2011 BERMUDA ENERGY WHITE PAPER

A NATIONAL ENERGY TRANSITION

GOVERNMENT OF BERMUDA
Ministry of the Environment, Planning and Infrastructure Strategy
Department of Energy

2011 Bermuda Energy White Paper: A National Energy Transition

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Foreword

by the Minister of Environment, Planning and Infrastructure Strategy

Bermuda's past use of energy is interesting and unique. Prior to the introduction of electricity and the internal combustion engine to Bermuda, inhabitants relied upon natural elements to work and survive. Wood was used for heating and lighting, and was later supplemented with whale oil. Water was hand-pumped or bucketed from rain-water tanks, and imported products were transported via wind on sail. The sun fed crops and evaporated water, providing sea-salt for food preservation. Out of simple necessity, early settlers used scarce natural resources in a much more responsible and sustainable manner than we do today.

The discovery of crude oil and its initial use in the form of fuel oil and kerosene was quickly adopted in Bermuda. The first electrical generator, a 50 kilowatt gas unit, was installed in the City of Hamilton in 1907. This generator lacked the power needed to meet increasing demand, so additional generators were soon imported via steamship. Over the next 100 years, as Bermuda's population rapidly increased, so did the energy demands of its people. Following electrical generators, came domestic appliances, incandescent lighting systems, and later motor cars, motorcycles, industrial vehicles and marine vessels.

Fossil fuels derived from oil were a natural choice to power this growth as they were cheap, easy to transport and could power a wide variety of machines. These fuels have in fact been so convenient that they now provide the majority of our energy supplies and we have become almost entirely dependent on them to power our economy. Unfortunately, as our use of fossil fuels has grown we have become increasingly aware of a range of issues related to their use and now realise our choice was short-sighted and is neither environmentally nor economically sustainable.

To address these challenges the Government created the Department of Energy in 2008, with a mandate to reduce fossil fuel dependency, maintain energy security and encourage greenhouse gas emissions reductions. The Department quickly took on these challenges through the publication of a consultation document on a national energy policy for Bermuda; the Energy Green Paper 2009. Feedback from this green paper was subsequently used to develop this white paper thus creating Bermuda's first national energy policy.

This white paper now provides a plan, which if followed, shall guide our small-island community to use energy in an increasingly sustainable manner. It promises a future not bound by fossil fuels, but one that is bright, exciting, and I hope will provide an excellent example to other small-island jurisdictions. Achieving the goals outlined in this white paper will however be extremely demanding, requiring nothing short of a national energy transition. We must quickly abandon the urge of jumping to identify problems we will face in meeting our goals and instead we must view each problem as a challenge, become innovative and search for solutions.

The Government will do its part by continuing to work with the private sector and non-governmental organisations as the policies outlined in this paper are implemented. Individuals and communities must also mobilise themselves to become more energy efficient and to harvest indigenous renewable energy resources. Working together with a shared vision will ensure progress is made for the benefit of Bermuda, her people and the natural environment on which we all depend. I encourage the entire community to take any steps necessary to decrease our fossil fuel consumption and thereby join this transition.

The Honourable Walter H. Roban, JP., MP.

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Glossary of Terms

Alternative Energy: Energy derived from a non-fossil fuel based energy source.

Barrel: A unit of volume equal to 42 U.S. gallons, or 159 litres.

Biomass: Biological material derived from recently living organisms; often includes agricultural crops, agricultural wastes, residues, and wood which can be used as fuel or an energy source.

Biofuel: A liquid fuel that has been derived from biomass, for example, biodiesel and bioethanol.

Carbon dioxide (CO_2): A compound of carbon and oxygen which is formed during respiration or combustion of carbon containing fuels. It is the main greenhouse gas that contributes toward global warming.

Capacity Factor: The percentage of a power plant's maximum continuous power production capability that is achieved over a given time period, usually a year.

Climate Change: A term generally used to refer to large-scale, long-term changes to the global climate caused by increased concentrations of greenhouse gases in the atmosphere.

Combined Heat and Power: The simultaneous production of electricity and useable heat from the combustion of a single fuel source.

Compact fluorescent light bulb: A small gas-discharge light bulb that typically uses 75% less energy than an incandescent light bulb.

Demand–side Management: The management of the timing or amount of consumer energy use. Often used to reduce peak demand for electricity, make more economic use of utility resources, and to align patterns of energy use with renewable energy generation.

Distributed Generation: The generation of electric power at various locations around the electrical grid, as opposed to a central power generating facility.

Dual Metering: Separate metering of electricity consumed and supplied between a grid operator and a third party. This permits separate electricity rates to be established for energy consumed and supplied.

Electric Grid: The infrastructure necessary to deliver electricity between electricity generators and consumers.

Electrical energy: The ability of an electrical current to produce work such as heat, light, or other forms of energy. The standard unit of measurement for electrical energy is the kilowatt hour (kWh).

Electric utility: A company that engages in the generation, transmission and/or distribution of electricity for sale.

Energy Audit: An inspection, survey and analysis of energy usage in a building or process. Energy audits are used to identify cost-effective opportunities to reduce energy consumption.

Energy Conservation: The avoidance of energy consumption, usually through behavioural change.

Energy Efficiency: A ratio of the energy input required to operate an energy consuming product, relative to the useful services received.

Energy Management: A profession that involves actively monitoring and managing energy consumption in a building or operation to achieve and maintain efficient energy use.

Externality: A hidden or indirect cost associated with a product or service. Greenhouse gases produced by the combustion of fossil fuels are a common example.

Facilities charge: A fixed charge that electric utilities often place on consumers to cover fixed operational costs. Facilities charges are often allocated on a monthly basis regardless of a consumer's actual electricity consumption.

Feed-in-tariff: A predetermined rate that is paid for electricity supplied to the electrical grid by a third party.

'First Generation' Biofuels: Biofuels produced through conventional methods using feedstocks such as grains, seeds, sugar cane and other biomass that can often be used to feed humans or animals.

Fossil Fuel: Any finite hydrocarbon based fuel that is formed by the decay of organic material such as plants, trees animals and bacteria over millions of years. Examples include coal, oil and natural gas.

Fuel Adjustment: A supplemental rate charged by the electric utility to cover costs of fuel that are not included in the base rate.

Greenhouse Gases: Gases that contribute toward global warming as they are transparent to solar radiation, but opaque to long wave radiation. Examples include carbon dioxide, methane, water vapour, tropospheric ozone and low-level ozone.

Incandescent light bulb: An electric light bulb in which light is produced by a hot filament powered by electrical current.

Independent power producer: Any entity other than the electric utility that generates electrical power for sale or distribution.

Installed Capacity: The maximum continuous power output available from an electrical generator, sometimes referred to as the name-plate rating.

Interconnection: The physical interconnection of two or more electric systems to permit a flow of electricity between them. This permits the sale and exchange of electricity between an electric utility and an independent power producer.

Kilowatt (kW): A standard unit of electrical power equal to 1,000 watts.

Kilowatt Hour: A unit of electrical energy equal to one kilowatt of power expended for one hour; the standard unit of measure used for electrical billing.

Kyoto Protocol: An international agreement under the United Nations Framework Convention on Climate Change that sets legally binding greenhouse gas emissions targets for signatory countries.

Megawatt (MW): One million watts, or one thousand kilowatts of electrical power.

Miles per Gallon (MPG): A measure of vehicle fuel efficiency, the number of miles a vehicle may travel using one gallon of fuel.

Municipal Solid Waste: Non-hazardous household and business waste material that often includes food waste, discarded products, containers and packaging.

Net Energy Yield (of biofuels): The difference between the energy content of a biofuel and the energy expended to produce the biofuel. The net energy yield of biofuels is often variable and highly dependent on the source of biomass, method of harvesting and production process.

Net Metering: Refers to a system of metering that registers the net flow of electricity between an electric utility and a customer-generator. Also commonly used to refer to an electric rate structure whereby a customer-generator is paid the full retail rate for any electrical energy supplied back to the electrical grid.

Ocean Thermal Energy Conversion: A process that uses the temperature difference between deep-ocean water and surface water to produce useful forms of energy.

Off-peak: A time period when the electric system experiences relatively low demand. These periods often occur in daily, weekly, and seasonal patterns.

Oil: A liquid fossil fuel composed of a mixture of hydrocarbons that usually exist in natural underground pools or reservoirs.

On-peak: A time period when the electric system experiences relatively high demand. These periods often occur in daily, weekly, and seasonal patterns.

Peak Demand: Usually refers to the absolute maximum demand for electrical power experienced by an electric utility at a single point over the course of a year.

Peak Oil: The point in time at which global rates of oil production reach their absolute peak; generally expected to be followed by a rapid and permanent decline in production rates.

R-value: A quantitative measure of resistance to heat flow in a material. Measured in m^2 K hr W^{-1}.

Renewable Energy: Energy that is obtained from naturally occurring sources that are replenished within our lifetimes. Commonly includes but not limited to solar, wind, ocean wave, ocean thermal, geothermal, hydro and tidal. Does not include electricity produced from municipal solid waste.

'Second Generation' Biofuels: Biofuels produced through a variety of non-conventional methods using feedstocks such as wood, corn stalks, wheat stalks and other inedible biological matter.

Smart Grid: An electrical grid that uses information and communications technology to achieve more efficient and dynamic operation.

Smart Meter: An electric meter that is capable of two-way communication between the electric utility, the consumer and compatible appliances.

Solar Water Heater: A renewable energy technology that uses solar radiation to heat water.

Solar Photovoltaic Technology: A renewable energy technology that converts solar radiation into direct current electrical energy.

U-Value: A quantitative measure of the rate of heat flow through a material. Measured in W m^{-2} K^{-1}.

Wind Turbine: A renewable energy technology that converts kinetic energy in moving air into electrical energy.

Executive Summary

This white paper on energy was written by the recently established Department of Energy, which was formed in 2008 in response to a direct recommendation of the Bermuda Government's Sustainable Development Strategy and Implementation Plan. The purpose of this paper is to provide a nine-year plan that outlines the key energy policies required to substantially reduce fossil fuel dependency, maintain energy security, and reduce greenhouse-gas emissions below 10 metric tonnes CO_2 equivalent per capita by 2020.

The Department of Energy's first major undertaking was the creation of the 2009 Energy Green Paper, Bermuda's first national energy policy consultation document. The public's responses to the green paper on energy have been used to develop this white paper and in doing so the Department of Energy has completed its initial directive to form an energy policy for Bermuda.

Of the chapters contained within this white paper, the first is perhaps the most important. Although energy can be a complex and sometimes confusing topic for the uninitiated, understanding the current and impending issues behind Bermuda's present approach toward energy will provoke questions that will naturally lead to a greater appreciation for the subject. Understanding these issues also provides the necessary context to place the remainder of the paper in perspective.

The vast majority of Bermuda's energy supply is currently provided by imported liquid fossil fuels derived from oil. Although Bermuda's energy supplies have historically been relatively secure, there have always been and will continue to be ongoing risks to short-term energy security; fortunately there is a great deal that has been done and will continue to be done to mitigate these risks. Of much greater concern is the peak in global oil production and subsequent decline in oil supplies, which is leading to a supply crunch that will cause oil prices to skyrocket.

Compounding growing concerns over Bermuda's long-term energy security, the environmental consequences of Bermuda's reliance on fossil fuels can no longer be ignored. The majority of Bermuda's greenhouse gas emissions are produced through the combustion of fossil fuels and municipal solid waste to provide the energy necessary for electricity generation and transportation. The scientific community generally accepts the combustion of fossil fuels is causing changes to the world's climate and emissions of greenhouse gases from Bermuda in 2008 exceeded twice the worldwide average. Experimental data continues to reinforce not only the theory behind the causes of climate change, but also the likely effects. Recent reports provide cause for concern as they predict a wide range of adverse impacts on Bermuda resulting from changes to the global climate.

As a vulnerable small island community, the Government believes it is imperative for Bermuda to set a responsible example and has therefore adopted a goal of reducing emissions to less than 1 metric tonne CO_2 equivalent per capita by 2050. This white paper outlines the critical first steps that must be made toward achieving this goal focusing on the shorter-term goals of halting emissions growth by 2013 and reducing emissions thereafter to less than 10 metric tonnes CO_2 equivalent per capita by 2020; a 30% reduction in greenhouse gas emissions from 2008 levels. Prior to 2020, a new Energy White Paper will be developed to provide more specific guidance on the policies required to reach a subsequent target of reducing emissions 56% below 2008 levels by 2030.

Progress toward meeting the goals of this white paper has already been made in parallel with its development. An Energy Act was created to establish an Energy Commission to regulate electricity pricing and introduce a statutory framework for licencing electrical generators. The Customs Tariff has been adjusted to encourage the uptake of energy efficient and renewable energy technologies. Rebates have been offered for solar photovoltaic and hot water systems, information has been made available to educate the public on the issues behind energy supplies and the solutions available, and Bermuda's first public opinion survey on energy, has provided much needed understanding for a subject that was previously little understood.

This white paper introduces a broad range of solutions for the future, and specifically identifies the select few that are particularly critical to driving the majority of change. Even as progress is made toward meeting the ambitious targets outlined in this white paper, it is inevitable that fuel poverty will continue to affect an increasing proportion of Bermuda's population as fossil fuel prices increase. Many existing businesses will also face an increasingly challenging environment and may no longer be economically viable in a world of increasingly expensive oil. The policies outlined in this white paper will encourage residents to begin making the changes necessary for their long-term economic survival. Reducing Bermuda's greenhouse gas emissions will be labour intensive and fortunately presents an opportunity for the development of a new sustainable energy industry that will be financed through money otherwise lost from Bermuda's economy to purchase foreign oil.

Questions surrounding access to the electrical grid have been a recurrent theme over the past few years. The Government will address this uncertainty by introducing a legal framework that provides greater clarity surrounding the relationship between the incumbent electric utility and independent power producers. The planning of new electrical generation capacity, which has historically been performed solely by the electric utility, will also be subject to new legislation that will ensure it becomes a more inclusive process, involving the entire energy industry in the selection of a more sustainable future generation mix. The electrical delivery system must itself be upgraded to lay the foundation required to meet the 2020 targets as the technical capabilities of this system are key to implementing many vital solutions.

A key element of achieving the growth in renewable energy necessary to meet the targets of this white paper will be the introduction of a legal obligation for the mandatory purchase of low-emission energy. Feed-in-rates for independent power producers will also be required to provide the financial security necessary to encourage investment in more sustainable forms of power generation. Public land and seabed will be allocated for utility-scale renewable electricity generation projects and the Government will be responsible for selecting which companies are permitted to use these sites to ensure the public interest is represented.

As the electricity generation industry diversifies, the Government will ensure it does so in a safe and controlled manner. All power producers will be required to obtain generation licences and a comprehensive set of interconnection standards will be developed with the electric utility, while an independent regulatory authority will maintain regulatory oversight of interconnected entities. The building code will also be amended to include quality standards specifically for distributed renewable energy systems. To accelerate growth in small-scale renewable energy, an expedited planning process will be created and renewable energy resource data will be released to the public.

Energy efficiency will play a leading role in meeting a target to reduce electricity consumption 20% by 2020. Minimum efficiency standards will be introduced to prohibit the importation of inefficient products to Bermuda, while consumer awareness will be increased through public education and mandatory energy performance labelling. Energy auditing will serve consumers by identifying both inefficient products and more cost-effective energy efficient replacements, while energy management will be promoted to ensure products are operated at optimal efficiency.

Historically, there have been no mandatory requirements for energy efficient building design and few incentives to voluntarily develop and operate energy efficient buildings. This is set to change through amendments to the building codes that will include requirements for energy efficiency and renewable energy. Mandatory and voluntary energy auditing will be introduced to identify cost-effective opportunities to make buildings more efficient, while energy management will be promoted as a solution to ensure buildings are operated more efficiently. These efforts will be reinforced through a legal framework that will be developed to better align incentives between landlords and tenants. An energy performance rating system will also be created for buildings to provide a straightforward way of benchmarking building energy consumption.

Reducing emissions from transportation is another important challenge that must be addressed if the overall targets of this white paper are to be achieved. The Government has therefore set a target to reduce greenhouse gas emissions from local transportation 30% below 2008 levels by 2020. Naturally, much of this target will be met through radically improving the efficiency of vehicles imported to Bermuda through the introduction of minimum fuel efficiency standards for new vehicles; Government vehicles will be no exception and will be required to meet an even higher level of efficiency than the national standard. Fuel quality standards will be introduced to ensure fuels are of a quality high enough to meet the specifications required by modern efficient vehicles.

The Government will also take steps to provide consumers with better information on fuel efficiency through mandatory labelling of new vehicles and the integration of efficiency information with vehicle licences. Fees for licencing vehicles will be changed to be based on fuel efficiency, which will provide a financial incentive to purchase more efficient vehicles and will also increase awareness of efficiency. More efficient use of vehicles will be promoted through public education and the development of a car-pooling programme. Alternative forms of transportation will be encouraged through a range of measures; in particular, rapid growth in the use of electric vehicles will be driven through continued duty reliefs, the installation of charging stations, licence fee incentives and the integration of electric vehicles into the Government fleet. To reduce fossil fuel consumption for public transportation, the Government has established an internal target of reducing fossil fuel consumption for the bus and ferry services 30% below 2008 levels by 2020.

A solid legislative and regulatory foundation will be fundamental to the timely and efficient implementation of this white paper. With the exception of the 2009 Energy Act, legislation and regulation in Bermuda were developed during a time when energy was cheap, widely available and the environmental impacts of its use were not fully understood or accepted. As a result, existing laws do not provide the Government nor the Energy Commission with the authority necessary for Bermuda to reach the targets outlined in this White paper. Both new and existing laws must therefore be quickly developed to create the foundation upon which Bermuda's future energy plan may be built. The most critical step in this process will be the development of a new Energy Act that transfers responsibility for the regulation of energy to an independent regulatory authority and provides the comprehensive authority required to regulate the energy industry during a period of substantial change that demands bold regulatory action.

Outcome of the Energy Green Paper Consultation Process

Introduction

The Energy Green Paper was released in February 2009 and over 50 organisations were invited to respond by offering their views on the policy proposals and technical options outlined in the document. Invitations for response were extended to industry associations, businesses, and non-governmental organisations representing a wide range of interests from engineering, architecture and transportation to the environment and sustainable development.

Seventeen formal submissions were received and responses addressed most topics in the Energy Green Paper, though particular emphasis was placed on energy policy and implementation. During the consultation period the Department of Energy also held discussions with a number of key stakeholders and interested parties who wished to elaborate on their written response. The responses received provided an important insight into many specific views on energy policy in Bermuda.

Summary of Responses

General comments

The publication of the Energy Green Paper was welcomed by most respondents who generally acknowledged and appreciated the Government's efforts in developing Bermuda's first consultation document on energy policy. There was also a strong consensus that the Energy White Paper should be comprehensive, action-oriented and account for local circumstances unique to Bermuda.

There was general agreement that energy policy should prioritise the security, reliability, and sustainability of electricity supply. Policies that promote the responsible adoption of alternative and renewable energy technologies, and the competitive viability of independent power producers, were encouraged.

Facilitating greater community involvement in energy efficiency initiatives was widely endorsed and several responses encouraged ongoing public education campaigns from the Government, electric utility and environmental organisations to improve knowledge and understanding of energy efficiency.

Many responses relating to the sustainability of energy supply referred to the threat of climate change to Bermuda. These concerns were particularly reflected in responses which advocated substantial increases in the use of renewable energy technologies.

Security of energy supply

The risk to security of supply as a result of the finite nature of global oil and gas supplies was a strong theme in many responses. The need to adopt alternative sources of energy was recognised as essential to the long-term security of Bermuda's future energy supplies.

Several respondents were concerned that climate change, in particular the projected increase in the severity of weather systems, may adversely affect electricity service because of damage to the electrical grid. Respondents cited Hurricane Fabian as an example due to the prolonged power outages that it caused in 2003.

The need to ensure a secure supply of energy for transportation in Bermuda was mentioned in many responses. Fuel diversification and the use of electric vehicles were deemed essential parts of any solution. The infrastructure and land required for the local production of biofuels were noted as significant barriers, though most responses were optimistic that Bermuda could decrease its reliance on fossil fuels for transportation.

Sustainable electricity generation

Power supply planning, projected increases in demand for electricity, and the resulting need for additional generation capacity were recognised as primary issues in most submissions. The lack of land available for expanding the central power station and the subsequent need for distributed generation led to comments supporting greater regulation of electricity to facilitate interconnection of alternative energy technologies with the electrical grid.

A target proposed by the electric utility for 20% of electricity supply to be produced from renewable energy by 2020 was broadly welcomed, although some respondents believed the Government lacked the will to support this target. The need for consistent support and collaboration between Government departments was recognised as a prerequisite for achieving the increased penetration of renewable energy necessary to provide a more sustainable energy supply for Bermuda.

Increasing the generation capacity of the Tynes Bay waste-to-energy facility was considered a logical part of reducing fossil fuel dependency, although the reliability of the facility was questioned, which has implications on its viability for inclusion in Bermuda's electricity supply planning. The use of combined heat and power technologies to take advantage of waste heat energy was identified as an area where energy efficiency could be greatly improved.

The pursuit of utility-scale wind energy projects was generally supported, though the intermittent nature of the resource was acknowledged as a potential issue. Clearer planning guidelines for the installation of residential wind turbines were requested as some proposed developments have encountered lengthy delays due to initial Government uncertainties toward the technology. A number of responses pointed to the need for energy storage or dedicated back-up generation capacity for wind energy projects, to ensure that a reliable supply may be maintained at all times.

Sustainable energy use in buildings

Environmentally responsible building regulations for new and existing buildings were suggested in many responses. In particular, much higher levels of energy efficiency and the integration of renewable energy technologies were recommended. Responses also suggested the public sector has an obligation to lead by example through the adoption of such measures.

Competitiveness of energy supply

While competition in the supply of electricity was generally welcomed, some respondents expressed concerns that encouraging competition in the electric industry may not result in lower costs due to the capital intensive nature of electricity generation plants, especially in a limited market such as Bermuda. It was also suggested that the current structure of customs duty rates for fuels and electrical generators restricts competition and should be changed.

Economic viability

Many respondents believed that financial incentives such as rebates, customs duty relief, and feed-in-tariffs are necessary for renewable energy to be economically competitive with fossil fuel powered generation. Ongoing financial incentives that improve the return on investment for energy efficiency and renewable energy technologies were suggested by most.

Policy delivery

There was broad recognition of the complexity of policy drivers in the energy sector and the challenges involved with implementing policy in a rapidly changing technological and economical environment. Many called for greater clarity on the various roles of Government ministries in delivering energy policy and suggested that proactive and regular communication is introduced along with detailed explanation of regulatory decisions.

