferred mode when fragile prestige goods, such as cars, are in transit. Rail traffic for waste haulage can be economic over distances as short as 19 miles and may integrate seamlessly into waste to energy (WTE) facilities.	Integrate freight (cargo) rail system into the existing bauxite/alumina rail network. This may require the vertical separation of the existing monopoly infrastructure from operations, whilst retaining vertical integration to facilitate schedule planning, etc.	Conduct study to determine feasibility and modality for same, with a view to rehabilitating sections of the JRC rail system and integrate same into the bauxite/alumina tracks for rail transport, especially inter-city and between the ports and cities.	When considered in terms of ton-miles (tonne-kilometers) hauled per unit of consumed energy, rail transport is more efficient than other means of other form of transportation. However, shipment by rail is not as flexible as by highway, which has resulted in much freight being hauled by trucks.

Source: Elaborated by author.

4. Transport fuels

TABLE 17
IMPLEMENTATION STRATEGIES PROPOSED FOR THE PRIVATE TRANSPORT SECTOR

Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
Ethanol/Gasoline Blends: E10, or 10 % ethanol in 87 octane gasoline, was introduced in Jamaica on a phased basis on November 1, 2008. By November 2009, all motorists across the island were receiving E10 fuel in both 87 and 90 octane fuels as their only gasoline option.	Consider additional ethanol/gasoline blends such as E15, E85 and E-100; E10 and E15 have application in regular gasoline vehicles, while E85 and E100 would target flexi-fuel vehicles. Without government financial support, blends that require retrofitting should be avoided.	Examine the cost benefits and efficiency gains for E10, by establishing a full performance review. Model the potential for higher ethanol blends, e.g. E85 and E100, in the market.	Accordingly to the PCJ, Jamaica is projected to save about USD 92 million on its energy bill annually due to the introduction of E10, which replaces imported Methyl Tertiary-Butyl Ether (MBTE) with ca. 70,000 liters of ethanol.
Biodiesel/Diesel Blends	Use the ethanol case as a model for introducing biodiesel options to the market.	Conduct feasibility on the cost benefits and efficiency gains for B10, B15, B85 and B100 blends.	
Compressed Natural Gas (CNG)	Consider the introduction of CNG into limited vehicle fleets which are heavy liquid fuel users. This strategy is dependent upon the progress of present gov't policy to introduce natural gas into the energy matrix for Jam.	Conduct feasibility for large vehicle fleets, with high energy intensity (drive many miles a day). JUTA cabs and buses, JUTC buses, and NSWMA garbage trucks may be used as pilot cases since they have the potential to host central CNG filling facilities and ability to suitably retrofit their fleet.	CNG has significantly lower comparative energy cost per million BTU than other fossil-based liquid fuels, viz. Gasoline, E10, Diesel or LPG.

(continued)

Table 17 (concluded)

Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
Petroleum Refining and Blending: The petroleum refinery (Petrojam) will undergo expansion to allow, among other things, the production of low sulphur diesel (LSD).	Use the opportunity of the refinery expansion to include facilities for biodiesel refining and blending to produce B10, B15, B85 and B100 fuels.	Look at cost analysis for including commercial size biodiesel refining capacity to Petrojam during its expansion.	The cleaner (low sulphur) diesel fuel opens the door to diesel cars that can be as clean as gasoline cars, yet offer 20 to 40 % better fuel economy.

Source: Elaborated by author.

C. Policy and regulatory framework

1. Government policies on energy efficiency and energy conservation

TABLE 18
IMPLEMENTATION STRATEGIES PROPOSED FOR GOV'T POLICIES ON EE

Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
National Energy Policy (2009 – 2030)	Relevant import substitution that seeks to replace oil with indigenous energy sources should be pursued in tandem with "cheaper options" that swap one imported fuel for another.	The pursuance of energy security should be identified as the main goal of the policy, the "drivers" for the energy sector selected, and incentives for promoting uptake suggested –	The policy recommends Diversification of Energy Types and suggests exploration of fossil-based sources (natural gas and coal) towards the future fuel mix as well as defining and development of the country's renewable energy sources. None of the fossil-based deposits are indigenous to Jamaica and consequently, instability in oil supply may easily translate into instability in coal or natural gas supply.
Energy Conservation and Efficiency Policy: Addendum to the Energy Policy (2008 – 2022) recently upgraded to the draft National Energy Conservation and Efficiency Policy 2010 – 2030 Draft available	Provide an addendum to the policy with direct objectives and timelines. Draft policy completed October, 2010	Determine via assessment the focus points for the "nationalized" energy efficiency programme and set indicators and rolling targets for same.	Recommendations, within the first draft policy, to support reduction targets were rather weak. Such targets can only be realized through specific activities and goals whilst targeting the most "inefficient" energy use sectors, including electricity generation and distribution, water treatment and deliveryand the electricity and water end-use within the public, household and commercial sectors.
Carbon Trading Policy: Draft available	Identify national energy efficiency (EE) initiatives for development and funding under the Clean Development Mechanism (CDM). Draft Policy completed October, 2010	Utilize the programmatic CDM (pCDM) approach to identify and bundle DSM projects for water and electricity, so as to create large – scale impact on national energy efficiency end-use. This type of emission reduction activity will attract CDM funding under the new paradigm.	In June 2007, the Executive Board of the CDM acknowledged the potential and niche for end-use energy efficiency under the new programmatic approach of the CDM.

(continued)

Table 18 (concluded)

Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
Renewable Energy Policy: Draft available	Stimulate new renewable electricity generation through transparent (and explicit) power purchase rules, with minimum electricity price guarantee. Draft Policy completed October, 2010	To encourage renewable energy uptake, provide minimum floor price for low-carbon electricity from renewable sources. A possible model to stimulate new renewable electricity generation would be for the electricity price to be guaranteed. Fixed contract periods (or concession) could be at a fixed price (with escalators) for supply	The privatized nature of electricity generation reduces the ability of Government to be prescriptive, but the market will not provide all the solutions by itself; fiscal and tax incentives will be needed.
Biofuels Policy: Draft available	Diesel from renewables (biodiesel), particularly from indigenous grass or wood, should receive more encouragement. Draft Policy completed October, 2010	Develop biomass energy services model for Jamaica and design rules and incentives package for potential investors within the sector. Target especially the direct replacement of diesel and/or the provision of “syn” gas for electricity generation.	Bio-oil has the potential to replace some of the current fuel oil and diesel supply in electricity generation without significant changes to existing infrastructure within the sector. Industry standards must be developed to protect the sector from opportunists who may seek to “cut corners”.
Energy – from – Waste Policy Draft available	Energy from waste presents a secured source to provide electricity and at the same time positively impact the country’s waste management challenges. The development of appropriate technologies to efficiently convert waste to energy should be encouraged. Draft Policy completed October, 2010	Update waste characterization study and implement projects that are economically feasible and which will be in harmony with the environment. Facilities at the western and eastern ends of the island too be supported by transfer stations and appropriate logistic support.	Preliminary assessment is that annual waste disposal will support at least 65MW of electricity supply to the electric grid.
National Electricity Policy Draft not available	Complete Electricity Policy and that is being developed and ensure the prescription of appropriate initiatives and strategies for modernizing the electricity infrastructure and that the operating practices and procedures are adequate to facilitate new investments in the sector	Review of the current Electricity License, if necessary, negotiate requisite changes with the JPS, strengthen the sector regulator and ensure the initiatives are consistent and in harmony with government overall strategy for the sector	The current JPS licence is in conflict with several of Government’s policy prescriptions and inimical to the development of renewable energy sources and energy efficiency improvement
Ocean Energy Policy: Not under consideration, although addressed to some extent in the draft National Renewable Energy Policy 2010 – 2030.	Introduce policy to examine energy provision from ocean technologies, such as wave and OTEC. Should be developed as an addendum to existing energy policy, given the vast potential surrounding the island Current pilot project under consideration should be supported and its replicability determined for future deployment	Conduct assessment and strategy development to determine regulatory support for ocean technologies. Replicability of systems to allow for sufficient penetration. Public / Private sector partnership will be necessary.	Ocean technology, especially OTEC, has the potential to provide some energy services, such as air conditioning, in SIDS.

Source: Elaborated by author.

2. Electricity regulations

TABLE 19

IMPLEMENTATION STRATEGIES PROPOSED ON ELECTRICITY REGULATION

Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
Net-Billing Policy: Supported via Standard Offer Contract issued by JPS.	Update present Net-billing Policy to Net-metering Policy.	Hold consultation with JPS and interested stakeholders, such as the JMA, to determine possible penetrability of distributed generation activities.	Policy allows for the addition of small power producers of 100 KW capacity and less and offers rates at “avoided generation” cost, which may be too low to make it economically attractive to potential investors.
Net-Metering Policy:	Introduce net-metering policy to stimulate small- and medium- scale distributed generation.	Offer “green incentive” to JPS for uptake of power provided from more efficient (with additional bonus for renewable) distributed generation facility – develop pricing and Standard Offer Contract.	
Electricity Wheeling: Wheeling is “implied” in current All-Island Electric License (2001).	Introduce electricity wheeling to facilitate distributed generation.	Conduct analysis to determine cost per KWh for transmission and distribution on JPS grid in order to develop pricing and Standard Offer Contract for wheeling.	
Efficiency Regulation of Public Utility:	Introduce regulation for overall JPS generation and T&D efficiency targets.	Determine baseline efficiency for JPS generation and transmission and distribution, and propose incentives for exceeding required level and penalties for missing same.	

Source: Elaborated by author.