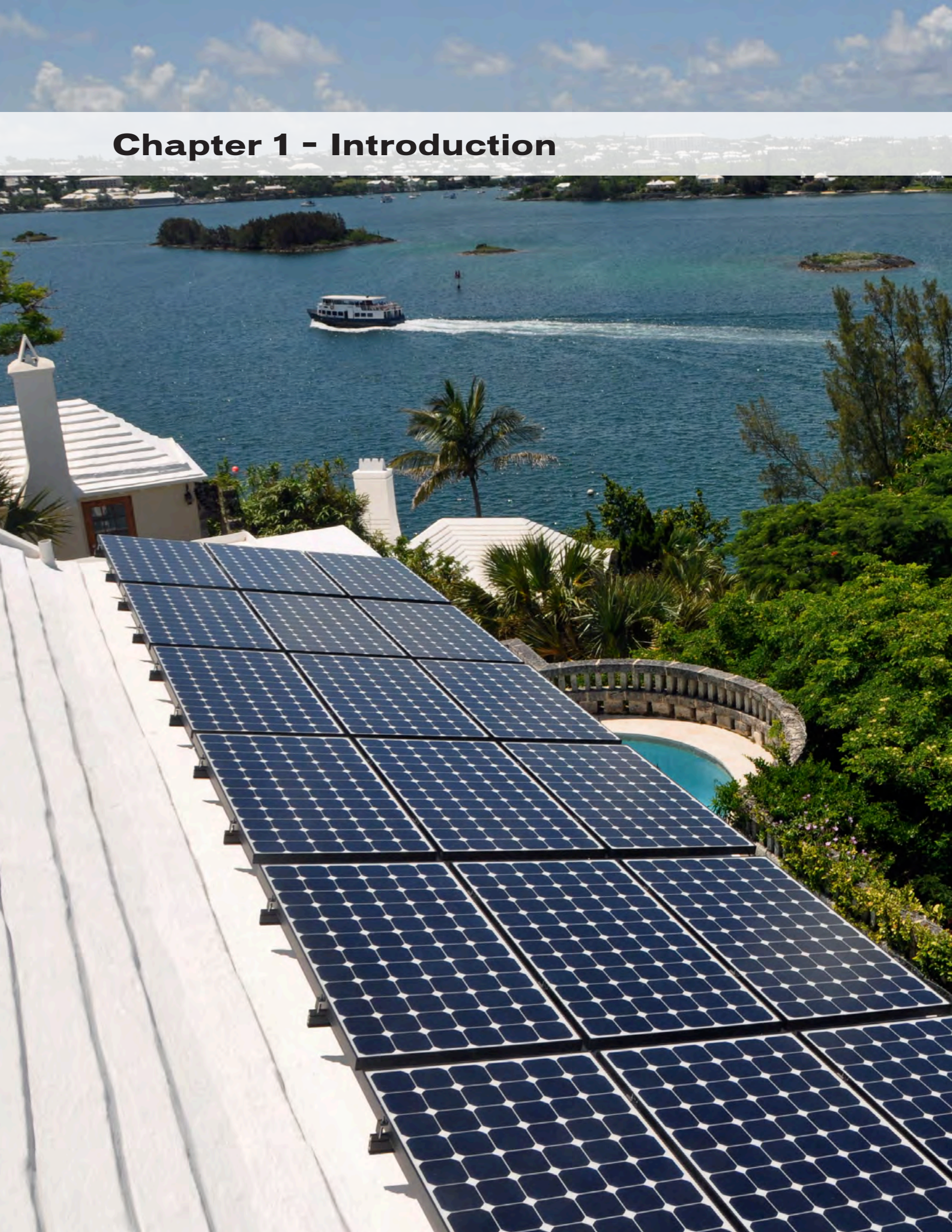
Energy regulation

Several respondents suggested that any regulatory authority for energy should be independent from Government and industry, while maintaining input from both. Some responses focused on the balance of responsibility between the Energy Commission and the Minister with particular attention to the challenge of combining regulatory independence with ministerial powers. Many responses stressed the need for greater consumer focus in regulatory decisions, recommending the establishment of formal consumer representation in the regulatory framework.

Conclusion

The public responses to the Energy Green Paper 2009 provided valuable input to the development of energy policy in Bermuda and most responses were supportive of the direction taken in the green paper. Although respondents had different opinions regarding the specific approach that should be taken, the overwhelming majority were generally optimistic of the potential to reduce energy consumption and develop a sustainable energy supply for Bermuda.

Chapter 1 - Introduction



1 Introduction

The Sustainable Development Unit was established in 2006 to promote and facilitate policy making that is compatible with the Bermuda Government's Sustainable Development Strategy and Implementation Plan[1]. This Plan was developed through extensive and far-reaching public consultation and outlines options for Bermuda to move toward a more sustainable future. The plan is centred on five main themes that cover a range of social, economic, and environmental issues; many of which require more sustainable use of energy in Bermuda.

The Plan also asks the question, 'How do we meet our energy needs without relying almost entirely on imported fossil fuels?' and Action 2.1.A.2 specifically recommends that the Government develop an energy strategy for Bermuda. As a result, a national policy consultation on energy was held[2] and subsequently, this White paper was developed to outline Bermuda's future national energy policy. Many of the policies outlined in this document will address more specific elements of the Energy Strategy for Bermuda which are outlined in the Sustainable Development Implementation Plan.

1.1 Purpose of the Energy White Paper

The purpose of this Energy White Paper is to provide a nine-year plan for Bermuda, which outlines the key energy policies that will substantially reduce fossil fuel dependency, maintain energy security, and reduce greenhouse-gas emissions below 10 metric tonnes CO_2 equivalent per capita by 2020. This white paper also introduces the Government's long-term goal of reducing Bermuda's greenhouse gas emissions below 1 metric tonne CO_2 equivalent per capita by 2050. Although it is impractical to determine exactly how this long-term emissions reduction goal will be achieved, it provides the context required for this white paper to set Bermuda on track toward achieving the necessary emissions reductions.

1.2 Objectives of the Department of Energy

The Bermuda Government established the Department of Energy to develop the policies necessary to meet future energy challenges and to use energy in a more responsible and sustainable manner.[3] The Department of Energy's strategic goals have been amended since the release of the Energy Green Paper 2009 to reflect the greenhouse gas emissions goal for 2050:

- Reduce fossil fuel dependency;
- Ensure a secure and reliable energy supply, in terms of both quantity and cost; and
- Reduce greenhouse gas emissions per capita below 1 metric ton CO_2 equivalent by 2050.

These will be achieved through the development of laws, regulation and incentives, which:

- Promote a culture of energy conservation;
- Encourage energy efficiency;
- Encourage alternative and renewable energy technologies;
- Lead to improved monitoring and regulation of energy importation, production and distribution; and
- Are developed through collaboration between government agencies and other key stakeholders.

The Department of Energy shall ensure an open and collaborative approach is taken by consulting on its proposed policies, legislation and incentives using the process outlined in Appendix 1.

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[1] Government of Bermuda. Sustainable Development Unit. (2008) *Charting Our Course: Sustaining Bermuda.* Bermuda.

[2] Through the release of the Energy Green Paper 2009.

[3] This also supported '*Action 2.1.A.1: Set up an energy unit within Government'* from the Government's Sustainable Development Strategy & Implementation Plan.

1.3 Energy Security

Over the past 100 years, many substantial economic opportunities have emerged for Bermuda thanks to a cheap and plentiful energy supply. Although the economy has enjoyed a huge success as a result, it has led Bermuda to become dependent on imported fuels derived from oil.[4] The realities of future issues with oil supply dictate that continuing this reliance is not sustainable. The present situation places Bermuda at the mercy of foreign energy suppliers as secure supplies of energy at affordable prices will only be available to Bermuda for as long as oil supplying countries and companies are able and willing to supply sufficient quantities of fuel at reasonable prices. This situation is potentially unstable as a secure energy supply is essential to maintain the current way of life, yet the supply chain outside Bermuda is vulnerable to many unpredictable external factors such as:

- Political instability;
- Exchange rate variance;
- Natural disasters;
- Accidents;
- Labour disputes;
- Terrorism; and
- Competition.

Despite the potential impact these factors may have on Bermuda, residents usually have little awareness of them and seem to take the continual availability of energy at affordable prices for granted. Although this suggests either confidence in future energy security or ignorance regarding potential supply issues, 86% of residents in Bermuda agree the price of oil is likely to increase significantly in the future and 64% believe that oil supplies are finite and production is predicted to decline within the next decade.[5]

Bermuda's geographic isolation compounds the problems associated with creating a secure energy supply and makes the consequences of any interruption to energy supplies even more serious. It has even been suggested that import-dependent nations such as Bermuda may have seen their last days of economic growth if they fail to transition to a new energy economy.[6]

1.3.1 Short-term energy security

Sudden disruptions to energy supplies as a result of issues with fuel or electricity deliveries to, or within, Bermuda could severely compromise short-term energy security[7]. Many residents and businesses are ill-prepared for the effects of energy supply shortages and would be unable to continue business as usual if a disruption were to occur. This was clearly illustrated on July 14, 2005 when a fire at the electric utility interrupted electricity supplies. Within a few days, several large businesses were forced to fly key staff abroad to maintain vital operations and some areas in the City of Hamilton were without power for several days. There are many factors that could threaten short-term energy security, and they include:

- Difficulties with purchasing foreign fuel;
- Sudden, unpredictable increases in fuel prices;
- Failure of an oil tanker to arrive due to severe weather;
- Failure of an oil tanker to dock and transfer fuel;
- Damage to the fuel pipeline between the fuel supplier and electric utility;
- Failure of one or more large electrical generators;
- Damage to the electrical transmission and distribution system; and
- Limited space to expand fuel storage facilities if demand continues to increase.

[4] Appendix 2 provides a sankey diagram of estimated energy flows, which clearly highlights the extent of Bermuda's dependence on imported fossil fuels.
[5] Mindmaps. (2010). *Bermuda Government Department of Energy Research Report.* Bermuda.
[6] New Economics Foundation. (2010). *Growth isn't Possible.* United Kingdom.
[7] Short-term energy security in the context of this White Paper refers to reliable day-to-day supplies of energy.

Historically, short-term energy security has been maintained through the efforts of private companies in Bermuda. Fuel importers continue to operate the fuel docks, storage tanks, delivery services and retail infrastructure in a generally reliable manner, while the electric utility works to provide a dependable supply of electricity. The fuel storage facilities owned by these companies act as a buffer to ensure short term energy security and have proven adequate in recent history. The Government will support these companies, as necessary, in their on-going efforts to maintain short-term energy supply security.

1.3.2 Long-term energy security

Traditionally there has been little consideration of the long-term prospects for a secure energy supply and energy sources have been selected based primarily on the cheapest short-term cost. Although this has been a short sighted approach that fails to account for future energy supply issues, the relatively low cost of oil allowed it to work until the price spike of 2008[8]. Despite this price shock, many energy related investment decisions continue to be based on present, rather than future energy supply realities and further commit Bermuda to many years of continued dependence on potentially unsecure energy supplies. The finite nature of fossil fuels dictates they cannot provide Bermuda with long-term supply security and the question is therefore 'when' rather than 'if' fossil fuels will cease to become available and affordable to Bermuda.

As reported in the 2009 Energy Green Paper[9], many leading geological experts believe the peak in production of oil has already occurred or will occur shortly. The International Energy Agency (IEA) has recently reported staggering depletion figures for many of the world's top 800 oil fields[10], stating that *"The world's energy system is at a crossroads. Current global trends in energy supply and consumption are patently unsustainable…..what is needed is nothing short of an energy revolution."*[11]. More recently, the IEA have even suggested the peak in oil production from known conventional fields has already occurred, as shown in Figure 1.1:

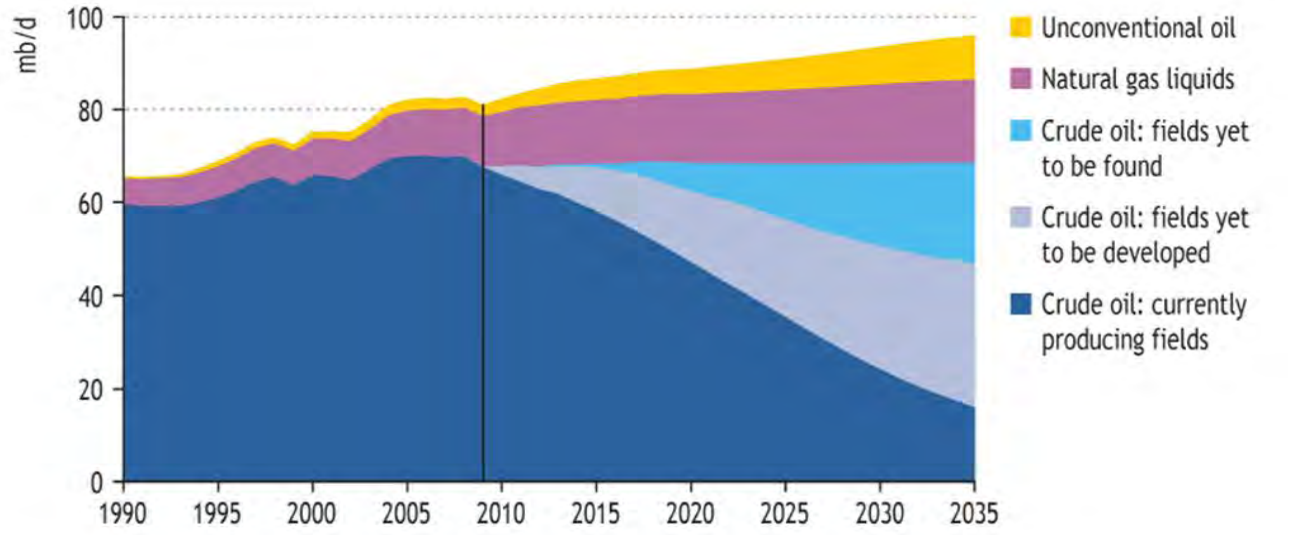

Figure 1.1 – Past and projected world oil production by source (International Energy Agency[12], 2010)

[8] Oil reached nearly $150 a barrel in the summer of 2008, more than double the price from a year before.
[9] Government of Bermuda. Department of Energy. (2009). *Bermuda Energy Green Paper.* p17. Bermuda.
[10] International Energy Agency. (2008). *World Energy Outlook.* France.
[11] International Energy Agency. (2009) *World Energy Outlook.* France.
[12] International Energy Agency. (2009) *World Energy Outlook.* © OECD/IEA. Figure 3.19. p120. France.

Of more practical importance than the peak of oil production is the point at which demand for oil begins to exceed available supplies. Substantial increases in the price of fuels are certain to occur once this inevitable 'supply crunch' takes place and the chief economist of the IEA has even claimed this supply crunch could limit any worldwide economic recovery[13]. Although it is difficult to predict exactly when this supply crunch will happen, Royal Dutch Shell has recently stated that *'By 2015, growth in the production of easily accessible oil and gas will not match the projected rate of demand growth.'*[14]

These circumstances are contributing to the end of cheap oil and have led to the spectre of increasingly unpredictable oil price spikes similar to those which '*drove inflation to higher levels during most of the year'*[15] in 2008. It is almost certain that oil price spikes will occur in the future and residents of Bermuda must ensure they are prepared as failure to act leaves Bermuda in an extremely vulnerable situation.[16] The first few months of 2011 have already witnessed an increase in oil prices of approximately 20%[17], which has placed steady upward pressure on the price of energy for Bermuda.

Over the long-term, Bermuda must therefore aim for a near-complete national transition away from imported fossil fuels and toward indigenous and renewable sources of energy. This transition will not be achieved without great effort on the part of many individuals; therefore the Government will ensure the development of a secure energy supply becomes an ongoing national priority. Confronting energy security issues and breaking from the status quo will ultimately benefit future generations of Bermudians and may prove to be one of Bermuda's most important long term investments.

1.4 Climate Change

For many decades, the scientific community has generally accepted that greenhouse gas emissions from human activities across the world are the most probable cause of climate change. The Intergovernmental Panel on Climate Change confirmed this in 2007 by stating:

> *"Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level….Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases…Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations."* [18]

1.4.1 Impact of climate change on energy in Bermuda

The Bermuda National Trust recently published a report detailing the potential effects of climate change on Bermuda[19]. The report projects a wide range of negative impacts to many aspects of life in Bermuda, in particular, substantial challenges are likely to be faced in trying to maintain a secure energy supply in the future as a result of:

- Rising sea levels, which could inundate the electric utility's central power plant and submerge parts of the transmission network;
- Increased frequency and severity of storms, which may cause interruptions to fossil fuel deliveries, lead to more frequent storm damage to electrical distribution infrastructure and may also pose a threat to certain renewable energy technologies; and
- Generally rising temperatures, which are likely to increase demand for electricity as a result of increased demand for air conditioning.

[13] Birol, Dr. F. (2009). Interview with The Independent. United Kingdom.
[14] Shell International. (2010). *Shell Energy Scenarios to 2050*.
[15] Bermuda Government. Department of Statistics. (2009). *Consumer Price Index*. Bermuda.
[16] The Department of Financial Assistance reported that hundreds of households were receiving financial assistance for their electricity bills in January 2011, while almost 1,200 households were disconnected by March 2011 for failing to pay their bills.
[17] Oil-Price.net. (2011) *Crude Oil and Commodity Prices* [online] Available at: www.oil-price.net
[18] Intergovernmental Panel on Climate Change. (2007). *Climate Change 2007: Synthesis Report*. Switzerland.
[19] Glasspool, A. F., (2008). *The Impact of Climate Change on Bermuda*. Report Prepared for the Bermuda National Trust. Bermuda.

These challenges represent a serious and increasing risk to the security of energy in Bermuda. The Government will therefore ensure the effects of climate change are recognised and accounted for in energy policy development.

1.4.2 Bermuda's contribution toward climate change

The Bermuda Government[20] and the United Kingdom Department of Energy and Climate Change[21] have both estimated Bermuda's greenhouse gas emissions[22] in recent years. The most up to date estimates[23] suggest that Bermuda's emissions reached equivalent to 927,000 tonnes of CO_2 in 2008. Although this is insignificant in an international context, Bermuda's emissions per person are relatively high at 14.44 metric tonnes per capita[24], more than twice the worldwide average[25]. Figure 1.2 shows the steady rise in Bermuda's greenhouse gas emissions over the last two decades.

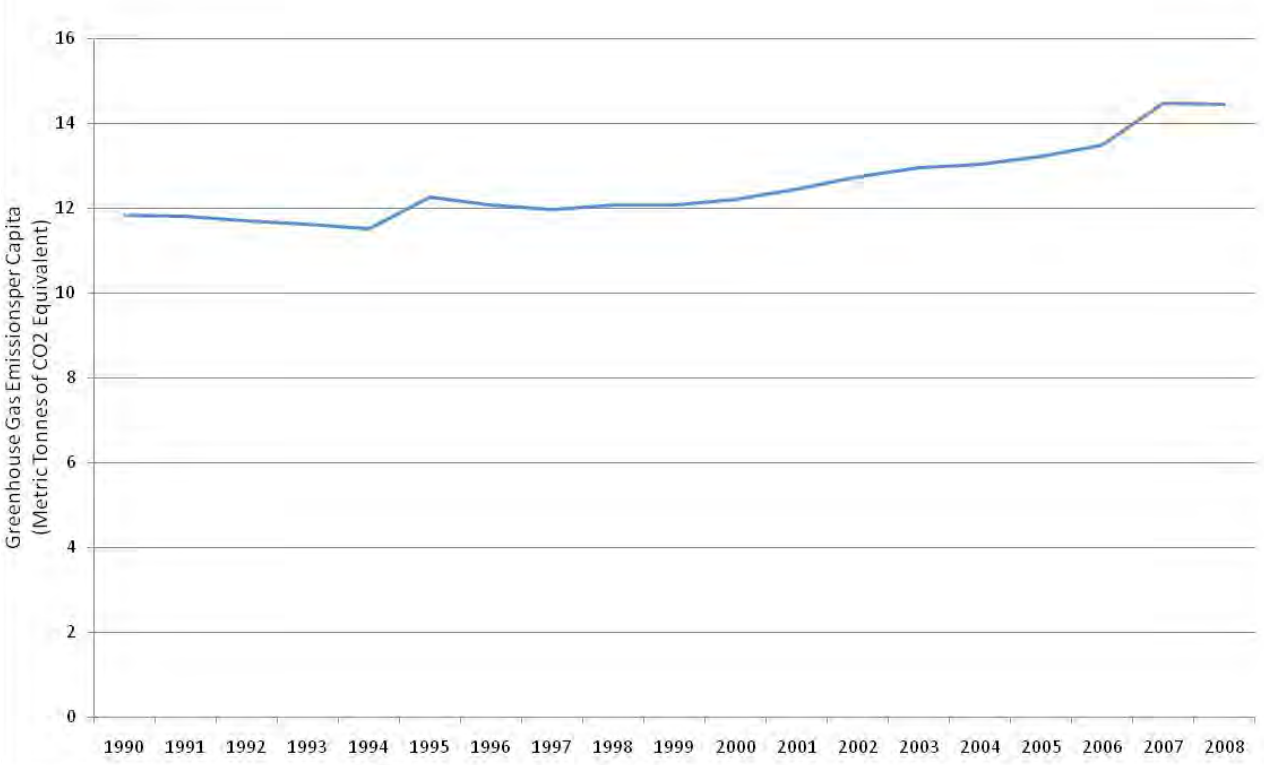

Figure 1.2 - Bermuda's greenhouse gas emissions per capita 1990-2008
(Department of Energy[26], 2011)

[20] Manson J. and Hasselbring, T. (2005). *Bermuda's Greenhouse Gas Emissions Inventory: 1990-2000.* A Technical Report prepared for the Government of Bermuda Department of Environmental Protection. Bermuda.

[21] As Bermuda is a signatory to the UK agreement of the Kyoto Protocol the United Kingdom Department of Energy and Climate Change has estimated Bermuda's annual greenhouse gas emissions from fossil fuel consumption, industrial production and agriculture since 1990. These emissions estimates are used to compile reports which are submitted to the European Union and the United Nations Framework Convention on Climate Change.

[22] National greenhouse gas emissions as defined by the United Nations Framework Convention on Climate Change.

[23] Based on data from the United Kingdom Department of Energy and Climate Change.

[24] Assuming a population of 64,209 in 2008, based on: Bermuda Government Department of Statistics. (2006). *Mid-Year Population Projections July 1, 2000 to July 1, 2030.* Bermuda.

[25] The World Resources Institute reported average worldwide greenhouse gas emissions per capita of 5.9 tonnes CO_2 equivalent in 2005.

[26] Produced using emissions data from the UK Department of Energy and Climate Change.

1.4.3 Establishing a long-term goal to reduce greenhouse gas emissions

Since the Energy Green Paper 2009 was released, climate scientists have reported that:

> *'If global warming is to be limited to a maximum of 2 °C above pre-industrial values, global emissions need to peak between 2015 and 2020 and then decline rapidly. To stabilise climate, a decarbonised global society – with near-zero emissions of CO2 and other long-lived greenhouse gases – needs to be reached well within this century. More specifically, the average annual per-capita emissions will have to shrink to well under 1 metric ton of CO_2 by 2050'.* [27]

This clearly indicates that current levels of greenhouse gas emissions from residents of Bermuda are fourteen times greater than the levels of emissions required for a stable climate. Avoiding dangerous climate change will not be possible without a sustained global effort to reduce emissions world-wide, therefore every nation must accept its moral responsibility to reduce emissions to a level which is sustainable over the long-term. Beyond the ethical drivers for reducing emissions, it is inevitable that Bermuda will soon have to adapt to the effects of climate change[28] and as this occurs it is likely that Bermuda's own efforts in reducing emissions will be closely scrutinised.

The Government will therefore develop energy policy with the goal of halting emissions growth by 2013 and reducing emissions thereafter to less than 1 metric tonne CO_2 equivalent per capita by 2050. This will require a 93% reduction in greenhouse gas emissions from 2008 levels[29] and will only be possible by nearly eliminating fossil fuel use for both electricity generation and transportation within the next forty years. [30]

Although some may argue this goal is not attainable, the penalties of failing are very real, they are very serious, and are increasingly better understood by climate experts. The Government will therefore take this goal seriously and real efforts will be made to ensure it is achieved. It is important to consider every step that is made toward reaching this goal will also reduce fossil fuel dependence, leading Bermuda from the unenviable position as an icon of unsustainable energy use to an exemplar of what can be achieved when appropriate action is taken.

1.4.4 Establishing shorter-term targets to drive energy policy

The Government has also established a shorter term target of reducing greenhouse gas emissions per capita from the 2008 level of 14.44 tonnes to 10.00 tonnes CO_2 equivalent by 2020, a reduction of approximately 30%. This interim target will guide energy policy over the next decade and ensure Bermuda is on track to meet the 2050 goal. Prior to 2020, a new Energy White Paper will be developed to provide more specific guidance on the policies required to reach a subsequent target of reducing emissions 56% below 2008 levels by 2030.

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[27] I. Allison et al. (2009). *The Copenhagen Diagnosis: Updating the World on the Latest Climate Science*. The University of New South Wales Climate Change Research Centre (CCRC). Australia.

[28] These effects are outlined in more detail in references 18 and 19.

[29] 2008 is the most recent reference year for which complete emissions data is available.

[30] Unlike other forms of atmospheric pollution, most greenhouse gas emissions cannot be reduced through pollution control technology; they can only be reduced by burning less fuel or by burning fuel that contains less carbon.

Chapter 2 - Reducing Emissions 30% by 2020

Chapter Summary

In support of the objectives outlined in this chapter, the Government has:

- Established a target of reducing greenhouse gas emissions below 10 metric tonnes CO_2 equivalent per capita by 2020;
- Established a target of reducing electrical energy consumption 20% below 2008 levels by 2020, through energy efficiency, energy conservation and non-electrical renewable energy technologies;
- Established a target for 30% of electricity to be generated by renewable energy by 2020;
- Established a target of reducing greenhouse gas emissions from transportation 30% by 2020;
- Created the Energy Act 2009 and subsequently established the Energy Commission;
- Lowered the Customs Tariff Duty for numerous sustainable energy products;
- Developed rebates for both residential solar photovoltaic and hot water systems;
- Created a range of public education materials to provide information on energy efficiency, energy conservation and renewable energy; and
- Commissioned a public opinion survey on energy in Bermuda.

To achieve the objectives outlined in this chapter, the Government will:

- Establish a formal reporting system to track Bermuda's greenhouse gas emissions each year;
- Develop a new energy white paper prior to 2020 to provide more specific guidance on the policies required to reduce greenhouse gas emissions 56% below 2008 levels by 2030;
- Ensure residents have better access to information on their energy use;
- Adopt energy management and renewable energy throughout Government buildings;
- Introduce legal requirements for the energy efficiency of new buildings and key groups of energy consuming products before the end of 2012;
- Establish electric rate structures to encourage energy efficiency and conservation;
- Develop a legal framework to outline how energy is to be billed between landlords and tenants;
- Introduce mandatory requirements for certain buildings to have periodic energy audits;
- Allocate areas of land and seabed for renewable energy technology development;
- Introduce regulated feed-in-rates for electricity produced by independent power producers;
- Ensure financial products are available to fund renewable energy and energy efficiency;
- Structure import duty rates specifically to support of the objectives of this white paper; and
- Legislate compulsory certification standards for certain professions in the energy sector.

2 Reducing Emissions 30% by 2020

Achieving both the 2020 and 2050 greenhouse gas emission reduction goals will require nothing short of a national transition in the way in which energy is used in Bermuda. It should also be recognised that a second, yet equally important driver for this change is the impending oil supply crunch[31], which is generally not considered seriously by both industry and the public. It is crucial to recognise as this transition begins the progress that is made toward achieving the goals will depend not only upon the viability of alternative energy technologies, but also on the shared vision, flexibility and ingenuity of the Government, energy industry and residents of Bermuda.

Maintaining sight of the 2050 goal is important as developing a policy framework based on this long-term goal will provide a clear energy vision for Bermuda, offer perspective on the interim steps required to meet short-term targets along the way and create the consistent long-term direction required to guide the energy industry during a period of substantial change.

2.1 Breaking the Target Down

Figure 2.1 shows that in 2008, over 87% of Bermuda's greenhouse gas emissions were produced as a result of the combustion of fuels and municipal solid waste to provide the energy necessary for electricity generation, heating and transportation. The majority of remaining emissions were due to methane release from landfills and although this contributed significantly to overall emissions in 2008, it is expected to decline over the next few decades[32].

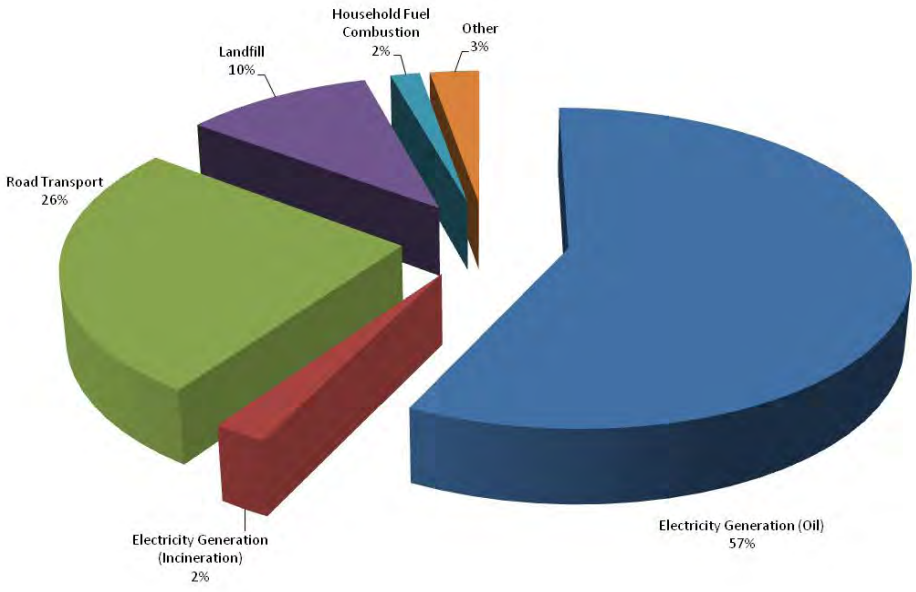

Figure 2.1 – Sources of Bermuda's greenhouse gas emissions in 2008 (Department of Energy[33], 2011)

[31] See 1.3.2, 'Long Term Energy Security'.

[32] Greenhouse gas emissions from landfills are predominantly caused by the anaerobic decay of certain types of waste. As the majority of municipal solid waste has been diverted from landfill to power Tynes Bay for over a decade and horticultural waste will also be diverted to Tynes Bay in the future, there are few remaining sources of landfill waste to contribute toward future emissions. Current emissions from existing waste will naturally decline over time as the waste is broken down.

[33] Produced using emissions data from the UK Department of Energy and Climate Change.

In other jurisdictions, greenhouse gas emission reduction targets are often split up between known sources of emissions within each sector of the economy; policies are then developed to meet these specific targets. The Government does not believe this is a practical approach for Bermuda due to the inherent complexity of tracking emissions in detail, which would require a substantial amount of data that is not currently measured or recorded. This would create a significant workload and would draw vital resources away from the work required to implement known emission reduction solutions such as energy efficiency and renewable energy.

The Government has therefore developed a more practical approach, which acknowledges the precise distribution of greenhouse gas emissions will remain uncertain and focuses instead on implementing the policies that are required to achieve the 2020 target. As emissions from landfills are expected to remain fairly significant through 2020, emissions from electricity generation and transportation will need to reduce by 30-35% to meet the overall target of reducing emissions below 10 tonnes per capita of CO_2 equivalent by 2020. The Government believes these targets are achievable with technologies available today and in most cases the solutions required will be economically beneficial to Bermuda over the long-term.

2.1.1 Reducing emissions caused by electricity generation

The electric utility currently forecast an annual increase of 1.5% for both annual electrical energy requirements and peak electrical demand, until 2025.[34] If electricity consumption continues to increase at this rate, it will be very difficult to introduce sufficient renewable energy to meet the 2020 emissions target. To ensure the target remains achievable, the Government believes it is essential to establish a target for reducing electrical energy consumption, in addition to a target for renewable energy generation. Seventy nine percent of the public agree they have a responsibility to conserve energy in order to avoid the need for the electric utility to expand[35] and residents have previously demonstrated that energy conservation can significantly reduce electricity consumption.[36]

The Government has therefore established the following interim targets for electrical energy consumption and generation, to ensure adequate progress is made toward the 2050 goal:

- Reduce electrical energy consumption 20% below 2008 levels by 2020, through energy efficiency, enegy conservation and non-electrical renewable energy technologies[37]; and
- Generate 30% of electricity from renewable energy resources by 2020.

In addition to Section 2.4, Chapters 3, 4, 5 and 6 outline the policies that will be used to achieve these targets.

2.1.2 Reducing emissions caused by transportation

No projections for transportation related energy consumption exist, however much of the increase in demand for petroleum based fuels seen over the past 10 years[38] is thought to be due to transportation. It will therefore be essential to reduce greenhouse gas emissions related to transportation if the overall 2020 target is to be achieved. The Government has therefore established a target of reducing emissions from transportation within Bermuda 30% below 2008 levels by 2020.

In addition to Section 2.4, Chapter 7 outlines the policies that will be used to achieve this target.

[34] BELCO. (2005). *Electric System Discussion Document*. Bermuda.

[35] Mindmaps. (2010). *Bermuda Government Department of Energy Research Report*. Bermuda.

[36] High oil prices are likely to have a significant impact on demand, as shown in 2008 when BELCO reported that 'Energy conservation by many households resulted in an average monthly consumption decrease of 4.34 percent'. BELCO Holdings Limited. (2008). *Annual Report: The New Energy Equation.*

[37] Such as solar water heating and sea water air conditioning.

[38] As reported in the Energy Green Paper 2009.

2.2 Ensuring the Target is Achieved

The policies introduced in this White Paper are designed, when combined, to reach the 2020 greenhouse gas emission reduction target and have been developed in a manner consistent with best practices as outlined in the Energy Green Paper 2009 and included in Appendix 3[39]. The manner by which this target will be achieved is difficult to predict as the speed and effectiveness of policies depends on many factors.[40] The Government will account for this through the revision of policies, as necessary, to ensure the targets are met and shall continue to encourage residents to contribute toward determining how policies will be implemented through public consultation.

The Government will track progress toward the 2020 target using greenhouse gas emissions estimates from the United Kingdom Department of Energy and Climate Change. To improve the accuracy of these estimates, a formal reporting system will be established for major sources of greenhouse gas emissions to ensure the information necessary to properly estimate Bermuda's emissions is collected each year[41].

2.3 Government Action to Date

2.3.1 Energy Act 2009

The Energy Act 2009 was created to provide the temporary legislative authority to better regulate the energy sector until such time that a definitive Energy Act is developed. The Act came into effect on the 28th November 2009 and transferred energy pricing controls regulated by the Price Control Commission under the Ministry of Finance[42] to the Energy Commission under the Minister responsible for Energy.

Provisions were also taken from the Telecommunications Act 1986 to broaden the scope of the Energy Act 2009, by prohibiting the production or supply of electrical energy for sale or distribution to the public without a licence. The resultant Energy Act 2009 created a basic statutory framework for the licencing and regulation of electricity in Bermuda.

2.3.2 Energy Commission

The Energy Act 2009 required the creation of an Energy Commission, which was duly appointed by the Minister of Energy, Telecommunications and E-Commerce in November 2009. Within weeks, the Energy Commission underwent a rigorous training seminar with staff from the Public Utility Research Centre of the University of Florida. Since receiving this training, the Energy Commission have been involved in the development of the electric utility's small-scale renewable generator interconnection agreement and have also been tasked with performing an inquiry into the electric utility's cost structure. This inquiry is necessary for the Energy Commission to gain a thorough understanding of the economics of electricity in Bermuda and will provide a foundation for the development of future rate structures.

[39] Appendix 3 contains the relevant section of Chapter 9 'Policy, Legislation and Incentives' from the Energy Green Paper 2009.

[40] Certain policies, such as the introduction of progressive electricity rate structures, have the potential to cause relatively significant changes to patterns of energy use within a short period of time, while other policies such as minimum efficiency standards will take longer to reach their full effect as older inefficient appliances are gradually replaced with more efficient models as they reach the end of their operational life.

[41] This is likely to include data on fuel importation, patterns of fuel consumption and waste disposal.

[42] Via the Price Commission Act 1974.

2.3.3 Customs Tariff incentives

In 2009, the Government introduced various changes to the Customs Tariff to encourage the importation of products that produce or use energy in a more sustainable manner.[43] To encourage the uptake of renewable energy, the duty was removed entirely for complete solar water heating systems, and both wind and solar photovoltaic electric generating sets, while the Government's commitment to distributed renewable energy and smart grid development was confirmed by the removal of duty for smart electricity meters with net metering capability. To support the use of compact fluorescent light bulbs, the duty was reduced to 10%.

The Government continued this theme into 2010 by removing the duty for ocean swell powered electric generating sets, inverters for solar photovoltaic systems and most replacement parts of solar hot water systems. Continued support for electric vehicles was provided by the reduction of duty on electric trucks to 12.5%, complementing the existing duty relief offered for electric cars and electric motor cycles. A reduced duty rate of 10% was introduced for heat pump water heaters based on the potential for energy savings[44]. Light emitting diode (LED) technology[45] also continues to improve and the energy efficiency of LED's has been recognised through a duty rate of 10% for certain products that use this technology.

To ensure all power producers are treated fairly, the Government expanded the electric utility's existing duty rate of 0% for electric generating and waste heat recovery equipment to all importers, providing the generator is over two megawatts. It was also specified that these generators must be powered by compression-ignition internal combustion engines, thereby creating a separate tariff code for fossil fuel powered generators so the duty may be amended in the future.

2.3.4 Solar Photovoltaic Rebate Initiative

The Solar Photovoltaic Rebate Initiative (SPRI) was launched in September 2009 to provide a rebate of $1 per installed Watt up to a maximum of $5,000 for residents who have solar photovoltaic generating systems installed on their properties. In addition to encouraging residents to reduce their own dependency on fossil fuel powered electricity, this initiative was designed to kick-start the solar energy industry in Bermuda by creating consistent demand for the products and skills necessary to install these systems. Nine solar installation companies have since registered to participate in the SPRI and applications for approximately 182kW of installed capacity have been received as of April 2011.

2.3.5 Solar Water Heater Rebate Initiative

The Solar Water Heater Rebate Initiative (SWRI) was launched in September 2010 to provide a rebate of up to $1,500 for residents who have solar water heating systems installed on their properties. The purpose of the SWRI was to complement the SPRI and to encourage industry diversification into solar hot water systems. Nine solar installation companies have since registered to participate in the SWRI and applications for dozens of systems have been received as of April 2011.

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[43] This also supports *'Elements 2.2 and 2.4 of Action 2.1.A.2: Facilitate take-up of new technology, and Improve energy efficiency'* from the Government's Sustainable Development Strategy & Implementation Plan.

[44] US Department of Energy Federal Energy Management Program. (1995) *Federal Technology Alert: Residential Heat Pump Water Heaters.* United States of America.

[45] US Department of Energy, (2009), *Commercially Available LED Product Evaluation and Reporting Program. Summary of Results: Rounds 7-9 of Product Testing*. United States of America.

2.3.6 Public education on energy

The Government has created a wide range of information on energy efficiency, energy conservation and renewable energy, which is available via displays in public buildings and the Department of Energy's website, www.energy.gov.bm; this information includes:

- A summary of peak oil and its anticipated effects on Bermuda;
- A series of energy efficiency fact sheets for major appliances;
- A series of guides for residents interested in purchasing small-scale renewable energy systems;
- Walkthrough guides and application documents for the solar rebates; and
- Various energy-related photos, links and documents.

2.3.7 Public opinion survey on energy in Bermuda

In recognition of the importance of broad public consultation in the formation of Bermuda's national energy policy, the Department of Energy commissioned a telephone survey of four-hundred residents of Bermuda, which was conducted in March of 2010. This public opinion survey was designed to complement the existing public consultation performed through the release of the Energy Green Paper.

The public were asked a variety of questions on topics ranging from opinions on renewable energy technologies, to energy efficiency standards and the perceived impact of climate change on Bermuda. The survey results have provided a better understanding of public opinion, which will be essential for well-informed policy development. The Government subsequently released these survey results to provide useful information on current opinions and behaviours relating to energy.

2.4 Jump-Starting the National Transition

Current patterns of energy use are unsustainable, yet they are embedded in many aspects of the Bermudian way of life. This presents a significant challenge in meeting the targets outlined in this white paper, particularly considering the magnitude of change that is required and the speed at which it must be achieved. To address these challenges and to jump-start a national energy transition, the Government shall concentrate short-term efforts on a highly focused range of hard-hitting policies, as outlined below:

- Public education;
- Visualising energy use;
- Government leadership;
- Energy efficiency standards for buildings, vehicles and imported products;
- Establishing electricity rates to encourage energy efficiency and conservation;
- Establishing a legal framework to specifically outline how landlords bill their tenants for energy consumption;
- Mandatory energy auditing;
- Allocation of land and seabed for large-scale renewable energy technologies;
- Feed-in-rates and interconnection standards for independent power producers;
- Micro-financing for investments in small-scale renewable energy and energy efficiency; and
- Customs tariff incentives for energy efficient and renewable energy technologies.

2.4.1 Public education

It is essential for the public to understand what is required to achieve the goals outlined in this white paper as they can only be accomplished through participation on a national level. Existing public education efforts will therefore be expanded to form a prolonged campaign to increase public awareness of the problems fossil fuel dependency creates for Bermuda and how the public can play a role in adopting solutions.[46]

2.4.2 Visualising energy use

The energy equivalent of thousands of barrels of oil is unnecessarily lost each day in Bermuda because residents are unable to see where or how energy is being consumed. This presents a stark contrast to resident's attitudes toward water consumption, where leaks and wastage are highly visible and action is quickly taken. Eighty six percent of residents have even indicated they believe that access to real-time information on their energy use would enable them to reduce consumption.[47] The Government agrees and will therefore introduce a range of measures to ensure that residents have access to straightforward information on energy consumption so they can make informed decisions regarding their use of energy to eliminate unnecessary waste. This will be achieved through a range of measures such as in-home displays of electricity consumption[48], energy audits and energy performance labelling of products.

2.4.3 Establishing Government leadership

The Government currently spends over $20 million a year on energy[49] and is committed to adopting energy management across the civil service to reduce these expenses. To ensure a structured and effective approach is adopted, a strategic energy management plan for the civil service will be introduced before the end of 2011 to cover all significant areas of energy consumption. This plan will ensure that energy audits take place, energy use is monitored, targets for reduction are set, accountability for meeting targets is allocated and an action plan is followed to implement solutions such as procurement policies for new products and vehicles. As a result, taxpayers will receive better value for money and Government operations will serve as examples in efficient and well managed use of energy.[50] The Government is also committed to adopting distributed renewable energy technologies to stabilise Government's ever-increasing electricity costs and promote the burgeoning renewable energy industry by providing a steady demand for systems of increasingly larger capacity.

To demonstrate best-practices in sustainable energy use, the Government shall develop several residential and commercial pilot projects across the island. These will provide tangible demonstrations of the lifestyles, technologies and general approach required to meet the targets of this white paper. The pilot projects shall also play a leading role in accelerating the search for solutions by providing a catalyst for discussion between the Government, businesses, academics and students.

2.4.4 Efficiency standards for buildings, vehicles and imported products

Energy efficiency is often recognised as one of the simplest and most cost-effective ways of reducing energy consumption. Establishing energy efficiency standards in Bermuda has the potential to greatly reduce energy consumption, however seeing real results will take time due to the lifespan of existing buildings, vehicles and appliances. It is therefore crucial that energy efficiency standards are introduced as soon as possible if they are to contribute toward meeting the 2020 targets in a meaningful way. To ensure progress is made, the Government will initiate a public consultation to identify appropriate efficiency standards in 2011 and will introduce legal requirements for the energy efficiency of new buildings and key groups of energy consuming products before the end of 2012.

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[46] This also supports '*Element 2.4 of Action 2.1.A.2: Improve energy efficiency*' from the Government's Sustainable Development Strategy & Implementation Plan.

[47] Mindmaps. (2010). *Bermuda Government Department of Energy Research Report.* Bermuda

[48] See Chapter 3, Section 3.2.

[49] This includes electricity, transportation fuels and other oil-based fuels used for heating.

[50] This also supports '*Element 2.4 of Action 2.1.A.2: Improve energy efficiency*' from the Government's Sustainable Development Strategy & Implementation Plan.

2.4.5 Establishing electricity rates to encourage energy efficiency and conservation

The Government shall work with the electric utility and Energy Commission to develop electric rate structures that provide strong incentives for the electric utility and energy consumers to meet the targets outlined in this white paper. Section 8.2.3 provides an overview of several options that have been used successfully in other jurisdictions and will be considered for application in Bermuda. Careful application will ensure these rate structures reduce electricity costs for many residents of Bermuda; particularly low-income households and those who use energy efficiently. Residents who use disproportionately large amounts of electricity will be hit the hardest, creating a strong incentive for them to become more energy efficient.

2.4.6 Establishing a legal framework to specifically outline how landlords bill their tenants for energy consumption

Traditional electricity metering practices often result in oversimplified energy billing arrangements between tenants and landlords. In many cases, this causes tenants who are energy efficient to cross-subsidise those who are not and also removes valuable incentives to invest in energy efficiency and renewable energy technologies. This also creates difficulties for energy auditors and energy managers who need to monitor patterns of energy use for individual tenants. To address these issues, the Government will develop a legal framework that specifically outlines how landlords can bill their tenants for energy consumption to ensure:

- Energy consumption can only be billed to tenants where it can be accurately proven the tenant has actually consumed the energy; and
- Landlords and tenants will be able to recover their investments in energy efficiency and renewable energy.

2.4.7 Mandatory energy auditing

Energy auditing is a cost-effective way of bringing experts with the skills required to identify often 'invisible' energy waste to those who are not able to identify it for themselves. The reports created following an energy audit serve to translate the sometimes complex language of energy into a simple set of recommendations the average person can follow to eliminate inefficient energy use. Energy audits will therefore become a normal part of owning many buildings as the Government introduces mandatory requirements for certain buildings to have periodic energy audits.