3. Transport sector regulations

TABLE 20

IMPLEMENTATION STRATEGIES PROPOSED FOR TRANSPORT SECTOR REGULATIONS

Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
Transport Policy	Renew focus on public transport efficiency in the Kingston Metropolitan Transport Region (KMTR), and other rural and urban population centres	Introduce transportation demand management (TDM) systems toward determination of public bus routing and schedule.	Around 75 % of Jamaicans use public transport and there is significant potential for efficiency in the transport sector if this group is targeted. The policy issues related to ECE in the transport sector, fails to deal with road network and traffic planning.
Biofuels Policy	Examine mechanisms for integration of the transport and biofuels policies.	Conduct assessment to determine the degree of retrofitting, and the associated costs for same, which would be required to accommodate a biofuel based transport economy – especially in the public transport subsector.	
Motor Vehicle Import Policy	Reflect current energy efficiency technology paradigm in vehicle import policy such that the most energy efficient vehicles are encouraged.	Determine via analysis, and stakeholder dialogues, a tariff structure that is tiered on the basis of fuel use efficiency (distance per unit volume of fuel) and/or vehicle technology (electric, hybrid, etc.).	
Vehicle Concession Policy	Set minimum limit on the energy efficiency limit, based on fuel consumption (miles per gallon) that may qualify for duty concession.	Determine via analysis and consultations with stakeholders within the public sector what the recommended minimum fuel use performance ought to be; tier fuel use performance to concession rates.	A policy for energy conservation supports neither the outfitting of government ministries nor agencies with gas guzzling SUV nor the purchase of same by individuals using concessionary duty rates.

Source: Elaborated by author.

4. Water regulations

TABLE 21
IMPLEMENTATION STRATEGIES PROPOSED FOR WATER REGULATIONS

Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
Water Policy: The issue of cross subsidization of utilities ought to be revisited as current water pricing method fosters inefficiency.	Examine current water tariff structure, with a view to promoting efficiency in water use.	Examine, through economic analysis and stakeholder dialogues, whether to place subsidies for water in the hands of the producer (NWC) or the end-users, who may not be able to afford to pay the real economic cost of water.	Unrealistic water rates support inefficient use of the resource by those who can afford it most and furthermore, hands the National Water Commission a "get out of jail free card" for its inefficient operations.
Agricultural Policy	Introduce irrigation policy as a sub-policy of the water policy.	Determine and recommend target indicators for water use efficiency in irrigation.	

Source: Elaborated by author.

5. Other related policies and regulations

TABLE 22
IMPLEMENTATION STRATEGIES PROPOSED FOR OHER POLICIES & REGULATIONS

Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
Standards Act	Introduce mandatory verification of appliance and vehicle efficiency rating.	Conduct study to establish accepted testing and monitoring regimen – use US, European and Mexican models as reference.	
Building Code	Introduce legislation to for mandatory compliance.	Conduct consultations and dialogues to design and discuss issues regarding benefits of compliance and penalties for breach.	
OUR Act	Provide powers of oversight to OUR, for monitoring of JPS and NWC efficiency target indicators.	Establish efficiency indicators for JPS and NWC, with associated penalties for breach and incentives for conformation – for instance, efficiency performance of the utility should be factored into rate increase analysis.	
Land Use Policy	Develop land use policy to delineate potential land for biofuel plantations and other energy services provision.	Install database to provide indication on available land status; inter alia, vacant lands, derelict land, and for land currently in use and allocated for redevelopment in a local plan, etc.	Before deciding on any indigenous biomass production, it would be advisable to execute a full-scale analysis of the social and economic implications. The land use policy would provide "clear" guidance on same.
National Science Policy	Embed technology transfer and R&D support for energy efficiency and renewable energy into national science policy.	Determine the intervention points for science and technology in the local sustainable energy services sector – this may be done via sectoral analysis and stakeholder dialogues.	
Sustainable Tourism Master Plan	Provide energy efficiency baselines for STMP with respect to electricity and water usage.	Provide disaggregated best practice details for the major energy services, i.e. cooling, lighting, water heating, etc. and measures for monitoring energy use on such basis; offer tax incentives for service providers who exceed threshold efficiency performance.	

Source: Elaborated by author.

D. Financing and incentives

TABLE 23
IMPLEMENTATION STRATEGIES PROPOSED FOR FINANCING & INCENTIVES

Item	Recommendation(s)	Proposed Implementation Strategy	Rationale
The Energy Fund: After 2 years, the uptake of the available funds is less than 14 %.	Provide pro-active sectoral support for uptake of the Energy Fund.	Implement pilot projects between DBJ and relevant commercial organization, e.g. JHTA, JMA, etc. to delineate mechanism for commercial uptake of Energy Fund – distribute same via JPS rather than AFIs to reduce collateral demand and interest rate.	There is a "seeming disconnect" between the administrators of the Fund (DBJ and the AFI's) and the intended clients. There is need for greater impact of an already available funding facility.
The PetroCaribe Fund	Provide fixed capital from the PetroCaribe Fund for distributed generation and demand side management projects on an annual basis.	Expand the Energy Fund via increased inflows from the PetroCaribe Fund, as well as facilitate the creation of an ESCo via JPS – PCJ joint venture partnership.	The creation of the ESCo is expected to facilitate the ease with which energy efficiency projects, to be funded via the Energy Fund, are developed and executed.
Financial and Fiscal Incentives	Rationalize existing financial and fiscal incentives for energy efficiency and small- to medium- scale renewable energy activities.	Conduct qualitative and quantitative assessments to determine the degree to which government financing and incentive schemes support the mechanism that are required for the "relative success" in integrating increased energy efficiency activities and the degree to which same has been accessed – include barrier to efficient uptake.	Such will provide the "pull" factors to support the legislative/regulatory "push" that is required for the widespread uptake of energy efficiency into the national energy economy.
Incentives Gap	Institute "rolling targets" to determine the impact of existing incentives and for continuous rationalization of same.	Conduct periodic analysis of incentives to determine where gaps may exist and improve same as necessary; include analysis of leakage that may occur via misappropriated activities.	This will measure the success of the relevant strategies on a "time-dependent" basis and will require use of relevant indicators

Source: Elaborated by author.

E. Institutional support and capacity building

The main and supporting energy sector institutions, as well as the policies, regulations, and requirements for implementation provide the context within which the "twin towers" of sustainable energy and climate change mitigation activities will occur. There is an "almost desperate" need for capacity gaps to be identified and filled and barriers that are inimical to these efforts be targeted. In treating energy efficiency as a specific case, the following are important:

- Determination of mechanisms for mainstreaming energy efficiency into the 2009 – 2030 National Energy Policy and Vision 2030 Plan;
- Identification of the cultural and institutional reasons for the "relative failure" for the uptake of past energy efficiency activities into the energy economy;
- Understanding the power or dominance exercised over the energy sector by the electric utility and the degree to which such has hindered – and is continuing to hinder – the efficient uptake of demand side management (DSM), distributed generation (DG) and renewable energy into the local energy economy; and

- Identification and integration of key stakeholders into energy efficiency activities a crucial issue is the potential role of the so-called “information society” in terms of how effective it might actually be in involving citizens more actively in decisions affecting their energy supply and consumption.

- Finding mechanisms to refocus attention away from “project based” structures and towards “business based” ones in order to create new confidence in the viability of initiatives once the public support stage is over.

The key institutions of the GOJ that hold responsibility for energy efficiency issues will be required to address the delineated items in turn. These institutions are, inter alia, Ministry of Energy and Mining (MEM); Petroleum Corporation of Jamaica (PCJ); Jamaica Bauxite Institute (JBI); Office of Utilities Regulations (OUR); Ministry of Transport and Works (MTW); and the Ministry of Finance. Institutions acting in support are: the Office of the Prime Minister (OPM); Ministry of Agriculture; Ministry of Tourism; National Environmental Planning Agency (NEPA); National Solid Waste Management Authority (NSWMA); Bureau of Standards, Jamaica (BSJ); Consumer Affairs Commission (CAC); National Housing Trust (NHT); Jamaica Urban Transit Company (JUTC); Planning Institute of Jamaica (PIOJ); and the Development Bank of Jamaica (DBJ). Currently, the Ministry of Energy and Mining has general responsibility for policy formulation and review, energy planning, monitoring and research among other things. Government has signaled an intention to expand the roles and functions of the present Energy Efficiency Unit (EEU), which now exists within the PCJ, to establish a National Energy Conservation and Efficiency Centre (NECEC). According to the draft Energy Conservation and Efficiency (ECE) Policy, the NECEC will “provide technical assistance at the national level” with the Ministry of Energy and Mining “providing policy directives to guide the work of the NECEC”. Caution is recommended against this approach however as this action attempts to place a single entity at the centre of the activities to mainstream energy efficiency into the economy.

In order to mainstream policies on efficient energy use, it is useful to separate actions and policy instruments for efficient energy use from those relating to renewable energy. While the design of converging instruments and actions may seem fittingly appropriate, they need —while being linked— to be autonomous and independent. Inasmuch as the strategic objectives and actors on which such policies are intended are similar, the target deadlines required for timely and positive impact are completely different.

In addition, the measures relating to pricing policies, fiscal incentives, regulations and market structure which can be implemented by the GOJ are different. It would be more useful to set-up a technical oversight institution, using the model of the OUR, for energy efficiency. Such a body would be responsible for integrating regulatory instruments and the national energy policy as part of a comprehensive approach. As such, the structure would serve the purpose of examining tangible energy efficiency use issues to determine whether or not such warrants legislation and concomitantly, the best way of designing and applying same. This would be done in such a way as to maintain synergy with climate change and renewable energy issues and would build upon existing international agreements and multilateral funding facilities for same.