2.4.8 Allocation of land and seabed for utility-scale renewable energy technologies

To meet both the short and long-term goals stated in this white paper, large areas of land and seabed will be required to locate renewable energy technologies. As Bermuda has limited space for these technologies it is very important that adequate space is set aside as soon as possible to allow for development in the future. The Government will shortly initiate a consultation process to determine which sites are appropriate, resulting in the formal allocation of public sites specifically for renewable energy development.

2.4.9 Regulated feed-in-rates and interconnection procedures for independent power producers

Most individuals or businesses who wish to invest in renewable energy technologies need to understand both the rates that will be paid for the electricity they produce, and the terms and conditions of interconnecting with the electric grid before they can secure financing and commit to projects. Interconnection standards are also important to ensure the electric grid continues to operate in a safe and reliable manner as independent power producers come on-line.

The Government will therefore introduce legal requirements for the purchase of low-emission electricity and shall work with the electric utility, Energy Commission and later regulatory authority to ensure clear rate structures are established for electricity fed back into the grid and the provision of standby power.[51] The Government and regulators shall also work with the electric utility to ensure that appropriate interconnection agreements are developed for independent power producers who wish to supply low emission electricity to the public through the electric grid.

2.4.10 Innovative financing for small-scale renewable energy and energy efficiency

Investments in energy efficient technologies often realise a fast payback and provide strong overall returns, while small-scale renewable energy technologies yield a consistent reduction in electricity costs and can even produce a stable source of income.[52] Regrettably, the capital cost of many energy efficiency retrofits and small-scale renewable energy technologies often creates a financial barrier to those who wish to invest in these technologies. The Government will therefore work with local financial institutions to ensure a range of financing products specifically tailored for renewable energy and energy efficiency are available. These products may range from micro-financing for individual systems, to much larger loans through which sustainable energy utilities are able to finance thousands of systems across the island.

2.4.11 Customs Tariff incentives

To provide consistent financial incentives to reach the goals outlined in this White Paper, the Government will perform a thorough review of existing customs duty rates. The most significant adjustment will be a revision in the allocation of duty rates for imported fossil fuels. While overall revenues will be maintained in line with inflation, the proportional allocation of duty rates will be readjusted over time in a manner that reflects the relative contribution of each fossil fuel toward overall greenhouse gas emissions.[53]

The duty rates of a wide range of imported energy consuming products will also be revised where the Customs Tariff structure allows. These revisions will be designed to provide Customs Tariff support for promising energy efficient or renewable energy technologies where the market does not yet provide a sound financial case for their importation[54]. This will encourage residents of Bermuda to become early adopters of efficient technologies as they become available. To complement these duty rate reductions, the duty rates for inefficient products will be increased where the Customs Tariff structure allows. The resulting combination of duty rate adjustments will send importers and consumers a clear price signal to purchase products that reduce greenhouse gas emissions.

[51] The Bermuda Electric Light Company Ltd. introduced a basic 'net-metering' rate for small-scale renewable energy in 2010 to encourage initial uptake of solar and wind powered generators. There is however a need to carefully develop long-term rates that ensure the targets of this white paper are financially viable for investors, while being economically sustainable for Bermuda.

[52] For example, purchasing an efficient refrigerator will consistently save hundreds of dollars a year, while a 5kW solar photovoltaic array will generate thousands of dollars worth of electricity each year for over two decades.

[53] These adjustments will decrease the cost of transportation fuels and increase the cost of electricity.

[54] For products which already have a good economic case, the Government will also use other means to encourage or mandate their use such as minimum efficiency standards, energy management and amendments to the building code.

2.5 Ensuring Energy Remains Affordable

As the policies outlined in this white paper are implemented over the next nine years, the Government will strive to ensure that energy remains affordable. This will require progress to be made in a timely manner, and careful attention paid to the affordability of energy. A standard measure of the affordability of energy in other jurisdictions is 'fuel poverty', which describes any households that need to spend more than 10% of their income on fuel to meet basic heating requirements[55]. The occurrence and impact of fuel poverty varies between countries due to differences in several factors, including[56]:

- Climate;
- Cost of fuel;
- Household income;
- Energy efficiency of homes; and
- Energy efficiency of energy consuming goods.

Of these factors, climatic extremes often have the most influence on the prevalence of fuel poverty. Fortunately Bermuda has a temperate climate, so the traditional definition of fuel poverty is not particularly relevant. Although it is not essential for many households in Bermuda to expend significant amounts of energy on heating or cooling, most homes require the basic services of refrigeration, lighting, water heating and cooking to maintain a reasonable quality of life. A more relevant definition of fuel poverty for Bermuda may therefore be any household which must spend more than 10% of their income on these essential services.

It is estimated these services would consume approximately 3,200kWh[57] a year through the use of reasonably efficient appliances in a three person household; this currently results in an annual expenditure of approximately $1,450[58]. When compared with household income in Bermuda it is apparent that a very small percentage of homes are likely to experience real fuel poverty[59]. It is however likely that many homes are paying far in excess of this threshold annual expenditure of $1,450 due to excessive energy consumption as a result of a general lack of interest and understanding regarding the use of energy.

Unfortunately fuel poverty will affect an increasing proportion of Bermuda's population, possibly with little warning, as fossil fuel prices increase. The policies outlined in this white paper have therefore been developed, and will be implemented, in a manner designed to insulate residents of Bermuda from increasing energy costs. This will be achieved by limiting both the number of people who experience fuel poverty and the extent to which they are exposed.[60] The Department of Energy will also continue to work with the Department of Financial Assistance to help those already in need to reduce their expenditure on energy.

[55] In many countries, basic levels of heating are essential to maintain a reasonable quality of life.

[56] Buzar, S. (2007). *Energy Poverty in Eastern Europe: Hidden Geographies of Deprivation.* United Kingdom.

[57] Based on a three person household using: a refrigerator consuming 400kWh, an electric stove consuming 500kWh, two 11 watt compact fluorescent bulbs used for 8 hours a day using 64kWh, and a 40 gallon electrical resistance water heater consuming 400kWh through standby losses and 1800kWh for water heating, throughout the year.

[58] Based on a monthly facilities charge of $30 and electricity rates of $0.34 per kWh.

[59] Bermuda Government Department of Statistics. (2008). *Low Income Thresholds: A Study of Bermuda Households in Need.* Bermuda.

[60] For example, the introduction of policies such as minimum efficiency standards will save consumers thousands of dollars of electricity over the lifetime of appliances.

2.6 Growing an Industry

2.6.1 Skills and employment

As fuel prices rise, many existing businesses will face an increasingly challenging environment and some will even find their entire business model is no longer economically viable[61]. As this occurs, demand for certain skills will decline and both employers and staff will be forced to readjust to accommodate the changing energy landscape. The policies introduced throughout this white paper will encourage local businesses to begin making the changes necessary for their long-term survival and shall specifically discourage businesses that do not use energy in a sustainable manner.

Fortunately, reducing Bermuda's greenhouse gas emissions will often be labour intensive and presents an opportunity for the development of a new sustainable energy industry that provides the services and products necessary to reach the goals outlined in this white paper. The creation of this industry will principally be financed through the diversion of funds currently lost from Bermuda's economy to pay for foreign oil. This will naturally lead to the development of a more sustainable energy sector in Bermuda, which is expected to form around the following core professions:

- Energy auditing;
- Energy management in medium to large businesses;
- Installation of small to medium-scale renewable energy generation systems;[62]
- Electric vehicle maintenance;
- Management and administration of large-scale renewable energy operations; and
- Maintenance and repair of both large and small-scale renewable energy facilities.

Those working in traditional labour sectors such as building construction, building operation, general installation and vehicle servicing will need additional training to adopt the new skills and knowledge necessary to take advantage of these employment opportunities. The Government and renewable energy industry will work to make sure this training is available through the National Training Board and other local educational organisations by embedding it into existing programmes where possible and creating new programmes where necessary.[63,64] The Government shall also provide guidance, where possible, on current and future employment opportunities in the sustainable energy industry.

2.6.2 Certification of renewable energy designers, installers and energy auditors

To ensure members of the local energy industry have the appropriate knowledge and understanding of the field in which they are working, the Government will introduce legal requirements[65] for individuals working in key professions to submit evidence of appropriate certification to the National Training Board. Initially, certification will be required for designers and installers of renewable energy systems, and energy auditors; additional professions will be added as necessary.

Certified individuals will be permitted to use the title "nationally certified" to indicate they are appropriately qualified and electrical generation licences will only be granted to systems which have been installed or approved by a certified individual. To ensure certifications are kept up to date, certified individuals will be required to renew their certification at least every 5 years[66], or as otherwise directed by the National Training Board. Applicants may also be required to periodically pass additional examinations or undertake further training as required to stay up to date with technological developments and latest practices.

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[61] International Energy Agency. (2004). *Analysis of the Impact of High Oil Prices on the Global Economy.* France.

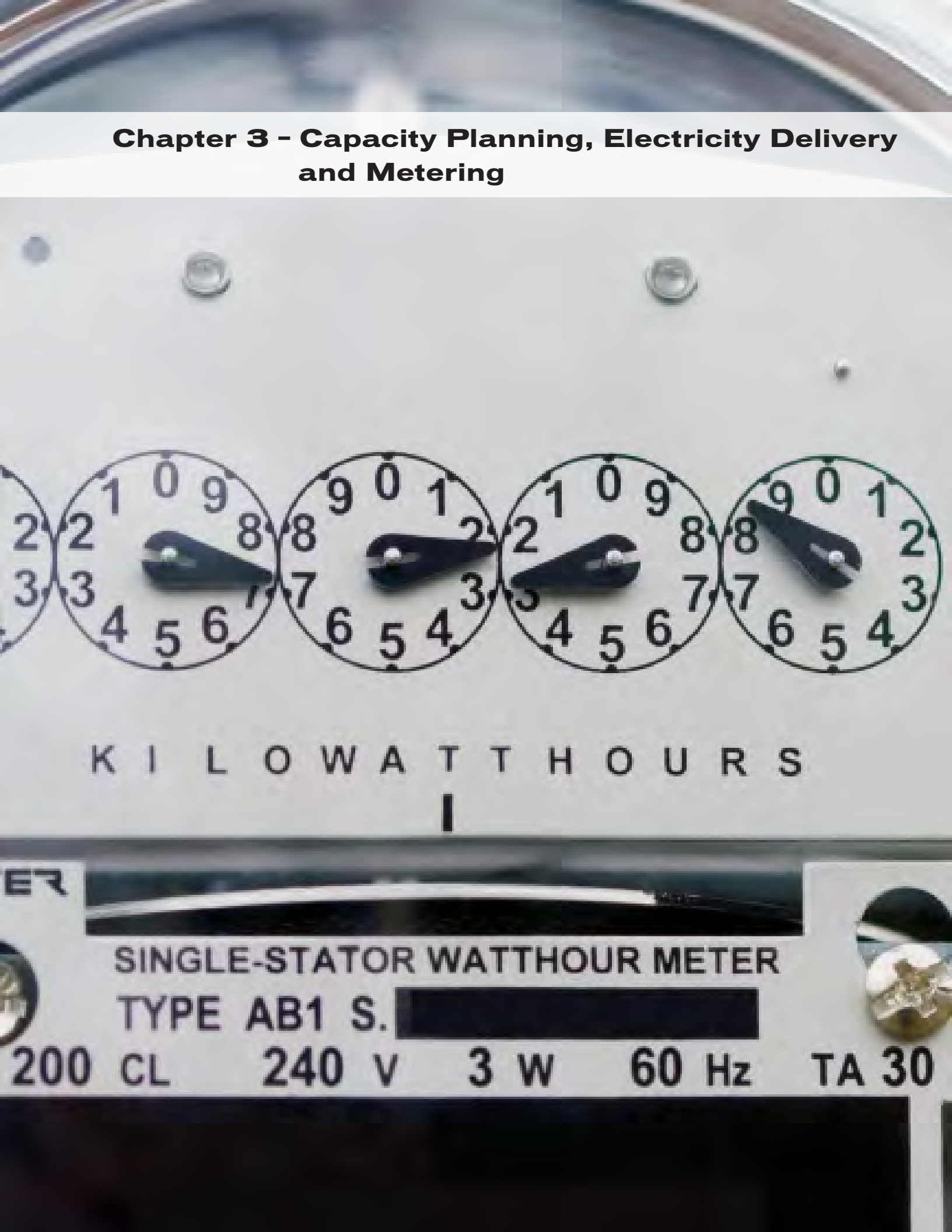
[62] This is likely to create new opportunities for electricians, plumbers, builders and administration personnel.

[63] This also supports '*Element 2.2 of Action 2.1.A.2: Facilitate take-up of new technology*' from the Government's Sustainable Development Strategy & Implementation Plan.

[64] The local renewable energy industry has already begun to work with the National Training Board to develop a curriculum for the installation of solar energy systems.

[65] Through the National Occupational Certification Act 2004 and National Occupational Certification Regulations 2008.

[66] As required by the National Occupational Certification Act 2004.


KILOWATTHOURS
SINGLE-STATOR WATTHOUR METER
TYPE AB1 S.
200 CL 240 V 3 W 60 Hz TA 30

Chapter Summary

To achieve the objectives outlined in this chapter, the Government will:

- Introduce a legal framework to outline the responsibilities between the electric utility and independent power producers;
- Work with the energy industry to develop a collaborative capacity planning process for new generators;
- Work with the electric utility to create a framework for the future of electrical delivery and metering systems, which will ensure that:
    - Electricity consumers have real time access to easy to understand information on their electricity consumption;
    - Patterns of consumer electricity demand can be influenced both voluntarily and automatically by the electric utility;
    - Electricity from distributed renewable energy generators can be delivered to consumers;
    - The electric utility is able to cope with increasingly intermittent flows of electricity without adversely affecting system reliability;
    - The electric utility is able to manage the information necessary to offer the various electric rate structures which will be necessary to provide financial incentives for energy conservation, efficiency, demand side management and renewable energy technologies; and
    - The Government is able to track energy produced from independent power producers to measure progress toward the 2020 targets.
- Work with the Energy Commission and future regulatory authority to develop electric rate structures that provide the opportunity for the electric utility to recover the costs of developing the electricity network and encourage consumers to use energy in a more sustainable manner.

3 Capacity Planning, Electricity Delivery & Metering

Over the past few years, the energy industry in Bermuda has been uncertain who will be responsible for balancing the electricity produced by independent power producers and who shall serve as the provider of last resort when independent power producers are offline. To resolve these issues, the Government will introduce a legal framework which clearly outlines the responsibilities between the incumbent electric utility and independent power producers. While the specific details of this framework will be determined through consultation with the energy industry, the Government expects the electric utility to retain ultimate responsibility for operating the electrical grid and maintaining adequate reserve capacity.[67]

3.1 Capacity Planning

The Bermuda Electric Light Company Ltd. has historically taken sole responsibility for capacity planning to ensure adequate electrical generation capacity is in place to meet Bermuda's growing need for electricity. Figure 3.1 compares the electric utility's most recent forecast of business-as-usual electricity demand growth against the timelines for retirement of existing generation plant. Although this projection does not account for any of the targets outlined in Chapter 2, it provides an important baseline for future capacity planning and clearly highlights the need for new generation capacity over the next decade if a reliable supply of electricity is to be maintained. This is particularly important as many renewable energy technologies cannot reliably contribute toward meeting peak demands[68] and it is essential to have a reserve capacity planning strategy in place, in case targets are not met.

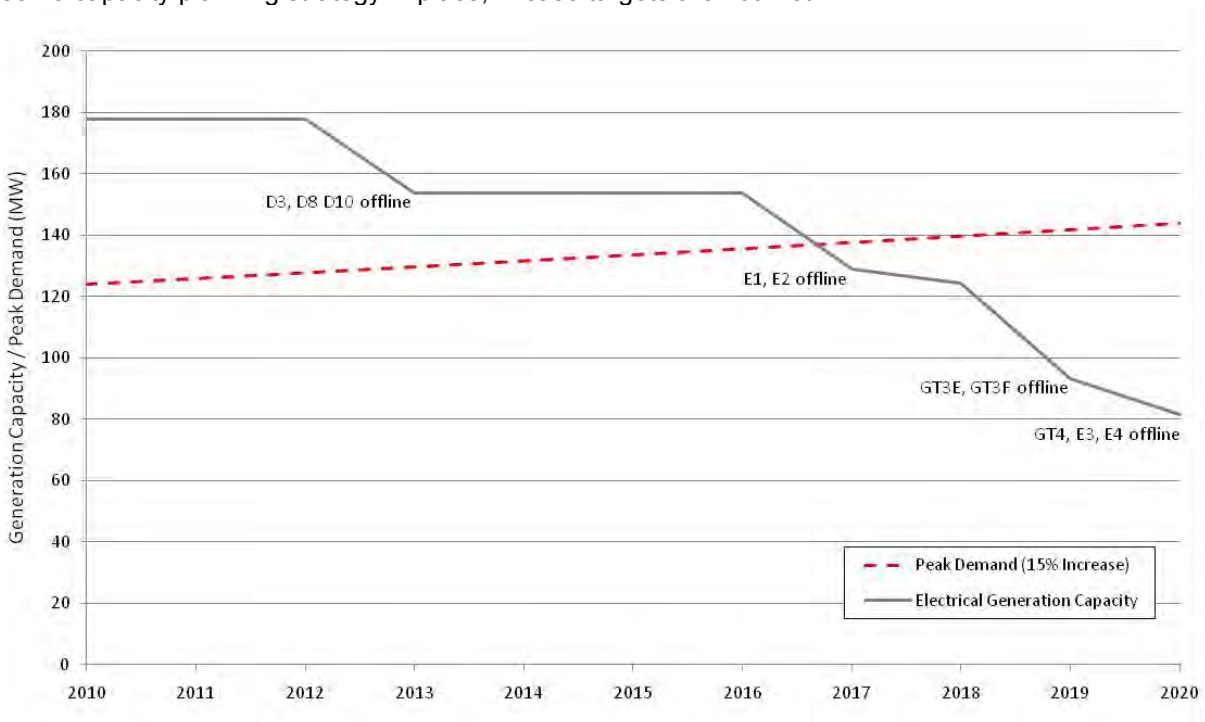


Figure 3.1 – BELCO plant retirement schedule and potential increase in peak electrical demand[69] (Department of Energy[70], 2011)

[67] This will require the development of new rate structures to ensure the electric utility has the opportunity to earn a reasonable return for the provision of these services.

[68] As they only generate electricity intermittently.

[69] Peak demand is the maximum instantaneous demand for electrical power experienced at a single point in time throughout the year and should not be confused with overall annual electrical energy consumption, as shown in Figure 4.1.

[70] Based on data from the Bermuda Electric Light Company Ltd/Mott McDonald. (2011) *North Power Station Development: Environmental Impact Statement*. Bermuda.

Although these baseline projections are well suited to maintaining a reliable supply of electricity, reaching the targets outlined in Chapter 2 will require more collaborative development of parallel capacity planning scenarios. The Government shall therefore begin work immediately with the energy industry to develop a range of scenarios, which include a variety of measures that have the potential to reduce peak electricity demands, including:

- Government policies such as minimum efficiency standards;
- Innovative electric rate structures to encourage energy conservation;
- Energy storage technologies;
- Demand reduction technologies; and
- Alternative energy technologies.

Progress will be evaluated on an annual basis to determine which scenario is most likely to occur in the coming years. The Government will then grant licences to permit the electric utility to install replacement fossil fuel generation plant as necessary.

3.2 Electricity Delivery and Metering

The primary purpose of the electrical grid over its first century of operation has been to transfer relatively cheap and plentiful electricity from a large centralised fossil fuel generation plant to a distributed customer base. As levels of demand for electricity change, the electric utility has estimated in advance how much will be required to ensure sufficient generation capacity is on-line. Electricity consumption is frequently estimated and consumers are only shown how much electricity they use once a month.[71]

Although technology has advanced, the transmission network is now completely underground[72] and some meters can now be read remotely, many additional changes will be required to address the following limitations with the electricity delivery and metering system that would otherwise inhibit progress toward the 2020 targets:

- The electric grid is not optimised to accept energy from distributed renewable energy generators;
- There is little, if any, capability of automatically managing demand for electricity, and generation must therefore be constantly adjusted to meet demand; and
- Electricity meters are not capable of providing the information necessary for most consumers to understand how much electricity they are using at any given time, and for the utility to introduce dynamic rate structures.

3.2.1 Requirements of the electricity delivery and metering systems of the future

To address the limitations outlined above, it is essential that in the future:

- Electricity consumers have real time access to information on their electricity consumption;
- Patterns of consumer electricity demand can be influenced by the electric utility;
- Electricity from distributed renewable energy generators can be efficiently delivered to consumers;
- The electric utility is able to cope with increasingly intermittent flows of electricity without adversely affecting system reliability;
- The electric utility is able to manage the information necessary to offer the various electric rate structures that will be necessary to provide financial incentives for energy conservation, energy efficiency, demand side management and renewable energy technologies; and
- The Government is able to track energy flows to measure progress toward the 2020 targets.

The electricity metering technologies of tomorrow must monitor and communicate the information necessary to make electricity use visible to consumers. Residents must have the ability to see their

[71] Although consumers could read their own meters, it is often a difficult and impractical way to monitor consumption.
[72] BELCO (2005). *BELCO Holdings Limited 2005 Annual Report; A Century of Commitment and Service.* p.21. Bermuda.

electricity use as soon as they turn on an appliance, instead of having to wait until the end of the month for a bill. This information must be easy to access and understand, and will pave the way for energy auditing and energy management island-wide. The technologies used to offer this information must also be affordable and available to every consumer. The majority of residents have expressed a desire for access to this information, with 81% stating they would like the ability to track their energy consumption in real-time.[73]

To efficiently reduce peak demand and better align electricity consumption with renewable energy resources, the electric utility must develop the capability to both voluntarily and automatically influence patterns of electricity demand. This will be achieved through automated demand side management technology in selected appliances such as air conditioners, water heaters[74] and electric vehicle charging systems[75]. This technology will respond to signals from the electric utility and alter the electricity consumption of appliances accordingly. Consumer participation will be voluntary and shall be encouraged through appropriate electric rate incentives.

As the amount of renewable energy used in Bermuda increases, it will become important for the electrical grid to integrate energy storage technologies as these will further reduce dependence on fossil fuels that would otherwise be required to firm-up intermittent renewable energy supplies. The electric utility and independent power producers will also need to adopt reliable methods of predicting how much electricity will be produced from renewable energy technologies and the electric grid must be able to handle bi-directional power flows from an increasingly diverse mix of distributed generators.

Perhaps the most important capability of the future electricity delivery and metering system is the ability to offer a wide range of dynamic rates to both consumers of electricity and independent power producers. Rate flexibility allows for the creation of powerful and effective financial incentives, and is the ultimate tool in aligning the incentives of a wide range of energy producers and consumers with the Government's policy goals outlined throughout this white paper. The technical capabilities that are necessary to develop rate flexibility will also provide the information necessary to track progress toward the 2020 targets.

3.2.2 How the electricity delivery and metering systems of the future will be achieved

The capabilities described in 3.2.1 will largely be achieved through the integration of information and communications technologies with existing generation, delivery and metering systems. This is likely to use many of the key technologies outlined in Figure 3.2 and will require close collaboration between the Government, electric utility, independent power producers and electricity consumers to ensure it is successful.

The costs of implementation will be carefully assessed, spread over time, and balanced against the potential savings they will create. Fortunately, many of the necessary modifications can be integrated into the electric utility's long-term energy planning, which will ensure appropriate technologies are smoothly integrated to electricity generation, delivery and metering systems over time. The Energy Commission and future regulatory authority will be responsible for working with the electric utility to develop rate structures that provide the electric utility with the opportunity to recover the costs of the necessary upgrades, and create innovative rate options that encourage consumers to take advantage of the additional features outlined in 3.2.1.

[73] Mindmaps. (2010). *Bermuda Government Department of Energy Research Report.* Bermuda.
[74] New Zealand Government. (2007). *New Zealand Energy Conservation and Efficiency Strategy*. p.68. New Zealand.
[75] Consumers will often be unaware when this occurs, as a result of careful control of demand side management.

Due to the importance and urgency of electrical system reform, the Government shall begin work with the electric utility immediately to lay out a framework for the future of electricity delivery and metering systems in Bermuda. Modifying the electrical system to provide the features outlined in 3.2.1 will present a combination of economical, social and technical challenges. The Government shall address these challenges through voluntary collaboration where possible, though legislation and regulation will be used where necessary.

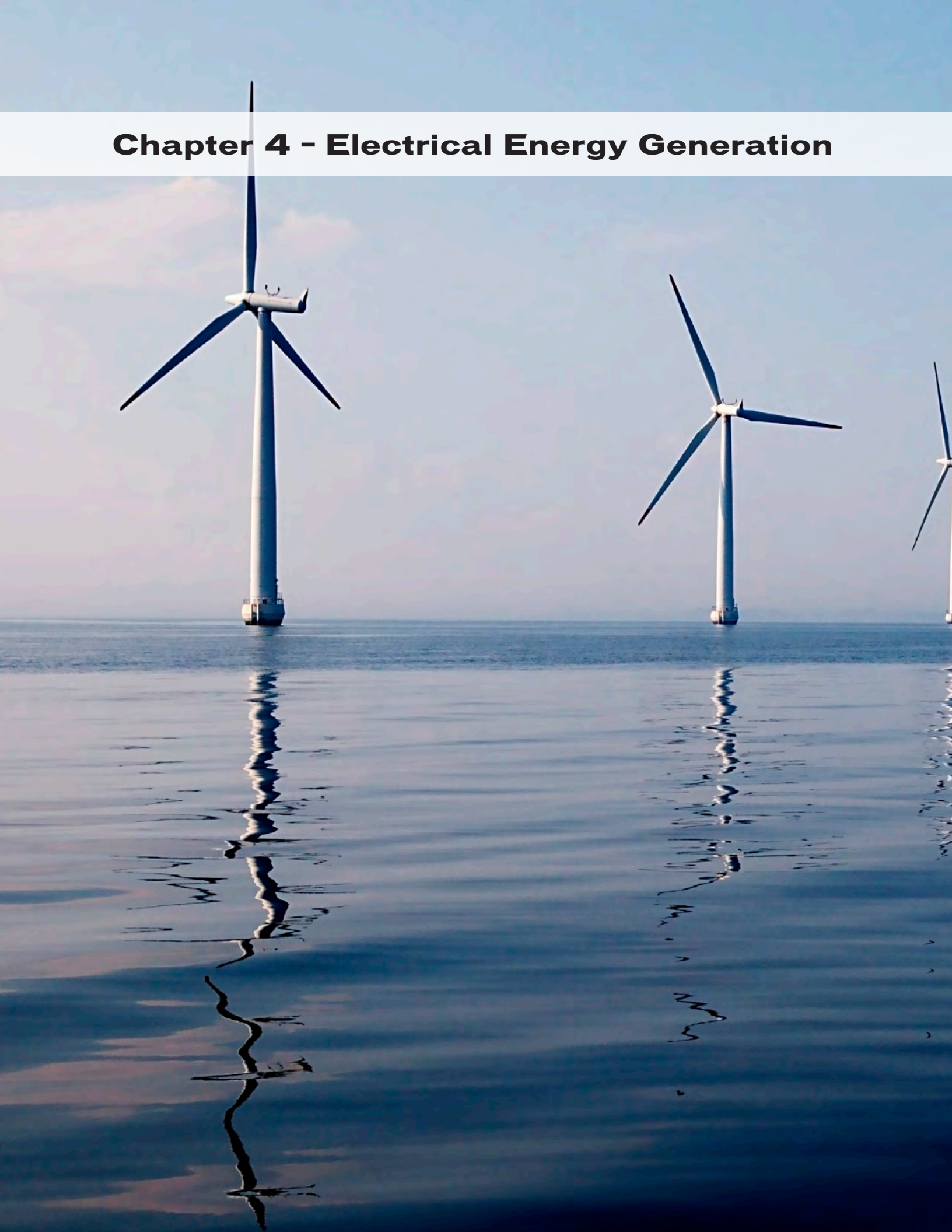
Key foundation technologies	Outcomes enabled by integration of these technologies	Summary of benefits
Advanced electricity meters with multiple metering capabilities Major appliances and control systems with wireless communication capabilities Information technology capabilities to manage power flow information and automatically apply to the generation and delivery of electricity Island-wide communications infrastructure Automated prediction of renewable energy production Transmission and distribution infrastructure capable of interacting with communications network Thermal[76] and electrical energy storage technologies[77]	Automated demand side management of appliances[78,79] and electric vehicles Access to real time energy consumption information Real-time information on power flows fed into grid from distributed renewable energy systems More complex tariff structures such as time-of-use and time-of-production pricing Separate tariffs for electricity generated from renewable energy Integration of intermittent renewable energy supplies in meeting demand[80]	Reduction of peak power demand On-going reduction in overall energy consumption Optimising use of most efficient generators Synchronisation of power demand with renewable energy availability Prices may reflect actual generation costs more accurately Permits a revenue stream to be established for renewable energy projects Enables optimal use of energy produced from renewable energy resources Increased reliability of electricity supply

Figure 3.2 – Key technologies, outcomes and benefits of developing a more advanced electrical delivery system.
(Department of Energy, 2011)

The developments to the electrical delivery and metering system that will be required represent a long-term investment that will form an essential part of the technical framework necessary to meet the 2020 greenhouse gas emission reduction target. They will also improve both long and short-term energy security through the creation of a more robust electricity network that is reliable, intelligent, and able to accommodate Bermuda's energy needs well into the future.

[76] Ice Energy. (2010) *Ice Energy*. [online] Available at: www.ice-energy.com
[77] Dyer, J & Corey, G. (2010). *Energy Storage for the Electricity Grid: Benefits & Market Potential Assessment Guide*. United States of America.
[78] Association of Home Appliance Manufacturers. (2009) *Smart Grid White Paper*. United States of America.
[79] Peak Management Alliance. (2009). *Market Potential Study for Water Heater Demand Management*. United States of America.
[80] Danish Wind Energy Association. (2010) *Wind Power Capacity on the Rise.* [online] Available at: *http://www.windpower.org/en/news/news.html#556*

Chapter 4 - Electrical Energy Generation



Chapter Summary

To achieve the objectives outlined in this chapter, the Government will:

- Develop policies, legislation and regulations to ensure 30% of electricity is generated using renewable energy by 2020;
- Develop a transparent and stable regulatory environment for the electricity generation industry, where each business clearly understands their individual responsibilities within the overall generation and delivery system;
- Introduce legal requirements for the priority use of electricity generated from the lowest emission source;
- Work with the electric utility and regulatory authority to develop rates for the provision of standby power service provided by the electric utility;
- Work with the electric utility and regulatory authority to develop feed-in-rates for electricity generated by independent power producers;
- Allocate development zones for large-scale renewable energy generation projects;
- Manage the solicitation process for large-scale renewable energy generation projects;
- Issue licences for electrical generators;
- Work with the electric utility and Regulatory Authority to establish interconnection standards for independent power producers;
- Amend the building code to include requirements for the proper installation of distributed small scale renewable energy generators;
- Develop a streamlined planning application process that is free of charge for certain small scale renewable energy technologies;
- Release data on renewable energy resources to the public;
- Expand the Tynes Bay Waste-to-Energy Facility to 7.5MW generation capacity; and
- Work to ensure at least 5,000 homes are powered with on-site solar photovoltaic technology by 2020.

4 Electrical Energy Generation

To meet the greenhouse gas emission reduction goals outlined in Chapter 1, it will be necessary for 30% of total electrical energy requirements to be obtained from renewable energy resources[81] by 2020. This chapter outlines the policies and technologies that will be used to achieve this challenging target[82]. It will also be necessary to curb growth in electrical energy consumption and to reduce it 20% below 2008 levels by 2020; the policies to ensure this is achieved are outlined in Chapters 5 and 6. Figure 4.1 provides a more detailed scenario of how these targets are likely to be achieved, against business-as-usual growth in electrical energy consumption.

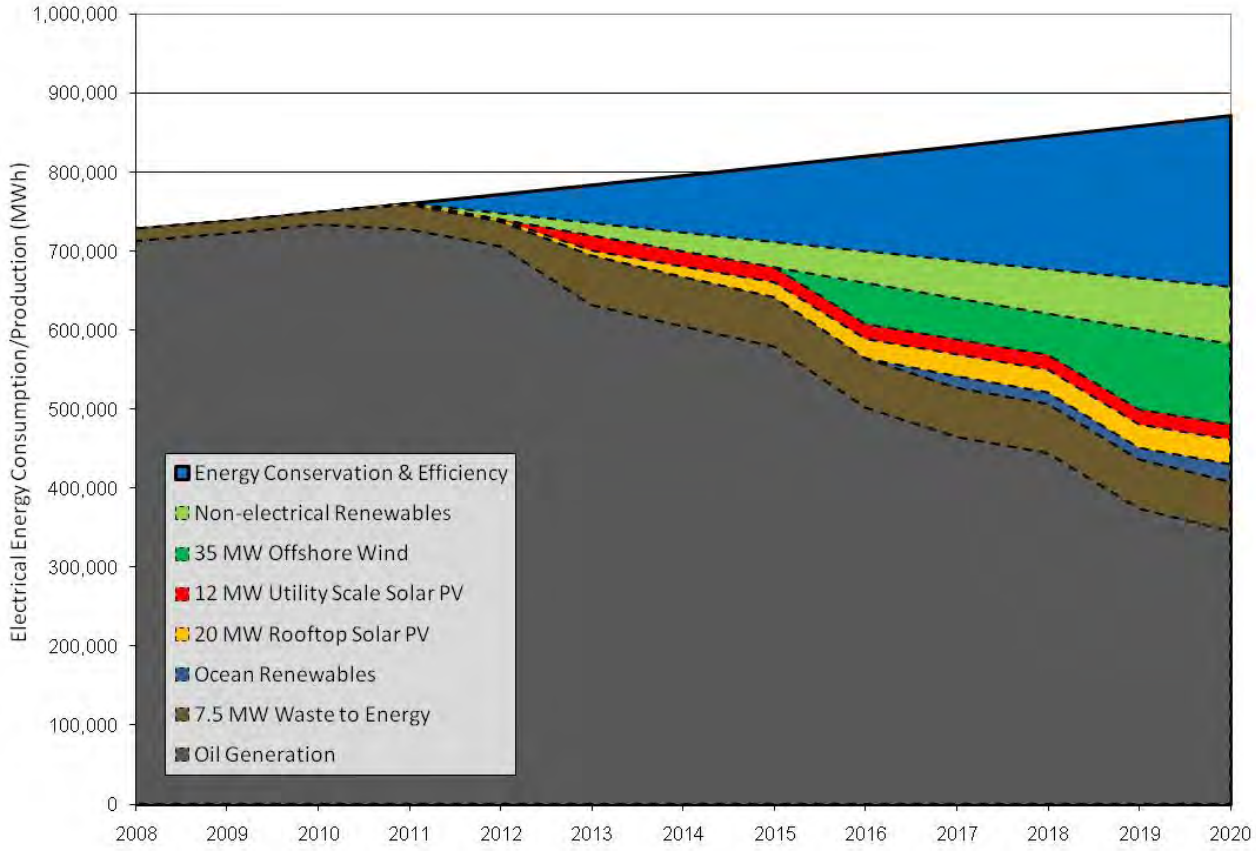


Figure 4.1 – Electricity consumption/generation scenario to reach the 2020 emissions target[83] (Department of Energy, 2011)

[81] Municipal solid waste is not a renewable energy resource and is therefore not included as part of this target.

[82] This also supports '*Element 2.1 of Action 2.1.A.2: A renewable energy target'* from the Government's Sustainable Development Strategy & Implementation Plan.

[83] Certain technologies produce more energy over the course of a year than others as a result of both their relative efficiencies and the abundance of various renewable energy resources (solar photovoltaic panels may be expected to produce approximately 1570 kWh per installed kW per year, while offshore wind turbines may be expected to produce approximately 2600 kWh per installed kW per year).

4.1 Key Electricity Generation Policies

The electricity generation industry in Bermuda needs stability, above all else, to evolve in the manner necessary to meet the targets of this white paper. The Government is therefore fully committed to creating a transparent and stable regulatory environment, and clearly allocating responsibility between businesses. Some will be responsible for generating electricity from indigenous renewable energy resources, while others will balance these intermittent supplies and safely deliver electricity to consumers. All will however clearly understand their role in an environment where many businesses with often competing interests will have to learn to work together for the betterment of Bermuda.

4.1.1 Mandatory purchase of low-emission energy

To provide electricity generation companies with a clear understanding of the order by which different generation technologies will be permitted to supply consumers with electricity, statutory requirements will be introduced for the mandatory use of low-emission electricity in preference to electricity generated from any technology that produces higher emissions. The energy industry will be consulted to ensure this is done in a practical manner, which does not compromise the security of electricity supplies.

4.1.2 Electric rates to support the use of low-emission energy

Feed-in-rates are to the renewable energy industry what the existing fuel adjustment rate is to the electric utility; a rate structure specifically designed to complement the economic realities of a particular electricity generation technology. While the electric utility needs a rate that can be rapidly adjusted to allow for volatile fuel prices, the renewable energy industry need the exact opposite; a rate that offers long-term stability. Once established, the regulatory authority will therefore be tasked with developing feed-in-rates for independent power producers.[84] These rates will be developed in a manner that ensures:

- The use of renewable energy technologies is economically viable for independent power producers;
- Rates are economically sustainable over the long-term and remain affordable to energy consumers;
- The electric utility has the opportunity to return a reasonable return on their operation of the electric grid, provision of balancing services and backup supply;
- Independent power producers are paid a fair price; and
- External costs of electricity generation such as greenhouse gas emissions and other social and environmental effects are taken into account.

4.1.3 Allocation of land and seabed for utility-scale renewable electricity generation

The allocation of land and seabed for utility-scale renewable electricity generation is of national importance, yet neither the conventional planning application process nor the Development and Planning (General Development) Order 1999 offer a suitable way to determine which sites should be used.[85] A broad and inclusive public consultation[86] within the context of the targets outlined in this white paper is necessary to ensure all key stakeholders are involved and the final areas selected are appropriate.

The Government will begin work immediately to initiate a public consultation to determine which areas of land and seabed are appropriate for renewable energy development. As outlined in Figure 4.1 the 2020 target is likely to require a 35MW offshore wind farm and 12MW of utility-scale solar photovoltaic modules, though it is important to note further renewable energy development will be necessary to meet subsequent goals.

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[84] This also supports '*Element 2.2 of Action 2.1.A.2: Facilitate take-up of new technology*' from the Government's Sustainable Development Strategy & Implementation Plan.

[85] The development of an offshore wind farm, for example, has many potential impacts that must be carefully managed through consulting on topics as diverse as: the marine environment, marine craft navigation, aircraft navigation, Doppler radar operation, seabed access rights, visual impact, historic wrecks, and tour, dive and fishing boat operators.

[86] As outlined in Appendix 1.

4.1.4 Solicitation of new electricity generators

Other than fossil-fuelled generators that are required by the electric utility to fulfil their role as provider of last resort, the Government will be responsible for the solicitation of new electricity generation capacity. This will ensure the electric utility is able to maintain a reliable supply of electricity with minimal interference, while also ensuring the public interest is represented as developers are given permission to use Bermuda's limited indigenous energy resources.

The solicitation process will generally follow a period of consultation with key stakeholders to ensure any potential issues with proposed projects are identified, once complete a request for proposals will be issued and made available to the public. Responses to the request for proposals will also be made public[87] together with the final decision and reasoning behind the decision.

4.1.5 Electrical generation licences

Although the Energy Act 2009 permits the Government to licence electrical generators, a framework surrounding the conditions for licencing has yet to be established. More specific licencing requirements will therefore be developed and integrated into legislation. At least three categories of licence will be created in a manner appropriate for the different regulatory requirements of various generator sizes[88], though they will generally include requirements to provide evidence of:

- The quality and reliability of proposed generators;
- The continued safety and security of the electrical grid if the proposed generator is online;
- The contribution of proposed generation toward the targets outlined in this white paper[89];
- A reliable methodology for predictions of energy output[90];
- Due care and attention to the environment[91];
- The anticipated impact on the cost of electricity; and
- Meeting the public interest.

The most basic generation licence will be created for small-scale renewable generators under 25 kW of installed capacity. A simplified and standardised licence procedure is appropriate for these systems as thousands will be installed over the coming years and the technologies generally meet well proven industry standards. No significant fee will be charged for this licence as the Government wishes to encourage rapid growth in this sector, though fines will be levied for those who generate electricity without a licence. The licence will primarily focus on maintaining safety and ensuring consumer protection through the use of internationally derived equipment standards[92] and standardised methods of predicting the performance of renewable energy generation systems.

Separate licence classes will be created for generators over 25kW and these will expand on the requirements of the smaller licence class. Additional requirements will be introduced, based on system size, to ensure proper system design and operation. Larger projects will require applicants to demonstrate they possess the financial capacity, industry experience and technical qualifications necessary to properly operate any proposed generation plant. This is necessary as the safe and reliable operation of utility-scale plant is critical to maintaining national energy security.

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[87] Respondents will reserve the right to redact certain parts of their response.

[88] It is unlikely that standby generators for on-site grid isolated generation during power outages will be required to hold generation licences.

[89] This will be required on application for an initial licence and on licence renewal through reporting of sufficient data on electricity production and fuel consumption, as appropriate.

[90] It is not uncommon for the energy production estimates of small scale renewable generators to be inaccurate to the extent that consumers make investments based on unrealistic performance estimates. A formal method of predicting energy output will be developed through public consultation with the renewable energy industry to ensure consumers are protected.

[91] Environmental impact assessments and statements will be required as outlined in the Bermuda Plan 2008, though additional project-specific requirements will be introduced as necessary.

[92] Such as Underwriters Laboratories 1741 Standard for Inverters, Converters and Controllers for Use in Independent Power Systems.

4.1.6 Interconnection standards & agreements

A comprehensive set of interconnection standards will be developed with the electric utility[93] to ensure that generators who wish to interconnect with the electrical grid are able to do so in a safe and controlled manner.[94] The standards and conditions of interconnected operation will generally be expressed and agreed through interconnection agreements, which the regulatory authority will review and ultimately be responsible for approving to ensure that all parties have been fairly represented. The Energy Act 2009 will be amended to give the regulatory authority the specific authority necessary to ensure interconnection agreements follow established industry best practices with regard to:

- General terms and conditions of interconnected operation;
- Technical and power quality requirements for interconnected operation;
- System inspection, testing, authorisation to interconnect and right of access to interconnected facilities;
- Date of commencement, term, termination and disconnection;
- Allocation of costs incurred to provide interconnected service;
- Billing, payment, finances;
- Assignment, liability, indemnity, force majeure, consequential damages and default;
- Insurance;
- Dispute resolution;
- Notice related to interconnected operation; and
- Other relevant miscellaneous matters common to interconnection standards.

4.1.7 Building code standards for distributed renewable energy

To complement the licencing and interconnection requirements previously outlined, the building code will be updated to include relevant standards specific to the installation of renewable energy systems. These standards will embody the traditional responsibilities of the building control division such as structural, electrical and fire safety. Existing building inspectors will carry out these inspections and will receive additional training as necessary. Inspection processes and scheduling will be amended to ensure they are practical for local installers of renewable energy systems.[95]

4.1.8 Planning process for small-scale renewables

Meeting the 2020 targets will require the installation of thousands of solar hot water and photovoltaic systems. It is therefore vital the planning application process is able to cope efficiently with hundreds of applications for renewable energy systems each year.

The Development and Planning (General Development) Order 1999 already permits up to 80 square feet of solar energy collection systems to be installed without planning permission. Although this is large enough for most residential solar hot water systems, it is inadequate for the size solar photovoltaic system typically required to provide the average home's energy requirements[96]. As a result, the majority of planning applications must be submitted to the Development Applications Board through a DAP 1 planning application, which can take 4-5 months or longer to process.

To address these issues, the Government will develop a streamlined planning application process for selected small-scale renewable energy technologies. This process will be free of charge, will be consolidated with other Government application processes where possible and will ensure projects that meet the predetermined criteria can be processed quickly and efficiently.

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[93] The electric utility owns the electric grid and has proven engineering expertise and experience in managing its operation; therefore it is appropriate they develop the standards for those who wish to interconnect with their network.

[94] This also supports '*Element 2.2 of Action 2.1.A.2: Facilitate take-up of new technology*' from the Government's Sustainable Development Strategy & Implementation Plan.

[95] Issues have arisen in the past due to difficulties in timing building inspections with key stages of the renewable system installation. This is largely due to the need to install renewable energy systems in certain weather conditions and the inherent difficulty in planning inspections around a construction timetable which changes on a day to day basis with the weather.

[96] A typical home requires approximately 200-400 square feet to locate a 3-5 kilowatt photovoltaic system and a solar hot water collector.

4.1.9 Renewable resource data

Designers and installers of renewable energy systems need access to reliable data on the energy resources which these technologies harness to produce accurate estimates of how much energy they will capture. Government-held data on key renewable energy resources has therefore been, and will continue to be, released to the public free of charge.[97]

4.2 Non-Renewable Electricity Generation Technologies

The overall volume of fossil fuels required for electricity generation will generally decrease as the amount of electricity produced from renewable energy technologies increases; however renewable electricity is often only available on an intermittent basis. Over time, this will be addressed through energy storage technologies that store renewable energy, and demand side management technologies that align demand for electricity with times when renewable energy resources are available. These technologies will however take time to develop and in the interim electricity generation technologies that use non-renewable energy will continue to be an essential part of maintaining a reliable supply of electricity.

4.2.1 Oil-fuelled generation

As outlined in Chapter 3, generators fuelled by liquid fossil fuels such as diesel, fuel oil and kerosene will form a substantial part of the overall generation mix for some time to come. The incumbent electric utility will retain their historical role as the principle owner and operator of fossil fuel plant in Bermuda as this will be necessary to facilitate their role as grid operator and provider of last resort.

4.2.2 Oil-fuelled combined heat and power generation (Cogeneration)

Combined heat and power generation offers increased efficiencies over conventional generation[98] and will therefore help to reduce greenhouse gas emissions by reducing the quantity of fuel required to provide the same amount of useful energy. Although suitable locations for combined heat and power plant are limited[99], it remains a logical interim option for Bermuda and will be integrated to the electricity generation mix wherever it offers an affordable and practical alternative to conventional generation.