Finally, the activities of the proposed “Energy Efficiency Office” would include the establishing of a medium-term horizon for the achievement of results and would act so as to set, monitor and adjust relevant target indicators on a rolling basis. The proposed Energy Information Clearing House will suitably support this initiative through the establishment of the relevant databases.

Indicators data

The importance of indicators data at the country level is that they provide guidance to policy makers on:

- Underlying drivers (economic activity and structure, income, prices, etc.);

- Trends in energy use and CO_2 and other GHG emissions;

- Energy efficiency opportunities and progress; and

- Policy effectiveness.

The importance of indicators data at the regional (and global) level is that they establish a harmonized framework for:

- Comparability;
- Understanding of global trends and drivers; and
- “Cross country” analysis.

Energy efficiency has been widely embraced by the GOJ as a political priority. The primary argument is however, that government should take an “agenda setting” approach in the sustainable energy economy as state budget appropriations and the amount of public funds available for the promotion of energy efficiency and renewable energy is marginal and, in some instances, nonexistent. External capital inflows are required for genuine market uptake of energy efficiency activities and government focus should remain with the creation of policies, regulation and incentives involving the key players on the energy supply and demand side: inter alia, the electric and water utilities, public transport, household and commercial sectors. The electric utility is especially central to any energy efficiency activity within the electricity sector, and the Petroleum Corporation of Jamaica, via Petrojam, is particularly influential in the transport sector.

TABLE 24
ENERGY INDICATOR DETAILS FOR THE VARIOUS SECTORS AND SUBSECTORS

Item	Indicator(s)	Data Required
National	Energy Consumption with respect to various indices, e.g. Population, per capita GDP, etc.	Energy consumption by source Population Exchange Rate Purchasing Power or Consumer Indices GDP based on various indices
Industrial	Energy Intensity or Energy use per unit of GDP	Electricity consumption by activity Value-added production volume ISIC (Activity classification)
Services/ Commercial	Electricity consumption per square metre	Electricity consumption by activity End-use activities Floor space
Residential	Electricity consumption per household Electricity consumption per capita	Household energy services Typical household appliances Appliance efficiency rating
Transportation	Fuel consumption with respect to Passengers-kilometres Fuel consumption with respect to Tonnes-kilometres	Transport Mode Vehicle Type Vehicle Load Fuel Consumption
Electricity Generation	Efficiency of power plants and “co-generation” plants	Fuel Input Electricity Output Heat Output Plant Type

Source: Elaborated by author.

V. Suggested follow up activities

A. Support for institution strengthening and capacity building

In this activity, the UN ECLAC should provide support to Jamaica to determine: (i) whether or not the institutional frameworks that generally exist are conducive to the implementation of energy efficiency policies and programmes; and (ii) whether or not the institutional framework provides incentives for organizations whose business it is to foster energy efficiency.

It becomes more important to have efficient institutions as transaction costs rise; the promotion of efficient energy use and, to a lesser degree, renewable energy sources entails large transaction costs. Efficient institutions are vital when the information available is incomplete, as is characteristically the case with the promotion of energy efficiency.

Over the past twenty (20) years, Jamaica has had a significant number of energy efficiency programmes and recently developed an Energy Conservation and Efficiency Policy, as an addendum to the National Energy Policy. Though progress has been made on energy efficiency, such as the JPS Demand Side Management Programme (1994-1998), progress has been at best short lived and there has been a consistent failure of programmes to significantly “transform the energy efficiency market” in Jamaica.

While many barriers have been identified as being deleterious to the uptake of energy efficiency and conservation (ECE), it is perhaps the institutional shortfalls that have resulted in the perennial failure of efforts toward “making energy savings an integral part of the Jamaican lifestyle”. Consequently, it is at the institutional level that effort is required to facilitate a sustained process of “organizing” the Jamaican energy sector such that projects are not mere sideshows but are rather, harbingers of a new energy economy. The optimization of the existing institutional framework and the appropriate capacity, for leading the commercial uptake of energy efficiency into a sustainable energy economy for Jamaica, is the most critical step for weaving the existing technological, economical and regulatory strands together.

VI. Conclusions

Jamaica, like most other SIDS, generally do not have specialized energy regimes but rely on petroleum derived fuels and inefficient usage patterns. This scenario is typically interlinked with problems related to social stability, agricultural productivity, and national balances of payment. This “injustice and inefficiency” in energy use requires as a start, an understanding that energy efficiency is the cheapest and largest energy source that is available to Jamaica.

Primarily, energy efficiency activities and projects have tended to focus on measures to reduce energy intensity and have largely ignored the required improvements in areas such as intersectoral coordination for the utilization of agricultural and waste by products, the use of electric vehicles, and further development of solar and water based energy sources, especially towards building cooling services (solar and ocean air conditioning).

The current energy policy (October, 2009) outlines seven (7) goals, in support of the Vision 2030 – the National Development Plan that highlights the role of “energy security and efficiency”. These have been identifies as, inter alia:

- Pursue opportunities for energy conservation and efficiency
- A modernized and expanded energy infrastructure
- Development of renewable sources
- Secure and sufficient energy supply to support long term development
- Defined and established institutional, legal and regulatory framework
- GOJ ministries and agencies to lead in energy conservation and environmental stewardship
- Embrace eco-efficiency for advancing international competitiveness

The Jamaican energy sector is dominated by electricity services – most of the imported petroleum is consumed in the bauxite/alumina industry (for the self-supply of electricity) and the second major consumer is the public electricity sector. The public electricity market continues to be dominated by the utility (JPS) despite an opening of the generation sector for independent power producers (IPPs) in the 1990s. The formerly state owned JPS was privatized and sold in 2001 and operates now under a 20 year licence, granting it the right to act as single buyer for electricity delivered by external producers and maintaining the sole ownership on transmission and distribution lines.

The three central pillars among the recommendations made within this report are directed at the electricity sector. These are, inter alia:

- The use of Combined Cycle (CC) or Cogeneration (cogen) technologies to increase electricity generation efficiency;
- The integration of Distributed Generation (DG), including small scale renewable technologies, into the existing electricity grid as a means to increase generation efficiency and reduce systems (transmission and distribution) losses; and
- The wholesale implementation of Demand Side Management (DSM) schemes for the commercial and household sectors via the utilization of energy efficiency technology.

The strategies outlined above require very little additional government legislation as these features are already supported by government policies and regulations; for instance, the Regulatory Policy for Addition of New Generating Capacity to the Public Electric System (2006) allows for private distributed generation systems to be added to the grid. Despite this, there is very little penetration of same due to the low power purchase rates, the comparatively short contractual period, the inexperience of potential cogenerators (like hotel owners and industries), the high up front costs without sufficient bank crediting and the lack of technical capability to combine renewable energy resources with cogeneration facilities, as is the case in biogas cogeneration from organic residues in the food processing industry that was attempted by Jamaica Broilers. So far, such features as self generation have remained with the bauxite/alumina and sugar industries and have penetrated neither the commercial nor household sub sectors.

To drive these initiatives forward will require a mix of government incentive and electric utility support. An important aspect for the future development of electricity is the provision to enable non discriminatory access to the transmission grid, so that self generators of electricity may transport (wheel) electricity for own use from the generation to the (remote) consumption site at transparent rates, defined and approved by the regulating entity (OUR) as current legal barriers discourage end users from self generating and using electricity for its own purposes. Currently, self generators may "feed in" excess capacity to the grid under the Net Billing Policy. In net billing, JPS would buy excess power from its customers at the "generation avoided cost", plus a premium (currently set at 15 per cent) if the source is renewable energy; this is perhaps the greatest disincentive to investment in small to medium scale self generation. Replacing the Net Billing with a Net Metering Policy would provide serve to remedy this scenario as in the case of net metering, JPS would buy excess power from its customers at the same rate at which it retails to customers. The fact is that if the utility is allowed to purchase power from its customers under the Net Billing rather than Net Metering arrangement, the company will be profiting from an investment for which the risk was taken by the customer. A more equitable arrangement would be for JPS to purchase at existing retail rate minus transmission and distribution cost (and perhaps a profit margin affixed to same).

It should be clear that the existing energy economy in Jamaica is such that, with the exception of the large self generators in the bauxite/alumina and sugar industries, electricity generation is centralized around JPS. Investment in generating capacity and efficiency technology is therefore dependent on the electric utility and a few select IPPs. Consequently, the timescale for effectively introducing the recommended generation efficiency is severely compromised in pursuit of the business goals of a privately owned utility company. The solution is to efficiency in the electricity sector is decentralization of the investment required for efficiency via distributed generation and demand side management through approaches that involve a wider range of electricity stakeholders.

To obtain substantial results, careful balancing of push factors (regulations and legislation) and pull factors (tax credits and incentives) is required. Government must act to introduce greater investor participation in the energy sector while simultaneously incorporating the electric utility at the centre; the role of the utility cannot be over-stated as it is critical in the management of the recommended distributed generation and demand side management activities.

In preparation for growth in Jamaica's electricity demand, distributed generation systems are a favourable compliment to the "legacy growth paradigm", which is based on expansion and reinforcement of the centralized grid. Various architectures might be appropriate for different requirements and opportunities and some amount of centralized management and planning is therefore required —hence the role of JPSCo—, the OUR and possibly the proposed "Energy Efficiency Office". Energy management layers can be accommodated within the framework to allow for concerns such as operating efficiency, environmental emissions, heat harvest, etc., to be optimized in a systematic manner. The existing barriers to distributed generation systems in Jamaica are: (i) standby charges; (ii) interconnection rules; and (iii) the "concept" of lost utility revenues.