4.2.3 Generating electricity from waste

The use of waste to generate electricity provides a valuable alternative to imported oil as it can provide reliable base load power. The Government is committed to waste incineration in favour of landfill and even though greenhouse gas emissions from waste-to-energy generation are higher than other generation technologies, these emissions will occur regardless of whether the electricity is used or not.

The Tynes Bay Waste-to-Energy Facility currently operates a 3.6MW generator to produce an average output of approximately 1.6MW.[100] A new 7.5MW generator is due to be installed in October 2012, with the existing generator retired as a standby unit. A third waste combustion stream will be commissioned in July 2013, which will permit the facility to have two streams in continuous operation. This will ensure the facility is able to generate a useful power output over 90% of the time. This expanded capacity will permit the addition of waste tyres and approximately 15,000 tonnes of horticultural waste to the waste stream, providing additional fuel sources if desired.[101]

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[97] This information is available from the renewable energy page of the Department of Energy's website, www.energy.gov.bm.

[98] Conventional oil-powered generation typically loses around 60% of the original energy content of the fuel as heat.

[99] Combined heat and power generation plant must usually be located relatively close to adequate fuel supply infrastructure and suitable consumers of thermal energy.

[100] This relatively low output can be attributed to various technical problems with the aging facility that should be addressed when waste streams one and two are refurbished in the future.

[101] This also supports *'Element 2.2 of Action 2.1.A.2: Facilitate take-up of new technology, and Action 2.3.A.1: Expand the Tynes Bay waste treatment facility'* from the Government's Sustainable Development Strategy & Implementation Plan.

Of the 7.5MW generation capacity, 1.8MW will be used to power the facility, while another 1MW will be used to power a nearby reverse osmosis water treatment plant. This will result in the capability to export an average of 4.7MW, equivalent to an annual energy production of 37 GWh, or 5.7% of the energy generated by BELCO in 2008. The Government will continue operations at the Tynes Bay Waste-to-Energy Facility for the foreseeable future and will periodically review best practices and new developments in waste-to-energy technologies to ensure waste resources are used effectively.

4.2.4 Nuclear

The Government does not support the development of a nuclear fission power plant in Bermuda at this time. One of the principle reasons, presuming that Bermuda would not dispose of nuclear waste locally, is that moving toward nuclear fission reactors as a source of power would create new reliances upon other countries to provide nuclear fuel and accept nuclear waste. As the world attempts to reduce greenhouse gas emissions, it is likely that the use of nuclear power will increase, therefore stable nuclear fuel prices and continued availability are not guaranteed. Additionally, key ores used to produce uranium and other materials used to power nuclear fission reactors are finite and will experience similar supply peaks to oil in the future[102,103].

Another important consideration is the regulatory environment that would be required for the safe operation of a nuclear power facility in Bermuda. This would require significant time and resources to develop in a satisfactory manner, which would draw attention away from other fundamental regulatory matters that must be addressed.[104] Regardless of these issues, the disposal of nuclear waste appears to remain a persistant issue in other jurisdictions, with the majority of waste temporarily stored at power plants in steel and concrete containers until permanent geological repositories are developed[105]. The Government does not wish to encourage the creation of nuclear waste which future generations must inevitably be responsible for, whether in Bermuda or overseas.

Residents of Bermuda appear to have mixed views on the use of nuclear power, with more than half expressing concerns over the location, waste disposal, safety and operation, as shown in Figure 4.2.

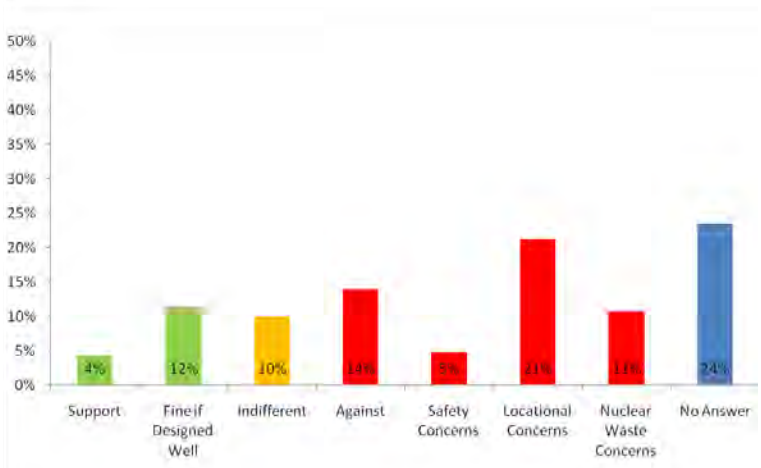

Figure 4.2 – Resident's views on the use of nuclear energy in Bermuda (Department of Energy/Mindmaps, 2010)

[102] Moriarty, P. and Honnery, D. (2007) Intermittent renewable energy: the only future source of hydrogen? *International Journal of Hydrogen Energy* 32, p.1616-1624.

[103] Moriarty, P. and Honnery, D. (2009) What energy levels can the Earth sustain? *Energy Policy* 37, p.2469-2474.

[104] For example, developing appropriate interconnection standards and electric rate structures to encourage other alternative energy sources.

[105] Nuclear Energy Institute. (2010). *Key Issues.*[online] Available at: http://www.nei.org/

4.2.5 Hydrogen fuel cells

Hydrogen is not a source or primary energy, though it may hold future potential as a means to store energy produced by intermittent renewable energy supplies, reducing the need for fossil fuel backup generation. At this time, the combined efficiency of creating, storing and using hydrogen is low and the overall process is not thought to be cost effective. The Government will therefore continue to monitor developments in hydrogen-related generation technologies for potential application in the future.

4.3 Renewable Electricity Generation Technologies

4.3.1 Utility-scale wind generation

As outlined in Chapters 2 and 3, offshore wind turbines will be the single largest contributor to Bermuda's renewable energy target through the development of a multi-megawatt offshore wind farm that will provide over 18% of electrical energy requirements by 2020. There are several reasons why wind energy will provide such as large part of the overall target, including:

- A strong wind resource[106] that is often available twenty-four hours a day;
- Large areas of seabed that may be suitable for utility-scale turbine installation;
- Reduced footprint of wind turbines relative to solar panels; and
- Competitive costs[107].

Despite these advantages, successful wind energy development is not without its challenges, which will complicate many aspects of the design, location and installation of turbines. The Government will ensure these challenges, outlined below, are addressed through public consultation, licencing and regulation:

- High wind and wave loadings created by hurricanes;
- Potential interference with radar systems;
- Environmental impact of construction and operation; and
- Lack of suitable sites for onshore wind turbines due to proximity to residential zoned land[108].

Although public opposition to large wind projects has been an issue in other jurisdictions, 76% of residents either support or are indifferent about the use of offshore wind turbines in Bermuda[109], as shown in Figure 4.3.

[106] In Bermuda, solar photovoltaic panels may be expected to produce approximately 1570 kWh per installed kW per year, while offshore wind turbines may be expected to produce approximately 2600 kWh per installed kW per year.
[107] British Wind Energy Association. (2009). *UK Offshore Wind: Charting the Right Course.* United Kingdom.
[108] Bermuda Government Department of Planning. (2008). *Bermuda Planning Statement.* Bermuda.
[109] Mindmaps. (2010). *Bermuda Government Department of Energy Research Report.* Bermuda.

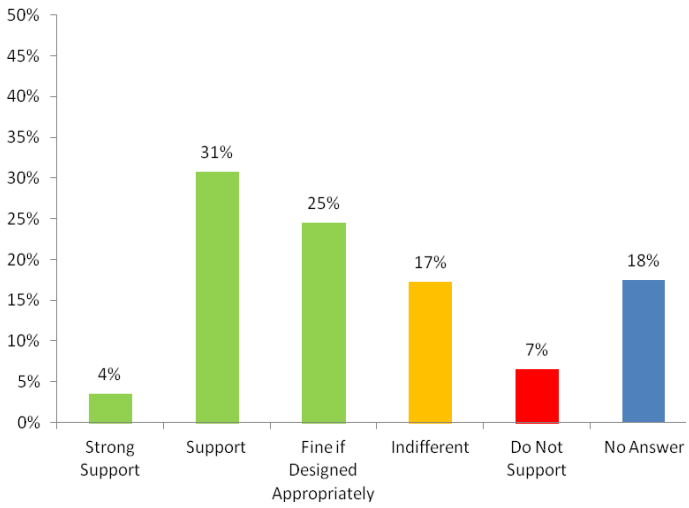

Figure 4.3 – Resident's views on the use of offshore wind turbines[110]
(Department of Energy/Mindmaps, 2010)

4.3.2 Solar photovoltaic generation

Solar photovoltaic technology will contribute just over 9% of annual electricity requirements by 2020, with 3% provided by 12MW of large-scale arrays and 5% provided by 20MW of small distributed systems. Although solar photovoltaic technology is still relatively expensive[111], costs are continually dropping[112] and solar photovoltaic technology is one of the most robust forms of renewable energy available to Bermuda. Solar energy is also available when demand for electricity is greatest; the middle of the day during the summer.

There are several potential sites which, when combined, provide more than adequate space to construct the ground-mounted systems required to meet the 2020 target for large-scale arrays, though none have yet been allocated for solar development[113]. A key advantage of large-scale solar systems is the reduced capital cost, which is likely to be more than 40% lower than for smaller distributed systems[114]. An open consultation process will be held to determine which sites will actually be used for solar development.

While large-scale photovoltaic arrays offer significant economies of scale, the most significant potential for photovoltaic technology in Bermuda exists with smaller distributed systems mounted on the ground, ancillary structures and rooftops.[115] Although the capital cost of small-scale solar photovoltaic systems is frequently cited as a barrier to the technology's adoption, the appropriate combination of feed in tariffs and micro-financing outlined in Section 2.4 will ensure the technology becomes affordable to the majority of residents. The Government has therefore adopted a specific target for at least 5,000 homes to be powered by on-site solar photovoltaic arrays by 2020.[116]

Although there have been concerns with the visual appearance of solar panels on Bermuda's traditional white roofs, the overwhelming majority of residents are in favour of their use on Bermuda homes, as shown in Figure 4.5.

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[110] Respondents were informed these turbines would be located several miles out to sea.

[111] Local installers report that commercial scale photovoltaic installations cost less than $5,000 per installed kilowatt, compared to $8,000 per installed kilowatt for residential systems.

[112] Solarbuzz. (2011). *Retail Price Environment.* [online] Available at: www.solarbuzz.com/facts-and-figures/retail-price-environment

[113] These sites include the airport peninsula and several large water catchments around the island.

[114] See footnote 111.

[115] Using just 10% of the current footprint of all buildings in Bermuda could provide dozens of megawatts of installed capacity.

[116] This also supports '*Element 2.2 of Action 2.1.A.2: Facilitate take-up of new technology*' from the Government's Sustainable Development Strategy & Implementation Plan.

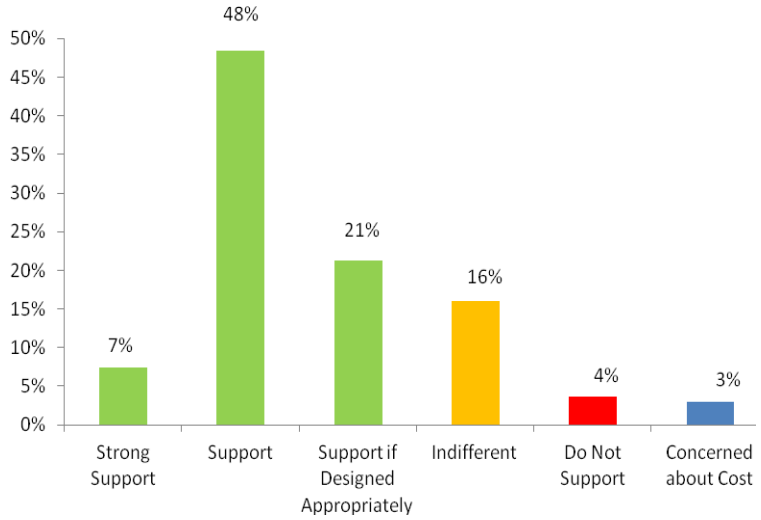


Figure 4.5 – Resident's views on the use of solar panels on Bermuda homes (Department of Energy/Mindmaps, 2010)

4.3.3 Ocean energy technologies

Ocean energy technologies will contribute at least 5% of annual electricity requirements by 2020, though it has not yet been specifically determined which technologies will be used to meet this target.

Bermuda has a good wave energy resource[117], but regrettably there are few, if any, commercially viable technologies currently available to convert the energy in ocean waves into electricity. The Government remains hopeful this situation will change within the next few years so wave energy may become part of the electricity generation mix before 2020. The Government will continue to assist with research and development efforts aimed at bringing commercially viable wave energy technology to Bermuda.

Cold deep ocean water also offers a great potential resource for several different renewable energy technologies. Seawater air conditioning systems are already installed and operational in several locations around the world and could work well in Bermuda, while cold ocean water can also be used to increase the efficiency of conventional fossil fuel generation technologies[118] and even to generate base load electricity. The Government supports efforts to utilise deep ocean water in a sustainable manner and will assist where appropriate with projects that use this resource.

[117] Triton Renewable Energy Ltd., a local company formed to develop large scale renewable ocean energy in Bermuda have reported that *"Wave energy (in Bermuda) is among the most concentrated and least variable forms of renewable energy and is suitable for base load power supply because of its reliability and predictability."*

[118] This may be achieved through the use of combined cycle turbines.

4.3.4 Onshore small-scale wind turbines

Although not officially included in the 2020 targets, a limited potential exists for small-scale onshore wind turbines, generally of 25 kilowatts or less[119]. While this technology is not expected to play a significant role in overall renewable energy generation, the Government recognises these devices can make a substantial contribution toward individual consumer's electricity requirements in appropriate locations and supports their use. Small-scale wind turbines are not however without their issues and as outlined in Figure 4.6 have proven somewhat controversial for a range of reasons, outlined below:

- Installation of turbines in locations that do not have a suitable wind resource;
- Unreliable performance estimates by manufacturers and installers;[120,121]
- Concerns over the ability of wind turbines to withstand hurricanes;
- Concerns regarding potential radar interference;
- Objections to the visual impact of turbines; and
- Concerns regarding the potential noise produced by turbines.

The Government will continue on-going efforts to clarify which issues merit further attention and ensure that appropriate steps are taken to mitigate them through planning processes, generation licencing requirements and public education[122].

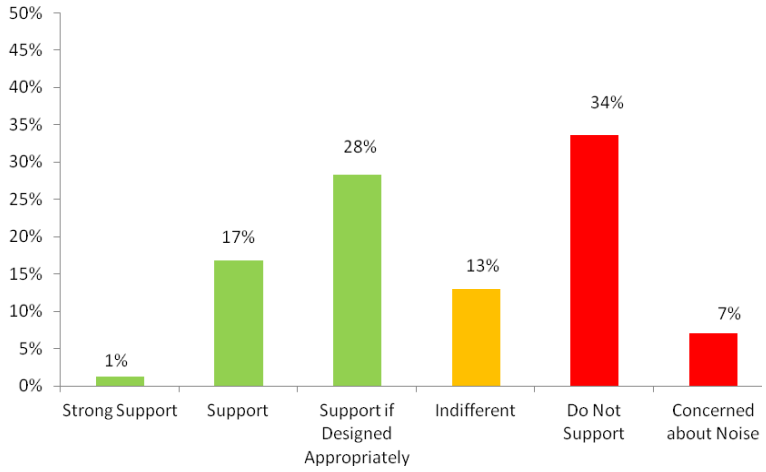


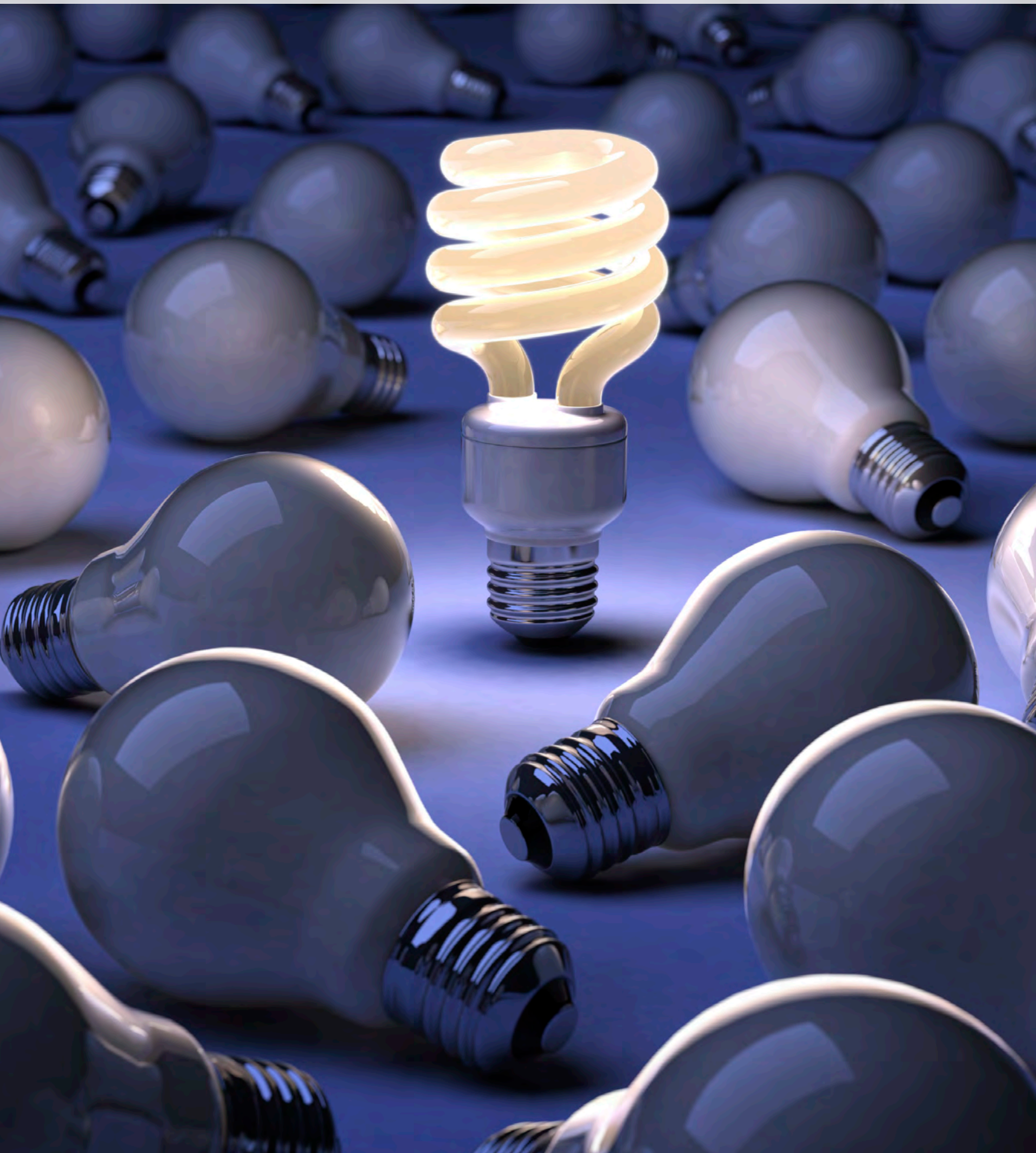
Figure 4.6 – Resident's views on the use of residential wind turbines (Department of Energy/Mindmaps, 2010)

4.3.5 Biomass

When sourced appropriately, biomass may be used as a sustainable fuel for the generation of electricity; unfortunately Bermuda's limited land area restricts the potential for locally grown biomass to only a small percentage of total energy requirements. The Tynes Bay Waste-to-Energy Facility plans to combust around 15,000 tonnes of local biomass[123] to supplement the current waste stream and increase annual electricity production; this will utilise the majority of existing local biomass resources. Government will also consider supporting the use of imported biomass to provide an alternative means of base load generation, providing any proposed generating facilities meet the general objectives of the Department of Energy, which are outlined in Section 1.2.

[119] The relatively low height of these turbines combined with turbulent airflows around Bermuda's built environment limits suitable locations for these devices.
[120] The Cadmus Group, Inc. (2008). *Status Report on Small Wind Energy Projects.* United Kingdom.
[121] Encraft. (2008). *Warwick Wind Trials Final Report.* United Kingdom.
[122] The Department of Energy released a renewable energy guide on micro-wind turbines in March 2011.
[123] In the form of horticultural waste that is currently composted at Marsh Folly.

Chapter 5 – Product Efficiency



Chapter Summary

To achieve the objectives outlined in this chapter, the Government will:

- Introduce minimum efficiency standards for a wide range of energy consuming products;
- Introduce energy performance labelling for key energy consuming products;
- Develop public education initiatives to inform consumers of the advantages of energy efficient products;
- Introduce both mandatory and voluntary requirements for energy audits, which will identify cost-effective opportunities for energy efficient products;
- Encourage medium to large businesses to adopt energy management, which will ensure energy efficiency becomes a normal part of doing business; and
- Adopt energy management within the civil service to lead by example.

5 Product Efficiency

The Government has set a target to reduce electricity consumption 20% below 2008 levels by 2020 through energy conservation, energy efficiency and non-electrical renewable energy technologies[124]. Energy efficient products will contribute toward the majority of this target as they offer one of the most reliable and cost effective ways to reduce energy consumption. Increasing the use of efficient products is also an important long-term policy goal, as looking beyond the 2020 target these products will continue to offer an excellent way to reduce energy consumption well into the future.

5.1 Why Government Action is Required

Despite the clear advantages of energy efficient technologies, many are not widely used in Bermuda[125]. As a result, residents are currently foregoing countless opportunities to reduce their energy consumption in a cost-effective manner. Independent studies have also identified this trend, with one stating that:

> *"in the absence of regulatory obligations or special financial persuasion, consumers will often fail to adopt, or delay the adoption of many cost-effective, energy-efficient devices"*[126].

The purchasing behaviours which contribute to this trend are thought to be the result of many common barriers that must be eliminated if the use of efficient products is to become widespread in Bermuda. As many consumers already lack the motivation to search for efficient products, these additional barriers act to compound an existing problem[127] and include:

- Lack of accurate information on energy consumption and energy efficiency of products;
- Uncertainty over economic payback of investments in efficient products;
- Misaligned incentives typical of many landlord/tenant situations; and
- Urgent purchasing of energy consuming products.

It is often difficult for consumers in Bermuda to access the information necessary to make informed decisions regarding the energy consumption of products. Although some products carry energy consumption labels from North America, these labels are often difficult to interpret and display operating cost estimates based on a much lower cost of energy than in Bermuda. At best, these labels do not offer consumers sufficient information and at worst they are completely misleading[128]. This is important, as poor purchasing decisions are likely to result when consumers have been led to believe the operating costs of certain products are lower than they are in reality.