One of the classic problems with energy efficiency arising out of electricity utility regulation concerns the issue of lost revenues. Electricity utilities are natural monopolies; i.e., they exhibit such strong economies of scale that it would not make sense to have active competition between multiple smaller suppliers. A common hypothesis is that utilities raise barriers to interconnection of self generation and also discourage energy efficiency investments because of this possible consequence for its revenue and profits. The fact is that however electricity demand will continue to grow and as the installed capacity of the utility is approached, large investments for installing new —or upgrading existing— power plants must be found. It is therefore more profitable to the utility to add incremental amounts of privately owned power to the grid, via distributed generation systems, than to invest in expansion.

A central issue with far-reaching consequences for all grid connected renewable energy projects are the current high transmission and distribution (including non technical) losses. Electricity generated with considerable technical efforts should not get lost on its way to the final consumers. Currently, such losses are by far exceeding the electricity produced by all renewable energy plants combined. It is obvious that technical, as well as non-technical losses, has direct effect on electricity pricing and should be addressed as a matter of urgency.

As is the case of self generation, the interest of the utility in demand side management (DSM) is perhaps not very obvious —a cursory glance suggests that it may be inimical for a company to encourage its customers to use less of its product—. Experience during the past several years, including the JDSMP, shows that DSM programmes provide resources that cost-effectively substitute for power plants. That is, direct load control programs and interruptible rates provide the same types of services that a combustion turbine does but at lower cost. Similarly, energy efficiency programs are often low cost alternatives to the construction and operation of baseload plants that use renewable energy sources. The recognition that DSM is a "resource" analogous to power plants effectively introduces a different way of planning for electric utilities and involves consideration of a broad array of ways to meet customer energy service needs, rather than only building and operating power plants.

Efforts to meet the nation's electricity demand via more efficient provision of electricity services must be complimented by lifestyle (conservation) programmes. It is necessary to ascertain whether the level of energy consumption can be influenced by traditional instruments based on individual behaviour and technological solutions, or whether consumption behaviour is really autonomous and associated with prevailing lifestyles. The former scenario is likely to ensue in an environment of incentive programmes for conservation. Consequently, this Report suggests that energy efficiency finance programmes, such as the Energy Fund, ought to not to be "stand alone" but issued with "a suite of tax credits and incentives" to promote uptake. Otherwise, the Fund will be treated as simply another loan instrument.

The activities supported by the Energy Fund are perhaps best managed through the Demand Side Unit of JPS as the capacity to identify end user efficiency issues is already present and may be expanded (if required) and the utility possesses the ability to collect repayment for the investments through its regular billing system. This largely reduces the risk of non compliance and lowers the demand for "up front" collateral and guarantees, as is now required by the AFIs – in this instance, the collateral is the access to electricity services.

The transport sector also accounts for a large portion of energy consumption in Jamaica – around 42 per cent in 2008. Significant efficiency gains may be derived in this sector via targeting the public transportation system as it is believed that as much as 75 per cent of Jamaicans do not own a motor vehicle. The use of vehicle technology, fuel efficiency, as well as general fleet maintenance and transportation demand management (TDM) systems are significant toward same.

On the private vehicle side however, the available fuel options and pricing is significant. In addition, government regulations on vehicle import tariffs and vehicle duty concessions must reflect an energy efficiency paradigm; concessions must be made applicable to only a limited class of vehicles as it is deleterious to allow vehicles with low fuel efficiency to be imported without tariff. It may also be useful to allow access to the Energy Fund for purchase energy efficient and alternate fuel fleet vehicles for commercial activities, such as electric buses for tour operators.

It is the view of this author that both the centralized organization of government and the high level of poverty in Jamaica are obstacles to the implementation of decentralized energy options such as energy efficiency and distributed generation via renewables. Government must, in managing the strategies for increasing uptake of energy efficiency technologies and conservation practices, find effective means for using the tools of legislation and regulation, as well as tax credits and fiscal incentives to simultaneously push and pull the relevant actors toward the desired destination. In so doing, there must be avoidance of “the market will deliver” philosophy and pursuit of a “market push” approach. The regulatory framework of government must be used to establish clear, stable market mechanisms that help lower the investment costs and risks for energy efficiency investments. This must involve the electric utility and the petroleum refinery at the centre of the electricity and transport sectors respectively.

The real need now is for the identification of robust public private partnership mechanisms so that public resources, both international and local, can be used more efficiently and effectively. A major effort should be made to refocus attention away from “project based” structures and towards a “business based” approach (commercial demonstrations) in order to create new confidence in the viability of initiatives once the public support stage is over. Compared to the progress made with energy intensity by the industrialized countries around two decades of implementation activities, the achievements of Jamaica are at best pedestrian.

The conclusion of this Report is that reducing the intensity of energy use in Jamaica is not only desireable but highly possible and there are significant opportunities for moving the energy system forward so that it can raise its productivity, become fairer and less vulnerable, produce fewer emissions, use natural resources in a more balanced way and more sustainably over time and make even greater use of renewable resources. On this basis, what is proposed are:

- Government led efforts, via “more direct” regulations and incentives, to strengthen the pursuance of efficiency in energy use beyond the bauxite/alumina sector;
- Increased participation of the public utility in the full gamut of electricity services – in essence, the pursuance of activities “behind the meter”; and
- Increased participation of energy end users in the provision of energy services, to be promulgated by legislation which enhances the profitability of same, e.g. the introduction of net metering and/or feed in tariff into the Addition of New Generating Capacity to the Public Electric System (2006).

The legislations in Jamaica as outlined at best gives tacit support to energy efficiency related activities, such as self generation, demand side management, etc. The weakness is however that on the one hand, there is belief (and active pursuance) of the idea that replacing oil with cheaper fuel options will inherently reduce energy costs; fuel substitution options that support a sustainable energy economy requires symbiotic measures to increase the efficiency of energy use, as well as a shift to indigenous resources. On the other hand, the existing regulations and policies are —in many parts— incongruent with the All Island Electricity Licence (2001) and the Addition of New Generating

Capacity to the Public Electric System (2006). Further, programmes (such as the Energy Fund) that are available for energy efficiency and renewable energy uptake tend to target electricity services and should be extended to include transport.

The legislations and incentives must provide a coherent mix of “push” and “pull” factors —with clearly delineated targets— that will shift the energy economy away from the traditional approach that focuses exclusively on individual behaviour and technological advances and requires cognizance that there is a wide range of possible measures that can be taken to promote “energy security and efficiency”.

From a projects approach, it is highly recommended that (as a matter of priority) relevant assessment be conducted towards the eventual development of a “commercial scale” ocean or solar air conditioning project. The surgical removal of large commercial air conditioning services from the electricity grid will have immediate impact on sustainable energy use in Jamaica.

Bibliography

Chapter 1: Pre-amble

Department of Energy/Energy Information Administration, (2010), Annual Energy Outlook 2010 (with Projections to 2035)http://www.eia.doe.gov/oiaf/aeo

Department of Energy/Energy Information Administration, (2010), Annual Energy Highlights 2010 http://www.eia.doe.gov/oiaf/aeo

Renewable Energy and Energy Efficiency Partnership, (2010), Jamaica Country Overview: http://www.oas.org/dsd/reeep/documentos.htm

Ministry of Energy and Mining, (2009), National Energy Policy: 2009 – 2030

Ministry of Energy and Mining, (2008), Energy Conservation and Efficiency (ECE) Policy (Draft): 2008 – 2022

Planning Institute of Jamaica, (2009), Vision 2030: National Development Plan; PIOJ ISBN 978 976 8103 28-4

United Nations Economic Commission on Latin America and the Caribbean, (2003), Renewable Energy and Energy Efficiency in Latin America and the Caribbean: Constraints and Prospects.

Chapter 2: Background to Study

Loy; Detlef, (2009), Energy Efficiency Potential in Jamaica (Unfinished Draft).

Ministry of Energy and Mining, (2009), National Energy Policy: 2009 – 2030.

Ministry of Energy and Mining, (2008), Energy Conservation and Efficiency (ECE) Policy (Draft): 2008 – 2022.

Ministry of Energy and mining, (2010), Energy Conservation and Efficiency (ECE) Policy (Draft): 2010 - 2030

Petroleum Corporation of Jamaica, (2008), Annual Report: 2006.

Planning Institute of Jamaica, (2009), Vision 2030: National Development Plan; PIOJ ISBN 978 976 8103 28-4.

United Nations Development Programme/Petroleum Corporation of Jamaica, (2007), Evaluation Report: Environmental Management in Hospitals and Schools.

World Bank/Global Environment Facility, (2006), Post Implementation Impact Assessment: Jamaica Demand Side Management Programme.

Deutsche Geselischaft fur Technische Zusammenarbeit Gmbh/UN Economic Commission for Latin America and the Caribbean, (2005), Renewable Energies Potential in Jamaica.

Chapter 3: Situation Analysis

Davis; Claude and Associates, (2010), Jamaica's Greenhouse Gas Mitigation Assessment Final Report.

Cabinet Office, (2009), Government of Jamaica Policy Register: July 2009.

Ministry of Energy and Mining, (2009), National Energy Policy: 2009 – 2030.

Office of the Prime Minister/Ministry of Energy and Mining, (2009), National Carbon Emissions Trading Policy (Draft).

Office of Utilities Regulations, (2009), Annual Report: 2007.

Planning Institute of Jamaica, (2009), Jamaica Survey of Living Conditions: 2007.

Planning Institute of Jamaica, (2009), Vision 2030: National Development Plan; PIOJ ISBN 978 976 8103 28-4.

Jamaica Public Service Company Limited, (2008), Annual Report: 2007.

Ministry of Energy and Mining, (2008), Energy Conservation and Efficiency (ECE) Policy (Draft): 2008 – 2022.

Ministry of Energy and Mining, (2010), Energy Conservation and Efficiency (ECE) Policy (Draft): 2010 – 2030

World Energy Council, (2008), Energy Efficiency Policies around the World: Review and Evaluation.

Ministry of Transport and Works, (2007), National Transport Policy (Draft).

Ministry of Water and Housing, (2007), Jamaica Water Sector Policy: Strategies and Action Plan.

Planning Institute of Jamaica/Statistical Institute of Jamaica, (2007), Residential Consumer End Use Survey: Household Energy and Transport.

Office of Utilities Regulation, (2006), Regulatory Policy for the Addition of New Generating Capacity to the Public Electricity Supply System.

Office of Utilities Regulation, (2004), Generation Expansion Plan 2004-2012, Decision and Recommendations to Minister of Commerce, Science & Technology.

Office of Utilities Regulation/Jamaica Public Service Company Limited, (2004), Least Cost Expansion Plan.

Office of Utilities Regulations/Jamaica Public Service Company Limited, (2001), All-Island Electricity License.

Deaton, Angus, (1997), The Analysis of Household Surveys: A Microeconometric Approach to Development Policy; Baltimore, Md.: Johns Hopkins University Press.

Bureau of Standards Jamaica, (1994), Jamaica National Building Code, Vol. 2: Energy Efficiency Building Code, Requirements and Guidelines.

Chapter 4: Strategies for Implementation

Binger, Al and Devon Gardner, (2009), Review: 2006 - 2020 Energy Green Paper and 2008-2022 Energy Conservation and Efficiency Draft Policy.

Global Environment Facility, (2000), Operational Programme No. 5: Removal of Barriers to Energy Efficiency and Energy Conservation http://www.gefweb.org.

Appendices

Appendix 1

List, Stakeholder Dialogue

Institution	Persons Represented	Contact
Ministry of Energy and Mining (MEM)	Hillary Alexander Permanent Secretary Conroy Watson Senior Director (former) Fitzroy Vidal Senior Director	Fitzroy Vidal Senior Director +876-754 29799 fvidal@mem.gov.jm
Petroleum Corporation of Jamaica (PCJ)	Ruth Potopsingh Group Managing Director Claon Rowe Senior Engineer	Claon Rowe Senior Engineer +876-929-5380-9 claon.rowe@pcj.com
Jamaica Public Service Company (JPS)	Damian Obligio President and CEO Sam Davis Head of regulatory Affairs	Sam Davis Head of Regulatory Affairs +876-878-3629 sdavis@JPS.com
Office of Utilities Regulations (OUR)	Maurice Charvis Deputy Director General Hopeton Heron Deputy Director General	Hopeton Heron Deputy Director General +876-968-6053 hheron@our.org.jm
Consumer Affairs Commission (CAC)	Racquel Chambers Senior Economist	Racquel Chambers Senior Economist +876-978-5309 rchambers@cac.gov.jm
Bauxite and Alumina Trading Company (BATCO)	Coy Roache Managing Director	Coy Roache Managing Director +876-926-4553 batco@cwjamaica.com
Ministry of Finance (MoF)	Devon Rowe Director General	Devon Rowe Director General +876-579-7441 devon.rowe@mof.gov.jm
Ministry of Transport and Works (MTW)	Alwin Hales Permanent Secretary Janine Dawkins Chief Technical Director	Alwin Hales Permanent Secretary +876-754-2613 ps@mtw.gov.jm
Jamaica Gasoline Retailers Association (JGRA)	Leonard Green Executive Member	Leonard Green Executive Member +876-428-8033 lcgreen1@hotmail.com

(continued)

List, Stakeholder Dialogue (concluded)

Institution	Persons Represented	Contact
Planning Institute of Jamaica (PIOJ)	Seveline Clarke-King Senior Economist Richard Kelly Science and Technology Planner	Seveline Clarke-King Senior Economist +876-935-5137 sclarkek@pioj.gov.jm
Jamaica Manufacturers' Association (JMA)	Omar Azan President Imega Breese McNab Executive Director	Imega Breese McNab Executive Director +876-922-8880-3 imega.jma@cwjamaica.com
National Water Commission (NWC)	Andrew Reid Senior Engineer	Andrew Reid Senior Engineer +876-538-5187 andrew.reid@nwc.com.jm
Jamaica Bureau of Standards (JBS)	James Kerr Manager, Analytical Svcs. Junior Gordon Director, Engineering	James Kerr Manager, Analytical Svcs. +876-881-6548 jkerr@bsj.org.jm
Jamaica Union of Travelers Association (JUTA)	Everard Chaplin Manager	Everard Chaplin Manager 876-927-4534 jutakc@hotmail.com
Jamaica Hotel and Tourist Association (JHTA)	Camille Needham Executive Director	Camille Needham Executive Director +926-3635-6 info@jhta.org
Jamaica Urban Transit Company (JUTC)	Paul Abrahams Managing Director Easton Allen Vice-President, Operations	Paul Abrahams Managing Director +876-788-0180 pabrahams@jutc.com.jm
Petrojam Limited	Winston Watson General Manager	Winston Watson General Manager +876-923-7434 wlw@petrojam.com
Development Bank of Jamaica (DBJ)	Howard Martin Manager, SME Energy Fund Dwight Fraser Account Executive, AFI Relations	Howard Martin Manager, SME Energy Fund +876-578-3545 hmartin@dbankjm.com

Source: Elaborated by author.

Appendix 2

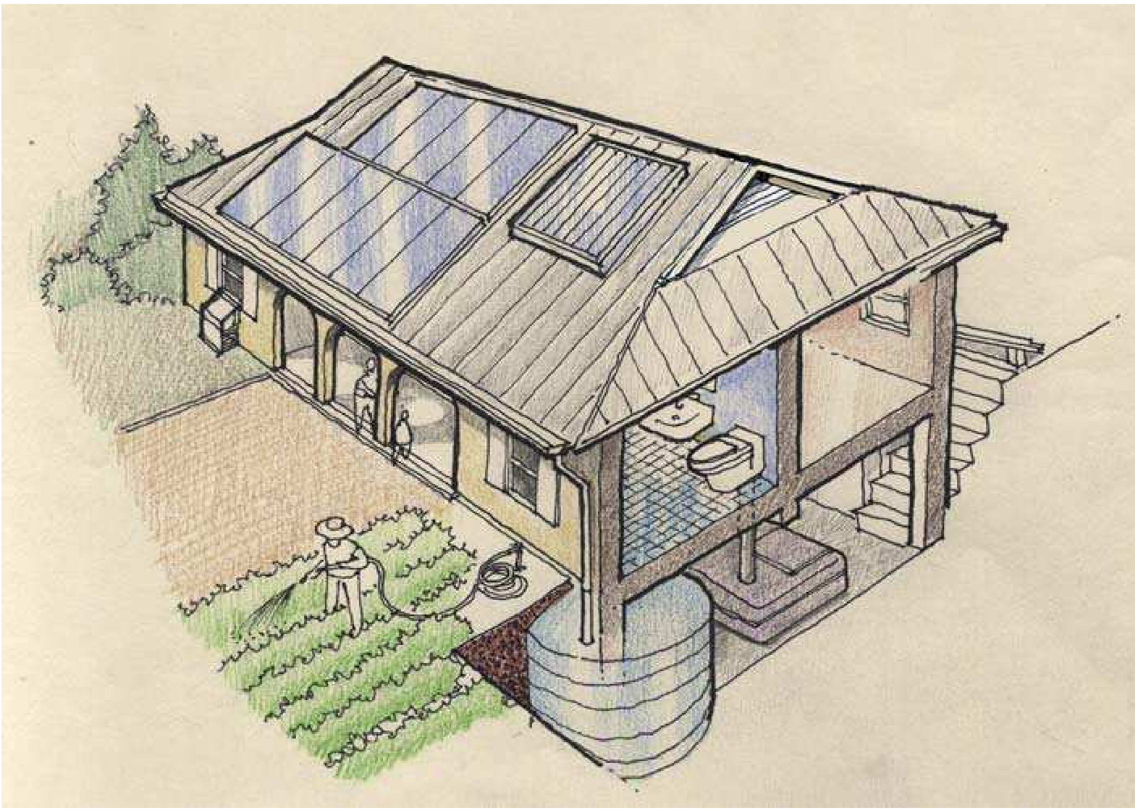
The economics of CFLs compared to incandescent bulbs

	Incandescent Bulb	CFL
Initial Cost of Bulb/ USD	0.50	10
Light Output/ lumen	900	900
Lamp Power/ watt	75	15
Efficacy/ lumens per watt	12	60
Lifetime/ operating hours	1,000	10,000
Calculation over 10,000 operating hours, assuming electricity charges of USD 0.20 per KWh		
Electricity Consumption/KWh	750	150
Cost of electricity/ USD	150	30
Cost of Lamps/USD	5	10
Total Cost of Lamp and Electricity/ USD	155	40
Total Savings for CFL		115

Source: Elaborated by author.

Appendix 3

The "Earth Home" idea



The Earth Home system is a fully integrated building system, using local materials to meet all the living needs of the occupants, for example electricity, hot water, cooking and sewer system.