The general lack of information on operating costs also leads to uncertainty over the economic payback of investments in energy efficient products. This is important as a fast economic payback and subsequent operational cost savings are strong incentives for consumers to purchase efficient products. The sentiments of consumers reflect these issues, with 87% of residents reporting they are unaware of the operating costs of major appliances over their lifetime and 68% believing local retailers do not provide enough information on the operating costs of appliances[129].

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[124] This is illustrated in Chapter 4, Figure 4.1.

[125] Examples include variable frequency drives and advanced compressor technologies for air conditioning systems, heat pump water heaters, compact fluorescent bulbs, automated lighting controls, energy efficient televisions, laptop computers and front loading clothes washers.

[126] Joskow PL, Marron DB. (1993). What does utility subsidized energy efficiency really cost? *Science.* 260, 281.

[127] World Energy Council. (2008). *Energy Efficiency Policies around the World: Review and Evaluation.* London.

[128] The cost of electricity in Bermuda over the past few years has been three to four times higher than in North America.

[129] Mindmaps. (2010). *Bermuda Government Department of Energy Research Report.* Bermuda.

Misaligned incentives are also a widespread barrier to energy efficiency in Bermuda. In situations where the purchaser of an appliance is not the user, for example a landlord buying an appliance, there is little incentive to seek an energy efficient product, particularly if the capital cost is higher than alternative models. The same scenario exists for building contractors who are likely to be more concerned with capital costs than operational costs, which will be paid by subsequent owners or occupants.

Another frequent barrier to energy efficiency is the urgent purchase of products owing to a sudden change in circumstances such as the failure of an existing product, changing seasons or moving to an unfurnished home. These situations often leave little time for consumers to consider energy efficiency, particularly when energy efficient products are not regularly available and must be imported as special orders.

5.2 Improving Product Efficiency

To increase the efficiency of energy consuming products imported to and purchased in Bermuda, the Government intends to introduce a combination of policies that will:

- Raise consumer awareness of product efficiency, the importance of energy efficiency and the economic advantages of energy efficient products;
- Prohibit the importation of inefficient products; and
- Align incentives to motivate consumers to buy energy efficient products.

To increase levels of product efficiency in a timely and effective manner, policy development shall be targeted at products that use relatively large amounts of energy and for which there is a reasonable potential for reduced energy consumption, through energy efficiency.[130] To minimise administrative burden, the Government shall rely on standardised energy performance and testing criteria used in other jurisdictions[131] rather than developing local testing programmes.

5.2.1 Minimum efficiency standards

Minimum energy efficiency standards will form the foundation of the Government's strategy to increase the efficiency of products imported into Bermuda.[132] These standards will prohibit the importation of products that do not meet a predetermined level of energy efficiency and will lead to the phased elimination of products which unnecessarily waste energy. Although some retailers opposed this measure in their responses to the Energy Green Paper, the majority of the public support the creation of minimum efficiency standards as shown in Figure 5.2. The particular level of efficiency for various products will be developed through an open consultation process with key stakeholders, as outlined in Appendix 1.

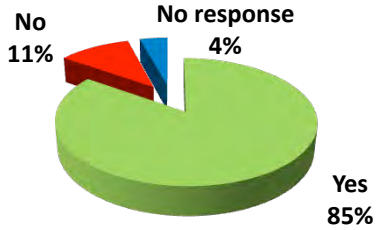


Figure 5.2 – Should the Government set energy efficiency standards for major appliances?
(Department of Energy/Mindmaps, 2010)

[130] Examples include air conditioners, water heaters and refrigerators.
[131] Examples include the North American Energyguide labels and EnergyStar efficiency standard.
[132] This also supports '*Element 2.4 of Action 2.1.A.2: Improve energy efficiency*' from the Government's Sustainable Development Strategy & Implementation Plan.

5.2.2 Product energy labelling

The Government shall work with local businesses to develop a combination of voluntary and mandatory product energy performance labelling for selected products. These labels will contain straightforward information on the energy consumption and operational costs of key energy consuming products, with particular emphasis placed on the total cost of energy consumed by products over their operational lifetime[133]. As these labels are developed, the Government will seek to adopt the best features of labelling schemes that have proven successful in other jurisdictions such as the European Energy Label, U.S. Energyguide Label and Australian Energy Rating Label.

5.2.3 Public education on product energy consumption

Improving consumer understanding of energy consumption is important as it creates a voluntary incentive for many residents to purchase products that are even more efficient than the minimum standards described in 5.2.1. The Government shall therefore launch an on-going public education campaign to complement existing efforts by the electric utility and local non-governmental organisations. This campaign will inform residents of the benefits of purchasing energy efficient products and will also provide updates on relevant programmes and incentives.

5.2.4 Energy auditing

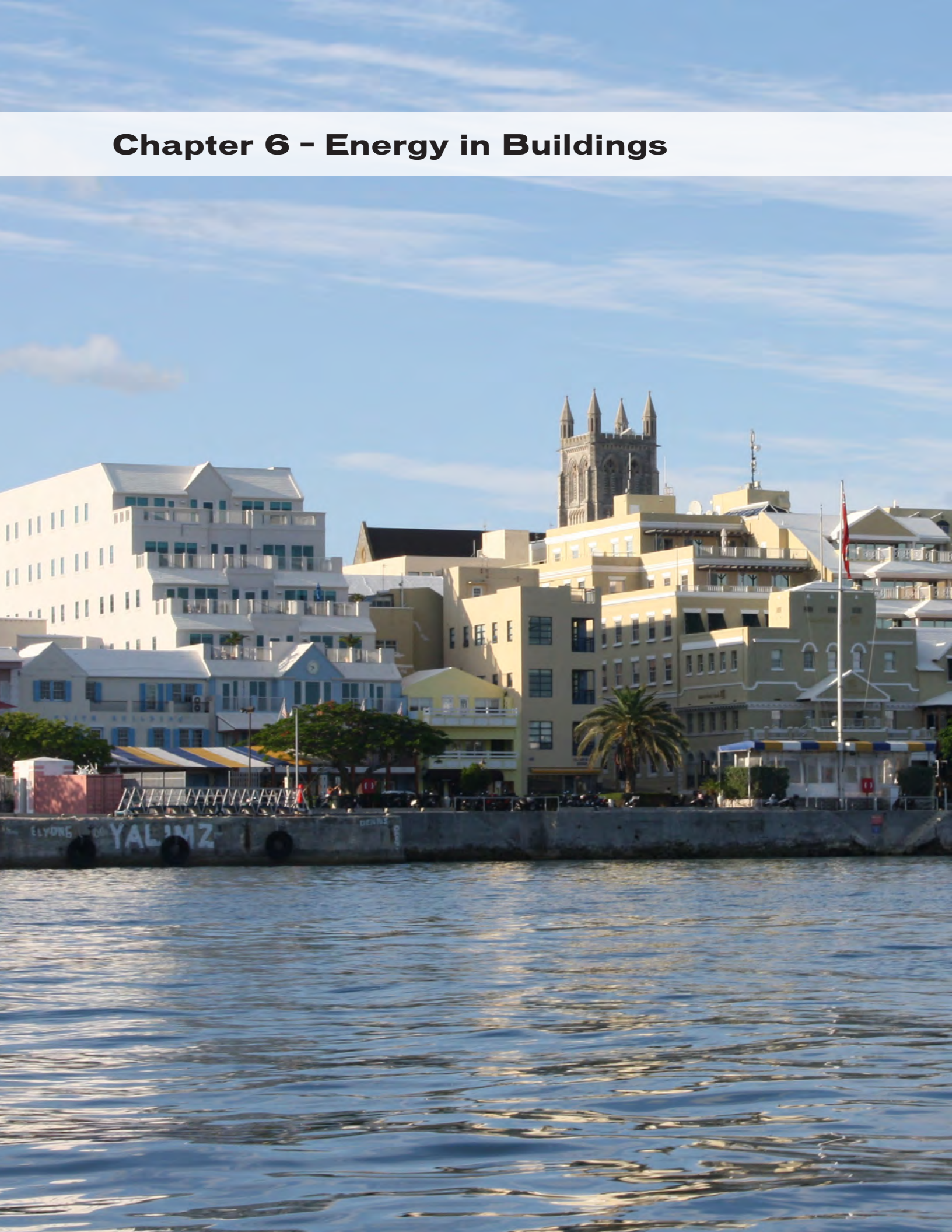
Energy auditors bring the expertise necessary to identify inefficient products to those who are unable to do so themselves. The report provided following an audit offers reliable recommendations on products that can cost-effectively reduce energy consumption in homes and businesses. To ensure energy audits are effective, the Government will develop a standardised auditing framework for Bermuda and shall introduce legal requirements for certain buildings to have periodic energy audits, through consultation with local building owners and facilities managers. Incentives will also be introduced to encourage building owners to voluntarily commission energy audits for their properties. New financial products such as energy efficiency loans will be introduced so the capital costs of implementing audit recommendations are not prohibitive.

5.2.5 Energy management

Although energy audits will periodically identify cost-effective opportunities for energy efficient products, many medium to large businesses will be left without guidance between audits and may also have difficulties maintaining efficient operation of energy consuming products once they have been installed. Energy managers can help to address these challenges by providing the knowledge and experience necessary to acquire and maintain energy efficient technologies. The Government shall therefore work with local businesses to promote energy management and will lead by example through the introduction of energy management to the civil service.

[133] The lifetime energy cost can often exceed the initial purchasing cost of many energy consuming products.

Chapter 6 – Energy in Buildings



Chapter Summary

To achieve the objectives outlined in this chapter, the Government will:

- Develop energy efficiency standards and renewable energy requirements for buildings;
- Develop a standardised framework for energy audits;
- Introduce mandatory requirements for energy audits in certain buildings;
- Adopt energy management within the civil service to lead by example;
- Encourage businesses to voluntarily implement energy management;
- Establish a legal framework to specifically outline how landlords bill their tenants for energy consumption; and
- Develop an energy performance rating system for buildings.

6 Energy in Buildings

The Government has set targets to reduce electricity consumption 20% below 2008 levels and for 30% of electricity to be generated from renewable energy resources by 2020. Energy efficient products and large-scale renewable energy will contribute towards the majority of these targets through the policies outlined in Chapters 4 and 5. It is however essential that buildings themselves also become more energy efficient and use on-site renewable energy generation if both targets are to be achieved.

6.1 Why Government Action is Required

Historically, there have been no mandatory requirements for energy efficient building design and few incentives to voluntarily develop and operate energy efficient buildings in Bermuda; as a result:

- Architects have rarely been tasked with designing highly efficient buildings;
- Developers and construction firms have not generally fabricated efficient buildings;
- Companies fitting out building systems have not consistently installed energy efficient technologies; and
- Building owners do not consistently operate buildings at their optimum efficiency and have not typically procured efficient products.

The creation of highly efficient buildings begins with their initial specification and design. Although most Architects are capable of designing buildings that use relatively small amounts of energy, there has been little demand to focus their skills on energy efficiency and encourage the innovative design approaches necessary to realise the full potential of energy efficient building design.

This may, in part, be due to a lack of demand for energy efficient buildings which has also permitted developers to focus on maximising profits through the reduction of design and construction costs. As a result, the integration of energy efficient building characteristics is often sacrificed to reduce capital expenditure. With little demand to fabricate energy efficient buildings, the construction industry and installers of building-integrated systems[134] have not generally been required to develop the skills and techniques necessary to build and equip highly efficient buildings.

Once a building is complete, its tenants are unlikely to pursue investments in energy efficiency that will not pay for themselves before the end of their lease. Even if tenants are willing to make these investments, many building owners may not allow tenants to modify the building shell, building systems, or even change energy consuming appliances. This limits tenant's ability to reduce their energy bills beyond basic energy conservation measures. This is particularly unfortunate as those who rent are frequently the least able to afford increasing energy costs.

[134] Such as heating, ventilation, air conditioning and lighting.

6.2 Addressing Energy use in Buildings

Other than improving the efficiency of energy consuming products through the policies outlined in Chapter 5, the Government intends to address energy use in buildings primarily by:

- Developing energy efficiency standards and renewable energy requirements for buildings;
- Encouraging and mandating energy auditing;
- Encouraging energy management[135];
- Ensuring consumers have access to real-time information on energy consumption[136];
- Establishing a legal framework to specifically outline how landlords bill their tenants for energy consumption; and
- Developing energy performance rating systems for buildings.

The policies used to achieve this shall ensure the same traditional ingenuity and frugality that have applied to Bermuda's freshwater harvesting and storage systems[137] will begin to apply to energy use in buildings. The Government will ensure as these policies are introduced, they are done so in a manner that is generally harmonious with the Bermuda image, traditionally defined as:

> *"The appearance of Bermuda resulting from a harmonious mix of natural features and man-made elements which produce a visual quality and a character of development which are distinctively Bermudian"*[138]

To ensure this is formally adopted in planning policy, the mixture of natural features and man-made elements that are currently recognised to produce the visual quality and character of development which are distinctively Bermudian[139] will be expanded to include:

> *"Passive energy efficient design features and the use of renewable energy technologies to harvest indigenous energy resources."*

These efforts will guarantee that, in the same manner that Bermuda's white roofs exemplify the architectural expression of a vital functional need for rainwater collection, energy efficiency and renewable energy will also become an expression of considerate energy use and the need to harvest naturally occurring indigenous renewable energy resources.[140] Achieving this vision will require ongoing collaboration between the Government, Architects, Developers, Builders, Engineers, Renewable Energy Installers and other industry members.[141]

[135] Review your organisations energy management performance using the energy management matrix in Appendix 4.
[136] As outlined in Chapter 3, Section 3.2.
[137] These systems are frequently cited as an excellent example of how to provide a sustainable water supply.
[138] Government of Bermuda Department of Planning, (2010). *The Bermuda Plan 2008 Planning Statement*. Bermuda
[139] The full definition of the Bermuda Image can be found in Appendix 5.
[140] This also supports '*Action 1.1.A.5: Build more sustainably'* from the Government's Sustainable Development Strategy & Implementation Plan.
[141] This process shall be initiated later in 2011, when the Government hosts a local conference on accelerating the pace of renewable energy development in Bermuda.

6.2.1 Energy efficiency standards and renewable energy requirements for buildings

Many energy efficiency measures and renewable energy systems add a relatively minor additional expense to the overall cost of a building[142] and the majority of residents support mandatory requirements for energy efficient buildings with integrated renewable energy technologies.[143] The Government shall therefore introduce mandatory building efficiency and renewable energy standards to the residential and commercial building codes by 2012[144]. These standards will apply to both new buildings and existing buildings undergoing major renovations. Specific standards will be decided through a building code review process, which will involve industry consultation, and include mandatory requirements for:

- Passive design features which minimise energy consumption[145];
- Thermal resistance ratings (R-Values) for walls and roofs;
- Thermal transmittance ratings (U-Factors) for glazing;
- The energy efficiency of building-integrated systems such as air conditioning and lighting;
- Energy-efficient water heating in residential and commercial buildings; and
- On-site renewable energy generation.[146]

6.2.2 Energy audits

In addition to identifying inefficient products, energy audits will also highlight inefficient aspects of building design and system operation.[147] As outlined in Section 5.2.4, the Government will develop a standardised auditing framework and shall introduce legal requirements for certain buildings to have periodic energy audits, through consultation with local building owners and facilities managers. Incentives will also be introduced to encourage building owners to voluntarily commission energy audits for their properties. New financial products such as energy efficiency loans will be introduced to ensure the capital costs of implementing audit recommendations are not prohibitive.

6.2.3 Energy management

Many medium to large businesses will find it challenging to properly manage the energy consumption of their building as they may not have the necessary skills and resources. Energy managers provide the knowledge and experience required to address this challenge and ensure that buildings perform at their optimum efficiency. As outlined in Chapter 5, the Government shall work with local businesses to promote energy management and will lead by example through the adoption of strategic energy management within the civil service.

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[142] Particularly for new buildings where it is often more cost effective to integrate these technologies into the original design than retrofit them at a later date.

[143] The 2010 public opinion survey commissioned by the Department of Energy revealed that 65% of residents believed the Government should mandate that existing buildings adopt cost effective energy efficiency measures and 85% believed similar requirements should also be introduced for new buildings.

[144] Many of the new standards will meet or exceed recognised international best practices such as the 2009 International Energy Conservation Code, ASHRAE 90.1 and European Union building energy performance standards.

[145] Passive cooling measures, for example, include the use of shading, natural ventilation and light paint colours to reduce heat gain.

[146] This also supports '*Element 2.2 of Action 2.1.A.2: Facilitate take-up of new technology*' from the Government's Sustainable Development Strategy & Implementation Plan.

[147] For example, damaged or missing insulation, inefficient operation of HVAC systems, and unnecessary solar heat gain.

6.2.4 Establishing a legal framework to specifically outline how landlords bill their tenants for energy consumption

Energy consumption is regularly metered and billed for entire buildings, rather than individual tenants. This often results in oversimplified energy billing arrangements between tenants and landlords. In many cases, these billing arrangements cause tenants who are energy efficient to cross-subsidise those who are not and they also remove valuable incentives to invest in energy efficiency and renewable energy as they are incapable of properly allocating the savings these technologies create.[148]

To address these issues, the Government will develop a legal framework which specifically outlines how landlords can bill their tenants for energy consumption. Although the details of this framework will be developed through consultation with the electric utility, building owners, and facilities managers, its principle purpose will be to ensure:

- Energy consumption can only be billed to tenants where it can be accurately proven the tenant has actually consumed the energy themselves; and
- Landlords and tenants will be able to recover their investments in energy efficiency and renewable energy.

6.2.5 Energy performance rating systems for buildings

As Bermuda endeavours to improve the energy performance of buildings it will be necessary to gain a better understanding of current levels of consumption, establish ways to benchmark performance against best practices, and to compare buildings with one another. The Government shall evaluate various building performance standards[149] and will consult with appropriate stakeholders to develop a building energy performance rating system specifically for Bermuda. The creation of a consistent method of rating the energy performance of buildings will enable residents to better understand building efficiency and will allow the Government to develop incentives for buildings to meet best practices.

[148] This also creates difficulties for energy auditors and energy managers who need to monitor patterns of energy use for individual tenants.

[149] For example, the European Energy Performance Certificates, ASHRAE Building EQ, and the U.S. Energy Star Portfolio Manager.

Chapter 7 - Transportation

Chapter Summary

To achieve the objectives outlined in this chapter, the Government will:

- Introduce minimum efficiency standards for private cars, commercial vehicles and taxis;
- Mandate that local auto retailers clearly display fuel efficiency information and estimates of fuel expenditure;
- Amend the vehicle licencing structure to include additional criteria such as fuel efficiency and greenhouse gas emissions;
- Amend vehicle licences to clearly display fuel efficiency information;
- Provide Customs Tariff incentives to import energy efficient vehicles;
- Develop public education campaigns to inform consumers of the advantages of fuel efficient vehicles and promote carpooling, motorcycles and pedal cycles;
- Introduce an island-wide carpooling programme;
- Increase the amount of motorcycle parking in strategic locations;
- Investigate the feasibility of advanced stop lines for motor and pedal cycles, and permitting motor and pedal cycles to turn left on red lights;
- Work with the Bermuda Police Service to make roads more cycle and pedestrian friendly by improving enforcement of current traffic legislation;
- Introduce cycle carrying facilities to public buses;
- Work with key stakeholders to provide dedicated cycle locking facilities around Bermuda;
- Make the railway trails friendlier to cyclists and walkers;
- Require all new government cars to achieve a minimum urban-cycle fuel efficiency of 40 miles per US gallon by 1 January 2012 and periodically procure vehicles that represent absolute best practices in fuel efficiency;
- Reduce fossil fuel use for public transportation 30% below 2008 levels by 2020;
- Develop appropriate fuel quality standards for transportation fuels available for purchase in Bermuda; and
- Work with the electric utility to install a series of electric vehicle charging stations across Bermuda.

7 Transportation

The Government has set a target to reduce greenhouse gas emissions from local transportation 30% below 2008 levels by 2020. Although the need to reduce traffic congestion has already led to the introduction of a variety of policies aimed at confining the number of vehicles on Bermuda's roads[150], these policies have not stopped the increase in demand for local transportation fuels, which now accounts for approximately 22% of total fuel imports[151]. As Figure 7.1 shows, private cars, motorcycles and public transportation are the dominant forms of transportation used by most residents of Bermuda to reach their place of work.

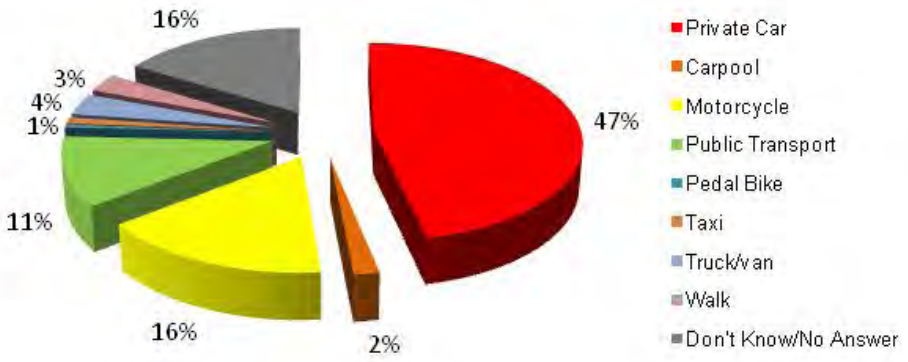

Figure 7.1 – Resident's primary means of transportation to their place of work
(Department of Energy/Mindmaps, 2010)

This Chapter introduces the range of policies which will be used to reach the 2020 emissions reduction target for transportation, through a combined approach of:

- Dramatically improving the energy efficiency of vehicles imported to Bermuda;
- Using existing vehicles in a more efficient manner;
- Using more efficient vehicles, such as motorcycles;
- Reducing vehicle use; and
- Adopting transportation technologies that do not require fossil fuels.

7.1 Reducing Emissions from Local Transportation

7.1.1 Minimum efficiency standards for private cars, taxis and commercial vehicles

The average fuel efficiency of private cars in Bermuda is approximately 26 miles per US gallon[152]; although respectable by North American standards, this is not particularly efficient when compared to many new vehicles currently available in European and other foreign markets[153]. The low fuel efficiency of private cars in Bermuda may be attributed to a preference for gasoline powered cars with automatic transmissions and in particular, the recent popularity of inefficient sport utility vehicles. Even though the taxi industry is adversely affected by high fuel costs, most taxi cabs in Bermuda are also relatively inefficient[154], which presents operators with additional financial pressure in a business environment that is already facing increasing challenges. Commercial vehicles and trucks also consume significant amounts of fuel, particularly as they generally work long hours and carry heavy loads.

[150] These include increases to vehicle import duty, increases in vehicle license fees, requirements to possess a home assessment number to own a car and prohibition of rental cars to tourists.
[151] Based on 2007 data received from Esso Bermuda and Rubis Energy Bermuda.
[152] Based on fuel efficiency data for 19,829 of the 22,703 private cars registered in December 2008.
[153] These markets now offer hundreds of vehicles which achieve over 45 miles per US gallon on an urban cycle.
[154] The average urban cycle fuel efficiency of taxis in Bermuda is 21 miles per US gallon, based on data from the Bermuda Government Transport Control Department.