Appendix 4

Energy savings details, Petroleum Corporation of Jamaica (PCJ) hospitals energy audit

1. Electric Power

Energy Efficiency Measure	Coverage	Annual Cost Saving (US$)	Implem. Cost (US$)
Install Capacitors for Power Factor Correction	1,779 kVAR in 13 hospitals	112,239	191,499
Replace Standard Motors with High Efficiency Models	410 HP in 4 hospitals	17,557	33,929
Install variable speed drive systems with high efficiency motors and two speed motors	158 HP in 4 hospitals	48,389	58,814
Total		178,275	284,242

2. Refrigerators and Small Air Conditioning Units

Energy Efficiency Measure	Coverage	Annual Cost Saving (US$)	Implem. Cost (US$)
Replace R22 Refrigerant in AC Units with Hydro Carbon Refrigerant	Total capacity of 1,386 tons in 21 hospitals	181,125	131,512
Replace R22 Refrigerant in Refrigerators with Hydro Carbon Refrigerant	409 units in 22 hospitals	46,784	36,983
Insulate Refrigerant Lines	670 feet in 4 hospitals	13,868	8,900
Replace Old Refrigerators	30 units in 12 hospitals	11,388	18,625
Replace Old Air Conditionig Units	15 units in 6 hospitals with total capactiy of 60.5 tons	18,547	43,391
Install Dessicant Dehumidifiers on Air Handlers	20 units in 2 hospitals	12,825	34,813
Total		284,537	274,224

3. Building envelope

Energy Efficiency Measure	Coverage	Annual Cost Saving (US$)	Implem. Cost (US$)
Install Radiant Barrier Paint to Metal Clad Roofs	41 Imp. Gal. for 4 hospitals	955	1,312
Install Polyurethane Insulation to Slab Roof	55,064 Sq. Ft. for 9 hospitals	63,706	40,516
Caulk and Weather Strip Doors and Windows	75 windows and 8 doors in 4 hospitals	62,062	6,084
Total		126,723	47,912

4. Lighting

Energy Efficiency Measure	Coverage	Annual Cost Saving (US$)	Implem. Cost (US$)
Replace Standard 2 x 40T12 Fluorescent Fixture with Efficient 2 x F32T8 and Electronic Ballast	2713 fixtures in 20 hospitals	56,276	144,307
Replace Standard 4 x 40T12 Fluorescent Fixture with Efficient 3 x F32T8 and Electronic Ballast	821fixtures in 4 hospitals	21,923	40,036
Replace Mercury Vapour 175W Security Light Fixture with 65W CFL Fixture	129 fixtures in 16 hospitals	13,842	9,277
Replace Incandescent Bulbs with CFL	938 bulbs in 21 hospitals	30,728	5,125
Install Occupancy Sensor and Photocell Light Switches	115 units in 4 hospitals	8,918	14,490
Total		131,687	213,235

5. Large Air Conditioning Systems

Energy Efficiency Measure	Coverage	Annual Cost Saving (US$)	Implem. Cost (US$)
Install Ice Thermal Energy Storage System and Replace Reciprocating Chiller with Screw Chiler	1 system of 70 tons capacity in 1 hospital	78,397	217,800
Total		78,397	217,800

6. Compressed Air

Energy Efficiency Measure	Coverage	Annual Cost Saving (US$)	Implem. Cost (US$)
Repair Leaks on Compressed Air Line	2 leaks in 1 hospital	2,908	1,500
Total		2,908	1,500

7. Water Conservation

Energy Efficiency Measure	Coverage	Annual Cost Saving (US$)	Implem. Cost (US$)
Repair Leaks on Compressed Air Line	229 leaks in 1 hospital	57,769	8,955
Install Low Flow Shower Heads	391 units in 22 hospitals	18,283	15,067
Install Low Flow Restrictors and Faucet Aerators	1,466 units in 22 hospitals	22,289	20,910
Replace Standard Toilets with Flapper-less or Low Flush Toilets	721 units in 22 hospitals	44,988	76,607
Total		143,329	121,539

8. Steam and Heating Systems

Energy Efficiency Measure	Coverage	Annual Cost Saving (US$)	Implem. Cost (US$)
Insulate Steam Lines	1,107 feet in 12 hospitals	19,678	10,402
Repair Steam Lines	17 leaks in 9 hospitals	68,446	6,597
Install Heat Recovery Systems	4 systems to be installed in 1 hospital (KPH)	6,024	41,530
Install Incinerators. Note: Many of the hospitals do not currently have incinerators. Therefore, the proposed incinerators would not replace any existing units but would be seen as an upgrade.	8 units in 8 hospitals	nil	190,000
Total		94,148	248,529

9. Cogeneration

Energy Efficiency Measure	Coverage	Annual Cost Saving (US$)	Implem. Cost (US$)
Install Cogeneration Systems on Standby Plants	1 unit in 1 hospital (KPH)	766,537	766,537
Total		766,537	766,537

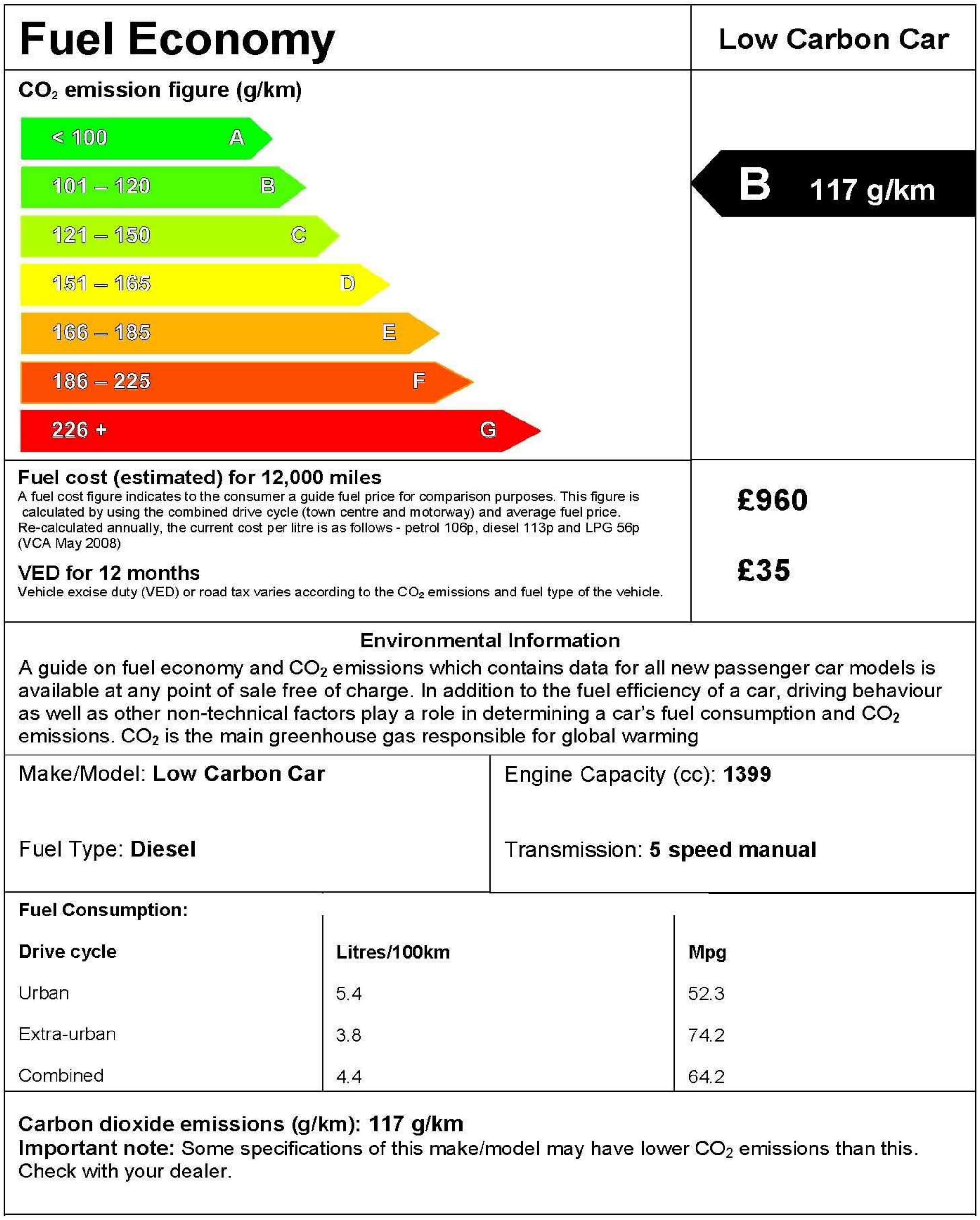
10. Solar Water Heaters

Energy Efficiency Measure	Coverage	Annual Cost Saving US$)	Implem. Cost (US$)
Install Modular Solar Water Heating Systems. Note: The hospitals do not currently have domestic hot water. Therefore, the proposed SWH would not replace any existing hot water systems, but would be seen as an upgrade.	73,840 US Gal. for 22 hospitals	nil	1,977,432
Total		nil	1,977,432

Grand Total for All Ten Categories		**1,806,541**	**3,566,052**

Appendix 5

United Kingdom (UK) fuel consumption classification for cars



Source: http://www.ecolabelindex.com/ecolabel/uk-fuel-economy-label

Appendix 6

Energy efficient items for suspension of the common external tariff (CET)

Existing list of items

Description of Items	Tariff Code
Occupancy Sensors	8536.41
Seven Day and Twenty Four Hour Timers	9106.10
Compact Fluorescent Lamps	8539.310
Electronic Fluorescent Ballasts	8539.310
Solar Driers	8419.39
Water Saving Shower Heads	8481.80
Flow Restrictors for Water Faucets	7307
Power Factor Correction Capacitors	8532.10
Ice Thermal Storage Air Conditioning Systems	8415.100
Air Conditioning Chillers with Rotary Screw Compressors	8414.80
Polyurethane Foam Insulation for Roofs	3921.13
Reflective Films for Glass Windows	3921.90
Photovoltaic Panels	8541.400
Charge Controller	9032.890
Safety Disconnects	8536.100
Load Breakers	8535.290
Negative Bonding Blocks	8536.100
Transfer Switch	8536.500
Inverters	8504.400
Photovoltaic Batteries	8506.800, 8507.80
Solar Electric Fans	8414.51
Solar Electric Refrigerators	8418.212
Wind Turbines and Support Accessories	8412.800
Solar Water Pumping System and Accessories	8413.810
Solar Screen and Walkway Lamps	9405.400
Parking Area and Security Solar Lighting Systems	9405.91
Brackets and Mounts for Solar Lights	8302.49
Bulbs for Solar Powered System	8539.39
Lightning Control Unit	8537.20

Recommended list of items (new)

Description of Items	Tariff Code
Solar Energy Systems	
Polyisocyanurate Foam Insulation for roofs	
Perlite roof insulation	
Polystyrene roof insulation	
KOOL KAT Heat Shield Coating	
Roof Skylights	
Solar water pumping systems and accessories	
Flat plate solar collectors	
Solar air heating systems	
Solar power generating systems	
Solar low pressure steam systems	
Accessories for solar driers	
Solar water heaters	
Solar water Heating Systems	
Solar Water Heating Mounting Accessories	
Photovoltaic devices and accessories	
Concentrating and pipe type solar collectors.	
Solar pumps based on solar thermal and solar photovoltaic conversion	
Solar stills and desalination systems	
Refrigeration	
Air Conditioning Chillers with Rotary Screw Compressors	
Absorption Refrigeration Equipment and materials utilizing Solar Energy, waste heat, LPG, LNG, or Kerosene Oil	
Vapour absorption refrigeration systems	
Screw Compressors	
Thermal Storage Air Conditioning Systems	
Hydrocarbon Refrigerants	
Cars / Vehicles	
Air Conditioning Chillers with Rotary Screw Compressors	
Absorption Refrigeration Equipment and materials utilizing Solar Energy, waste heat, LPG, LNG, or Kerosene Oil	
Fuel Cells	
Hydrogen Uninterrupted Power Supply systems	
Commercial stationary hydrogen fuel cells	
Hydrogen turbines and generators and accessories	

(continued)

(continued)

Description of Items	Tariff Code
Hydrogen – powered vehicles	
Materials incorporated into hydrogen powered vehicles	
Hydrogen – fuelling stations	
Electrically operated vehicles including battery powered or fuel-cell powered vehicles	
Appliances	
Household appliances and office equipment with energy star labelling	
PL tubes	
T8 Fluorescent Tubes	
T12 Fluorescent Tubes	
DC Fluorescent Bulbs	
Wind Energy Systems	
Windmills, parts of wind mills and any specially designed devices which run on windmills	
Wind turbines, support accessories and equipment	
Tower propellers	
Biogas Systems	
Bio-gas plants and bio-gas engines	
Biogas generators	
Biogas equipment, appliances and accessories	
Bio-diesel	
Materials used in the distribution of bio-diesel, including fuelling infrastructure, transportation, and storage	
Ethanol fuel imports	
Gasoline fuelling station pump retrofits for ethanol distribution	
Materials used in distribution of ethanol, including fuelling infrastructure, transportation, and storage	
Bio-diesel and diesel vehicles	
Back pressure pass out, controlled extraction, extraction condensing turbines for cogeneration along with pressure boilers	
Waste Recycling Investments Projects	
Waste Recycling Equipment and Accessories	
General	
Mounting accessories	
DC water pumps	
Resistors, LED, capacitors, Integrated Circuits, diodes	
Inverter/Chargers – transformers	
Fuses, resistors, LED, capacitors, Integrated Circuits, diodes	

(continued)

(continued)

Description of Items	Tariff Code
Charge controllers	
Deep Cycle Batteries	
Lighting control Units	
Coils, Resistors, LED, Capacitors, Integrated Circuits, diodes	
Black continuously plated solar selective coating sheets (in cut lengths or in coils and fins and tubes)	
Mounting Stands, DC duct fans, glass sheeting for windows, plastic sheeting for windows, reflective panels	
General (continued)	
Programmable thermostats	
Expanded metal sheeting	
Wielded water heater panels	
Flat Tempered Glass	
Aluminium angle with glove	
Any special devices including electric generators and pumps running on wind energy	
Data loggers, miscellaneous cabling, grounding equipment, wind vanes and anemometer	
Metmast computer equipment	
Ground rods, magnetic cards for blades, shield wires for substation, and transmission cables, permanent magnet alternator	
Breakers, current transformers, potential transformers, relays, control panels, PLCs, capacitor, capacitor banks, DC battery chargers	
Battery meters and charge controllers, DC auto transformers/ battery equalizers	
AC/DC disconnects, AC circuit breakers, DC circuit breakers, fuse-blocks, ground fault protection, lightning arrestors	
Hot stick, high voltage gloves, voltage detector, multimeters, short and ground sets, harnesses, lanyards, and cable glides	
Wind Turbine aligning tools, Mega Ohm testing equipment, hydraulic torque wrenches and pumps	
Deep-cycle batteries	
Pre-assembled AC/DC power panels	
Agricultural, forestry, agro-industrial, industrial, municipal and urban waste conversion devices producing energy	
Equipment for utilizing ocean waves energy	
Ocean thermal energy conversion systems (Hydropower systems)	
Impellers/blades, shaft, bearings	
Rotor Coils, bearings and armature	
Variable Speed Drives	
Organic Rankine Cycle Power Systems	
Low inlet pressure small steam turbines	
Tinted or reflective glass or shading films	
Variable Air Volume (VAV) Systems	
Caulking Material	

(continued)

(concluded)

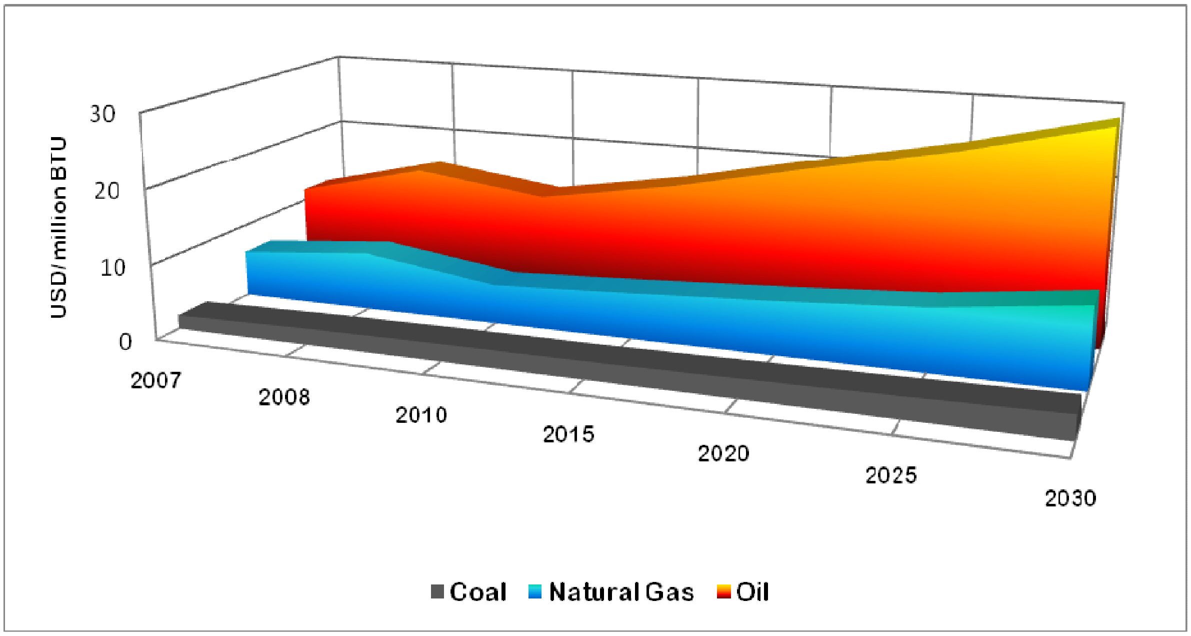
Description of Items	Tariff Code
Energy Management and Control Systems (EMCS) for lighting, heating and cooling	
Materials used in EMCS for lighting, heating and cooling	
Process heating or cooling systems (waste heat recovery)	
Materials used in process heating or cooling	
Energy Efficient Motors	
Net Metering Equipment and Accessories	
Boilers that meet standards of efficiency of 85.0 % or greater	

Source: Ministry of Finance and the Public Service.

Appendix 7

Cost (in USD per million BTU) of energy from various fossil sources, 2007-2030

FIGURE A.1
COMPARATIVE COST ANALYSIS, VARIOUS FOSSIL ENERGY SOURCES, 2007-2030

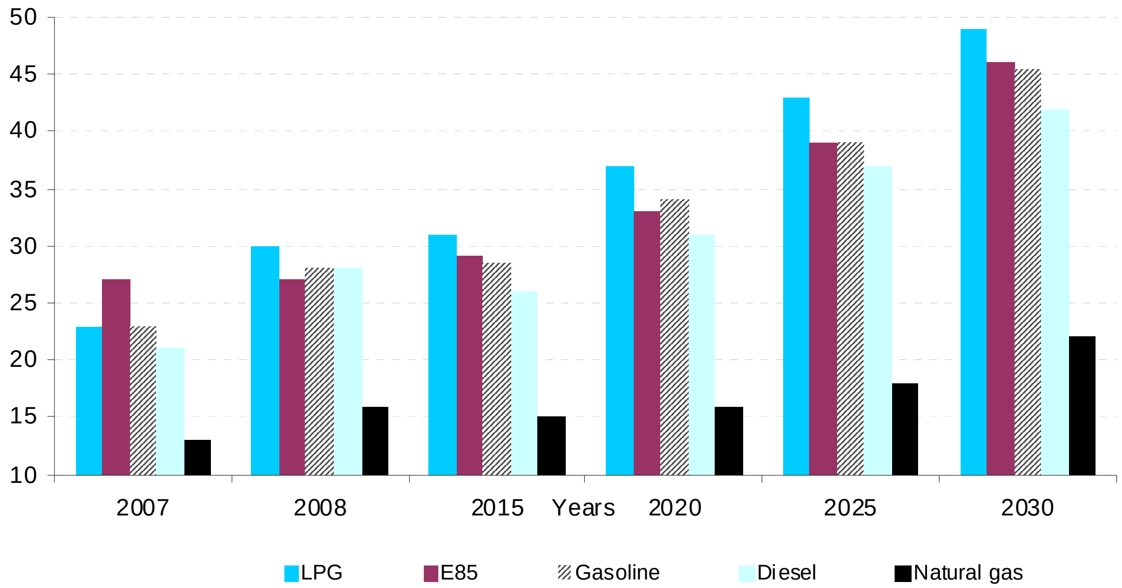


Source: World Energy Outlook, IEA, 2007.

Appendix 8

Cost (in USD per million BTU) of energy from various liquid fossil fuels, 2007-2030

FIGURE A.2
COMPARATIVE ENERGY COST (USD/MILLION BTU), FOSSIL TRANSPORT FUELS, 2007-2030'

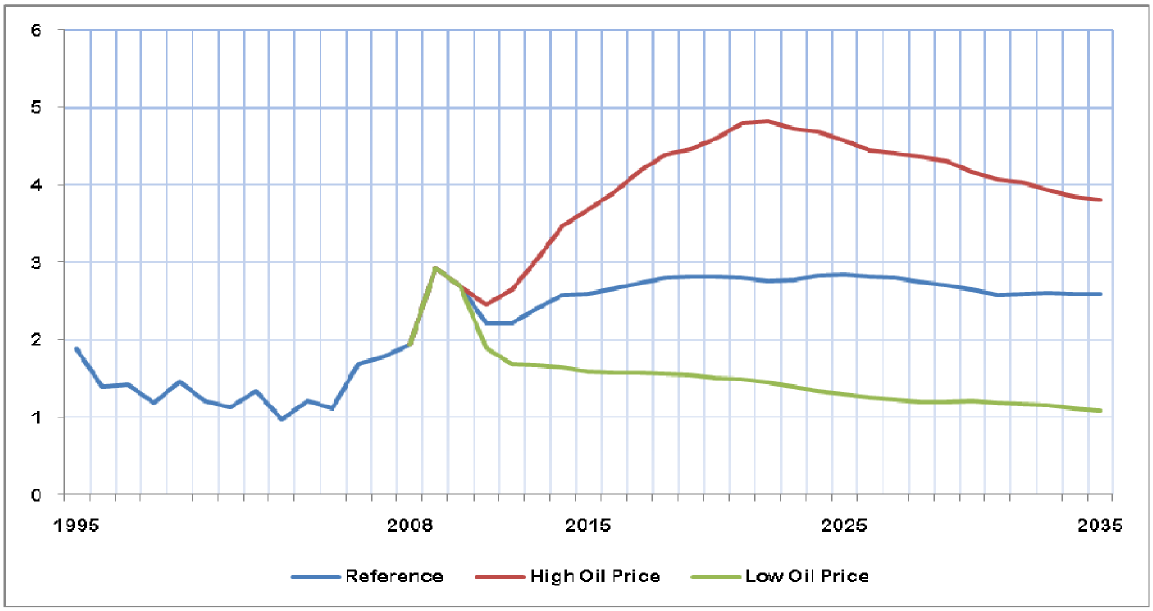


Source: World Energy Outlook, IEA, 2007.

Appendix 9

Low-sulphur light crude oil to natural gas price ratio (on an energy-equivalent basis), 1995-2035

FIGURE A.3
RATIO OF LOW-SULFUR LIGHT CRUDE OIL PRICES TO NATURAL GAS PRICES ON AN ENERGY-EQUIVALENT BASIS, 1995-2035



Source: U.S. Energy Information Administration, Annual Energy Review 2008, DOE/EIA-0384 (2008).

Appendix 10

Jamaica Public Service Company Limited System Generation Profile, 2003-2007

TABLE A.1
NET ELECTRICITY GENERATION, 2003 - 2007

Year	JPS Generation/ GWh	IPP Purchases/ GWh	Total Generation/ GWh	Net Change/ %	IPP Portion of Total/ %
2003	2,673.6	1,022.4	3,696.0	-	27.66
2004	2,764.1	952.8	3,717.0	0.57	25.63
2005	2,810.9	1,067.1	3,878.0	4.33	27.52
2006	2,702.0	1,344.4	4,046.4	4.34	33.23
2007	2,799.9	1,275.6	4,075.5	0.72	31.30

Source: Jamaica Public Service Company Limited.

Appendix 11

Jamaica Public Service Company Limited, transmission and distribution losses, 2000-2007

TABLE A.2
JPS TRANSMISSION AND DISTRIBUTION (T&D) LOSSES, 2000-2007

Year	Transmission and Distribution Losses/ %
2000	16.86
2001	16.56
2002	17.03
2003	18.29
2004	18.96
2005	20.87
2006	22.55
2007	22.88

Source: Jamaica Public Service Company Limited.

Appendix 12

National Water Commission Energy Use Projections 2006-2022

TABLE A.3
NWC ELECTRICITY USE PROJECTION, 2006 – 2022

(Base year 2006
Usage 192,320,507 KWh)

NWC Electricity Usage (Grow @ 2.5%)	Annual Reduction (3.5 %)	
Year	KWh/Year	KWh
2006	192,320,507	
2007	197,128,520	6,899,498
2008	202,056,733	7,071,986
2009	207,108,151	7,248,785
2010	212,285,855	7,430,005
2011	217,593,001	7,615,755
2012	223,032,826	7,806,149
2013	228,608,647	8,001,303
2014	234,323,863	8,201,335
2015	240,181,960	8,406,369
2016	246,186,509	8,616,528
2017	252,341,171	8,831,941
2018	258,649,701	9,052,740
2019	265,115,943	9,279,058
2020	271,743,842	9,511,034
2021	278,537,438	9,748,810
2022	285,500,874	9,992,531
Total	133,713,826	
Average Annual	9,550,988	

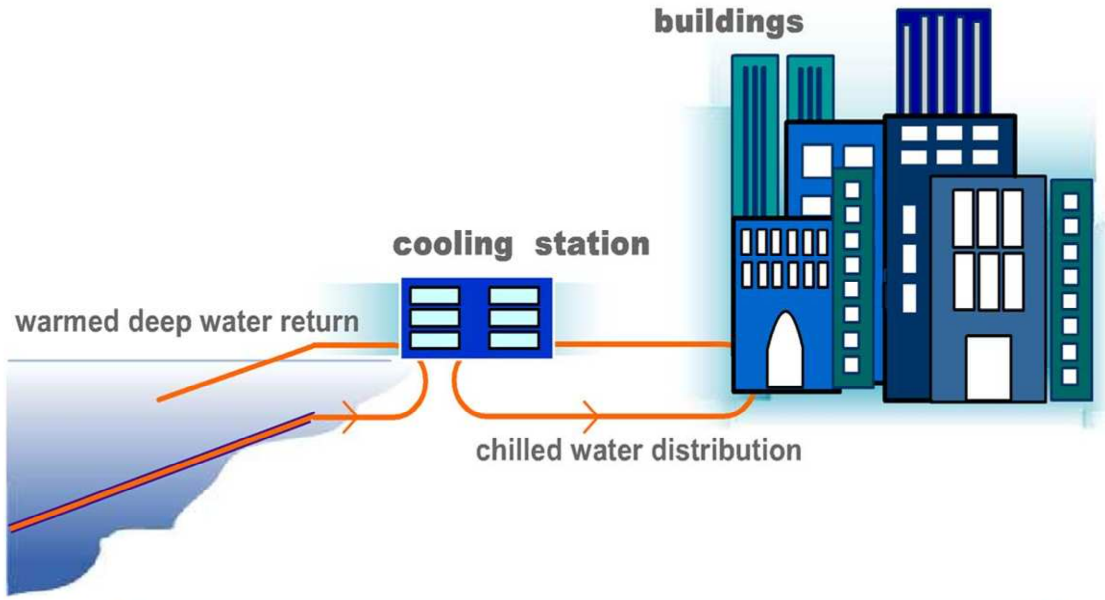
Source: National Water Commission.

Appendix 13

Seawater air conditioning system

Cold seawater circulates through a closed loop of pipes that replace the coolant and compressor found in conventional air-conditioning units.

FIGURE A.4
SCHEMATIC OF SEAWATER AIR CONDITIONING SYSTEM



Cold, deep seawater is pumped through a distribution pipeline to a cooling station on the shore. The intake pipe is located at a depth where the water temperature is 39-45 °F (4-7 °C) year round. The cooling station transfers the seawater's coldness to water circulating in a closed loop pipe system that provides air conditioning service to customer buildings. The cooling station ensures that the sea water and fresh water never mix.

It is estimated that a pipe 1 foot (0.3 metres) in diameter can deliver 4,700 gpm (0.08 m3/s) of water. If 43 °F (6 °C) water is received through such a pipe, it could provide more than enough air conditioning for a large building. If this system operates 8,000 hours per year and local electricity sells for US 10–20 per kWh, it would save USD 400,000–800,000 in energy bills annually. The InterContinental Resort and Thalasso-Spa on the island of Bora Bora uses an OTEC system to air condition its buildings.