To ensure imported cars, taxis, and commercial vehicles meet a level of fuel efficiency more representative of what is technologically achievable the Government shall consult with vehicle importers, the taxi association and trucking industry to develop minimum fuel efficiency standards for new vehicles[155]. The voluntary importation of efficient vehicles will also be encouraged as improving the fuel efficiency of taxis and commercial vehicles will offer businesses the opportunity to become more competitive by reducing their fuel costs, which will improve financial security by reducing exposure to future increases in the cost of fuel.

7.1.2 Improving consumer awareness of vehicle fuel efficiency

Currently, only 21% of residents feel that local auto retailers provide enough information on vehicle fuel efficiency, while 88% of residents believe it should be mandatory for auto dealers to display this information[156]. The Government believes it is important for consumers to be well informed regarding fuel efficiency as this creates a voluntary incentive for the purchase of fuel efficient vehicles. Requirements will therefore be introduced for local auto retailers to clearly display fuel efficiency information and estimates of fuel expenditure in promotional materials and on vehicles in showrooms. The Government will also amend vehicle licences to clearly display fuel efficiency information and public education campaigns will be used to inform consumers about the advantages of purchasing fuel efficient vehicles.

7.1.3 Vehicle licencing

Vehicle licence fees are frequently used in other jurisdictions to encourage more sustainable forms of transportation. The Government believes a similar approach will be effective in Bermuda and shall amend current vehicle licencing categories and vehicle taxation rates to create incentives for residents to purchase and operate more efficient vehicles.[157] Consideration will be given to the use of several criteria to define licencing categories, including:

- Fuel source;
- Fuel efficiency;
- Greenhouse gas emissions;
- Vehicle size/weight; and
- Engine capacity/horsepower.

7.1.4 Customs Tariff incentives

The Customs Tariff currently discourages the importation of conventionally fuelled private cars over hybrid vehicles, electric vehicles and motorcycles. The Tariff is however limited and has historically not recognised several highly efficient transportation technologies that frequently offer the same, if not higher, energy efficiency than hybrid vehicles.[158] As outlined in Section 2.4.11, the Government will continue to develop duty rates that provide incentives for residents of Bermuda to purchase more energy efficient technologies, including vehicles.

[155] The 2010 public opinion survey commissioned by the Department of Energy revealed this policy is supported by more than 80% of residents.
[156] Mindmaps. (2010). *Bermuda Government Department of Energy Research Report.* Bermuda
[157] Any changes to licencing structure or rates are unlikely to apply retroactively to existing vehicles.
[158] Such as modern diesel vehicles with common-rail fuel injection systems.

7.1.5 Carpooling

Many cars in Bermuda currently operate without carrying a single passenger[159], resulting in thousands of empty seats available on Bermuda's roads[160]. This represents a significant waste of energy, as most of the fuel is used to move the vehicle and not its occupants. Carpooling offers a simple and effective way to use fuel more efficiently by avoiding the need for passengers to drive their own vehicles. Carpooling also reduces traffic congestion, which has a negative perception with both locals and tourists,[161] and can deter people from using alternative forms of transport[162]. To encourage carpooling, the Government shall initiate a prolonged public education campaign and develop an island-wide carpooling programme.[163]

7.1.6 Motorcycles

Although there are almost as many motorcycles registered on Bermuda's roads as cars[164], only 16% of residents report using motorcycles as their primary means of transport[165]. In recognition of their relatively high fuel efficiency relative to other forms of transportation, the Government will encourage residents to make greater use of motorcycles and will promote their existing benefits, which include:

- Generally lower purchase, operational and maintenance costs than cars;
- The ability to avoid traffic congestion more easily than cars;
- Lower duty rate than cars (33.5% or 0% for electric models), compared to 75%-150% for cars;
- Lower licence fees for motorcycles than cars, ranging from $58 – $146, while cars are between $281 – $1,551;
- Generally less expensive insurance than for cars; and
- More readily available parking, which is usually free.

Despite these advantages, there are also several disadvantages which are likely to discourage residents of Bermuda from utilising motorcycles to a greater extent:

- Increased exposure to the weather;
- Limited carrying capacity for passengers and cargo;
- Greater risk of injury relative to larger vehicles;
- Importance of cars as a status symbol; and
- Reduced comfort of motorcycles relative to other means of transport.

The Government will also develop measures to increase the convenience of using motorcycles by increasing the amount of motorcycle parking in strategic locations[166], and investigating the feasibility of advanced stop lines and permitting motorcycles to turn left on red lights.

7.1.7 Cycling and walking

Pedal cycles and walking offer excellent alternatives to fossil fuel based transportation and have numerous benefits ranging from more efficient use of road space to the potential to improve public health[167]. Bermuda is well suited to cycle transport thanks to low elevations, a low speed limit and small size. Despite this, residents have various concerns with the use of pedal cycles, as shown in Figure 7.2.

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[159] Government of Bermuda. Ministry of Transport. (2001). *The National Transportation Management Plan*. Bermuda.

[160] Assuming that there is one or more spare seats available in many of the 22,703 cars registered in 2008.

[161] Government of Bermuda. Ministry of Transport. (2001). *The National Transportation Management Plan*. Bermuda.

[162] Mindmaps. (2010). *Bermuda Government Department of Energy Research Report.* Bermuda.

[163] This also supports '*Action 2.5.A.5: Encourage carpooling'* from the Government's Sustainable Development Strategy & Implementation Plan.

[164] According to data from the Government of Bermuda Transport Control Department: in 2008, 20,782 motorcycles were registered compared to 22,703 private cars.

[165] Mindmaps. (2010). *Bermuda Government Department of Energy Research Report.* Bermuda.

[166] Although six motorcycles occupy the same space as a single parked car, the Ministry of Environment reported in 2005 that there were only 2,500 motorcycle parking spaces compared to 5,000 car parking spaces in the City of Hamilton.

[167] Woodcock, J. et al. (2009). Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport. *The Lancet*. Volume 374. Issue 9705. Pages 1930-1943.,

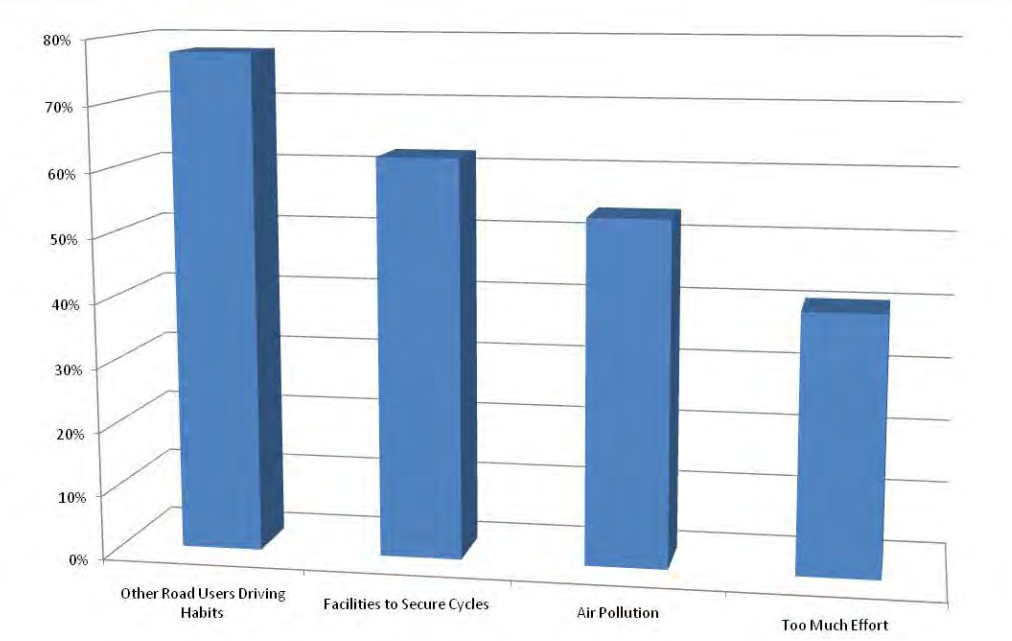

Figure 7.2 – Resident's concerns regarding the use of pedal cycles
(Department of Energy/Mindmaps, 2010)

The Government shall work with the Bermuda Police Service to make roads more cycle and pedestrian friendly by improving enforcement of current traffic legislation.[168] Cycle carrying facilities shall also be introduced to public buses, which will complement the ferries in providing cyclists with more transportation options. Several policies under consideration to encourage motorcycles may also be used to encourage pedal cycles, including advanced stop lines and left turn on red legislation.

To address security concerns, Government shall work with key stakeholders to provide dedicated cycle locking facilities around Bermuda. The Government shall also ensure that most Government-owned buildings have adequate cycle locking facilities, and will encourage the private sector to provide secure cycle locking facilities in the workplace.

Although cycle lanes and sidewalks are used to avoid traffic related problems in many European cities such as Amsterdam and London, Bermuda has little space to widen roads for cyclists or pedestrians. The railway trails however offer a generally safe environment with shallow gradients, away from motor vehicles and traffic pollution, and 91% of residents support their use as a national cycle/walking network[169]. Currently the trails are not clearly signposted, the surface is often irregular, and motor vehicle barriers and speed bumps are inconvenient for those using pedal cycles. The Government will address these issues to make the railway trails friendlier to cyclists and walkers.[170] In addition to encouraging sustainable forms of transportation, this may also lead to increased community and family interaction and will create opportunities for local businesses, such as cycle hire centres, cafes and restaurants.

[168] This also supports *'Action 2.5.A.9: Increase deterrents, modernise legislation, revise procedures and improve enforcement'* from the Government's Sustainable Development Strategy & Implementation Plan.
[169] Mindmaps. (2010). *Bermuda Government Department of Energy Research Report.* Bermuda.
[170] This also supports '*Action 3.1.A.3: Develop the railway trail and tribe roads, linking up areas of public space'* from the Government's Sustainable Development Strategy & Implementation Plan.

7.1.8 Public transportation

To reduce fossil fuel consumption for public transportation, the Government has established an internal target of reducing fossil fuel consumption for the bus and ferry services 30% below 2008 levels by 2020. This target will be achieved through the gradual replacement of less efficient buses and ferries with more efficient models, careful route planning that takes into account passenger demand[171], and matching vehicle size more closely to passenger demand. The Government shall also closely monitor developments in alternative transportation technologies for their feasibility in Bermuda and will take advantage of suitable technologies as they become available.

7.1.9 Government vehicles

To ensure Government vehicles meet basic levels of efficiency, as of 01 January 2012, all new Government cars will be required to achieve a minimum urban-cycle fuel efficiency of 40 miles per US gallon equivalent; this standard will be improved each year to reflect continued advances in vehicle technology. The Government will also periodically procure vehicles that meet absolute best practices in energy efficiency to provide the public with functional examples of the most efficient vehicles available on the market. Naturally, many of these will be electric vehicles, which have already been trialled by the Government in the past[172] and will be integrated into the Government fleet as suitable models become available from reputable auto manufacturers.

7.1.10 Marine craft

Options for reducing greenhouse gas emissions from marine craft are limited, although biofuels may eventually offer an alternative fuel source pending resolution of current issues with 'first generation' biofuels discussed in Section 7.2.5. Effectively improving the efficiency of marine craft through regulation is difficult to achieve as many craft are used solely for recreation, therefore it is unlikely the public would be willing to accept stringent fuel efficiency standards. Although it may be possible to encourage more efficient hull-forms or smaller craft, a lack of standardised fuel efficiency information and the wide variety of hull, engine and propulsion combinations impede efforts at developing practical and realistic policies to reduce greenhouse gas emissions from marine craft.

7.1.11 Regulation of fuel quality standards

Many efficient diesel vehicles require ultra low sulphur diesel to operate and although gas stations have only sold this type of diesel for several years, vehicle importers have suggested a legal requirement is necessary to ensure vehicles are not damaged by incompatible fuels. Regulation of locally produced biodiesel sold to the public is also required to guarantee this fuel adheres to recognised international fuel quality standards. The Government will therefore consult with fuel and vehicle importers and retailers to develop appropriate fuel quality standards for transportation fuels.

[171] Chester, M.V. and Horvath, A. (2009). *Environmental assessment of passenger transportation should include infrastructure and supply chains.* University of California. United States of America.
[172] Electric Vehicle Demonstration Committee. (2001). *2001 Electric Vehicle Trial Program*. Bermuda.

7.2 Alternative Transportation Fuels

7.2.1 Electricity

Electric vehicles can use up to 80% less energy than conventional fossil fuel powered vehicles[173] and offer the possibility of true fossil fuel independence when charged from electricity generated from renewable energy resources. Even when charged with electricity produced from fossil fuels, electric vehicles are typically able to travel over 51 miles per US gallon of fuel burned by the electric utility[174]; a level of efficiency offered by only the most efficient fossil fuel powered vehicles. Electric vehicles also offer several unique advantages over conventional vehicles as they require less maintenance, have no tailpipe emissions and produce negligible noise pollution. Fortunately, Bermuda is well suited for electric vehicles thanks to island-wide availability of electricity, relatively low elevations and short trip distances[175].

Despite a zero duty rate, only a few dozen electric cycles and a handful of electric cars were registered on Bermuda's roads in 2009[176]. The lack of electric vehicles in Bermuda may be primarily attributed to the fact that no major auto manufacturers have consistently offered affordable electric vehicles, and the level of quality and performance of electric vehicles that have been available has often been inadequate. It appears this is set to change as several reputable auto manufacturers have recently been engaged in leased trials of electric vehicles[177], and are now beginning mass-production of electric vehicles[178,179,180]. As a result, it is anticipated that mass produced electric cars and motorcycles may become viable alternatives to conventional vehicles within the next few years.

To ensure the adoption of electric vehicles is not held back by lack of charging infrastructure[181] the Government will purchase an initial series of charging stations and work with the electric utility to install them across Bermuda[182]. This will enable early adopters to charge their electric vehicles and will also allow residents to gain experience in electric vehicle charging and operation. The Energy Commission and future regulatory authority will be responsible for the regulatory oversight of charging station pricing and operation.

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[173] Based on comparison of the in-vehicle energy consumption per kilometre, between a range of electric vehicles and fossil fuel powered vehicles of efficiencies typically found in Bermuda.

[174] Assuming an electric car consumes 0.2 kilowatt hours per kilometre and the electric utility generates 4.35 kilowatt hours per litre of fuel.

[175] Most journeys in Bermuda will be well within the range of good quality electric vehicles.

[176] Based on 2009 data from Government of Bermuda Transport Control Department.

[177] Mini. (2010). *Mini E Field Trial.* [online]. Available at: http://www.miniusa.com/minie-usa/

[178] Peugeot. (2009). *iOn*. [online]. Available at: http://www.peugeot.com/en/news/2009/11/12/ion.aspx

[179] Nissan. (2010). *Meet the Nissan Leaf*. [online]. Available at: http://www.nissanusa.com/leaf-electric-car/

[180] General Motors. (2009). *Introducing Chevrolet Volt*. [online]. Available at: http://www.chevrolet.com/pages/open/default/future/volt.do

[181] Currently, electric vehicles are predominately charged at home due to the lack of workplace and public charging facilities.

[182] Despite initial Government involvement in financing charging stations, the private sector will be encouraged to take responsibility for further development and operation of electric vehicle charging infrastructure in the future.

7.2.2 Electricity/fossil fuel hybrids

Despite the positive media attention which hybrid vehicles commonly receive, the technology is not a reliable proxy for fuel efficiency and there are many conventional vehicles with standards of fuel efficiency that exceed the levels offered by some hybrid vehicles. The Government shall not therefore introduce policies to specifically encourage hybrid vehicles and will develop more appropriate incentives based on energy efficiency and greenhouse gas emissions.

7.2.3 Hydrogen

The Government does not support the adoption of hydrogen fuelled vehicles as an alternative to fossil fuel powered vehicles at this time, for the following reasons:

- There are few, if any, hydrogen powered vehicles currently available at competitive prices;
- It does not appear that major auto manufacturers plan to release any commercially available hydrogen fuelled vehicles in the near future;
- The majority of hydrogen is currently created using fossil fuels and the overall efficiency of converting renewable electricity to hydrogen, storing it and then using it to fuel vehicles is relatively low compared to other options such as battery electric vehicles; and
- Significant technical and economical barriers remain with the adoption of a transportation system that uses hydrogen as a fuel.

Developments in hydrogen-related technologies will however be monitored and this policy may be amended in the future if appropriate.

7.2.4 Liquid petroleum gas

Liquid petroleum gas (LPG) is a relatively clean burning, low carbon fuel that may be used in many conventional vehicles, providing their fuel systems have been modified to run on LPG. Despite these advantages, the cost of converting vehicles to operate on LPG can be significant while the economic advantages are questionable.[183] There is also inadequate infrastructure to refuel vehicles powered by LPG and it is an imported fossil fuel which will inevitably encounter supply issues in the future. The Government remains open to the use of LPG as a transportation fuel, but is currently focused on implementing the other policies outlined in this chapter.

7.2.5 Biofuels

Many conventional and hybrid vehicles are able to use fuels that contain plant-based biofuels such as biodiesel and bioethanol.[184] These fuels can reduce greenhouse gas emissions from transportation[185] and are not directly produced from fossil fuel based resources. A handful of vehicles in Bermuda are currently powered with biodiesel produced using waste vegetable oil from commercial kitchens. Regrettably, the annual volume of vegetable oils imported to Bermuda is equivalent to only 5% of current annual demand for diesel fuel[186] and is therefore insufficient to meet any reasonable percentage of diesel fuel requirements. Despite this, the Government supports the responsible conversion of waste vegetable oil to biodiesel.

[183] Based on bulk propane cost of $1.32-$1.59 a litre in Bermuda and accounting for the relative energy content of propane compared to gasoline.
[184] Some vehicles are also able to run on pure biofuels.
[185] The plants used to produce biofuels absorb carbon dioxide as they grow, some of which is released back into the atmosphere when they are combusted; this can result in lower overall emissions than would be produced if pure fossil fuels were used.
[186] Based on cooking oil import data from the Bermuda Government Department of Statistics.

The Government will not encourage the use of locally grown crops to produce 'first generation' biofuels at this time as 130 to 340 square kilometres of land would be required to produce sufficient crops to replace current demand for gasoline and low sulphur diesel[187]. Recent research has suggested the use of 'second generation' biofuels from alternative biofuel feedstocks such as lignocellulosic materials and algae could reduce the area required to a level where biofuels become a more realistic large-scale option for Bermuda.[188,189] The Government may modify policies to reflect such improvements in biofuel feedstocks and processing techniques in the future.

An alternative option to the local production of biofuels is the importation of biofuels that have been grown and produced in other countries. However, the Government will not encourage the importation of biofuels at this time for the following reasons:

- There are general concerns regarding the sustainability of producing biofuels using current techniques[190];
- The net energy yield of biofuels is often highly variable, depending on feedstock and process; and
- The cost and supply of biofuels is expected to be closely linked with oil-derived fuels as long as biofuels retain only a minor part of the market for liquid transportation fuels, which is likely to be the case while 'first generation' biofuels dominate supply.

7.3 Reducing Emissions from International Transportation

Although it is often taken for granted, Bermuda's economy and society relies on fossil fuel powered ships and aircraft to constantly move goods and people to and from the island, and the availability of affordable air and cruise travel is vital to the tourism industry, yet future increases in the price of fossil fuels threaten to push the cost of international transportation even higher. This is likely to directly impact the revenue stream of many businesses in Bermuda at a time when they will be facing ever increasing energy costs. The cost of importing goods is also likely to increase, with fuel surcharges and frequent price increases becoming the norm, rather than the exception as importers try to cover their operating costs. Unfortunately, addressing current dependencies on fossil fuel use for international transportation presents significant challenges, specifically:

- Many aircraft and ships obtain fuel from overseas, where local regulations do not apply;
- A large number of international transportation craft are operated by overseas businesses, which limits the Government's authority over their operation; and
- Regardless of local policy, it is likely that over time, international policies to reduce greenhouse gas emissions from international transportation will emerge; these are likely to have implications on transportation both to and from Bermuda and would take precedence over local policy.

Owing to these difficulties, the Government is primarily focused on domestic transportation policy at this time.

[187] Based on comparison of International Energy Agency data on biofuel yields with volumes of fuel imported in 2007 as reported by Esso Bermuda and Rubis Energy Bermuda.
[188] K.M. Weyer et al. (2009). Theoretical Maximum Algal Oil Production. *Bioenerg*. Res. 2010. 3:204-213.
[189] Sheehan J. et al. (1998). *Look back at the U.S. Department of Energy's Aquatic Species Program: biodiesel from algae; Close-Out Report.* United States of America.
[190] International Energy Agency (2004). *Biofuels for Transport.* France.

Chapter 8 – Legislation & Regulation

Chapter Summary

To achieve the objectives outlined in this chapter, the Government will:

- Amend the Energy Act 2009 to provide the additional legislative authority necessary to meet the 2020 greenhouse gas emission reduction target by:
    - Ensuring fair pricing and operation of fuel distribution and retail sales;
    - Regulating interconnection between the operator of the electrical grid and independent power producers;
    - Regulating new and existing rates for electricity;
    - Providing clearer guidance to energy regulators regarding their role and authority in maintaining consumer protection;
    - Introducing reporting requirements for companies operating in the energy sector;
    - Discouraging anti-competitive practices through regulation;
    - Ensuring safe operation of power producers; and
    - Developing quality of service standards for power producers.
- Amend a range of other legislation to create the legislative authority necessary to meet the 2020 greenhouse gas emission reduction target;
- Transfer future responsibility for the regulation of energy to an independent regulatory authority; and
- Maintain the 60/40 rule for local ownership of companies in the energy sector.

8 Legislation & Regulation

Many aspects of the energy sector were developed during a time when energy was cheap, widely available and the environmental impacts of its use were not fully understood or accepted. Policy, legislation and regulation were no exception and as a result existing laws do not provide the Government and Energy Commission with the authority necessary for Bermuda to reach the targets outlined in this White Paper. It is therefore essential that both new and existing laws be developed to create a solid legislative and regulatory foundation for Bermuda's future energy plan.

8.1 A Legislative Foundation for the National Energy Transition

As new legislation is developed and existing legislation is amended, the Government will consult, where appropriate, with key stakeholders to ensure a collaborative approach is taken to legislative development. This will be achieved through an open consultation process, which generally follows the practices and procedures outlined in Appendix 1.

8.1.1 A new Energy Act

An amended Energy Act will be necessary to create the comprehensive authority required to regulate the energy sector by transferring responsibility for the regulation of energy from the Energy Commission to an independent regulatory authority. The revised Energy Act will contain amendments that expand or more specifically outline the authority to:[191]

- Regulate pricing of all electricity rates;
- Regulate all businesses producing electricity;
- Regulate aspects of the production, distribution and sales of energy other than electricity;
- Introduce reporting requirements for fuel importers and power producers;
- Develop fuel quality standards;
- Develop minimum efficiency standards for imported vehicles and energy consuming products;
- Regulate competition;
- Ensure consumer protection;
- Maintain quality of service;
- Ensure consumers have access to information on energy consumption;
- Formally designate a provider of last resort for electricity;
- Mandate the purchase of low emission electricity;
- Ensure safe and fair interconnection of independent power producers with the electrical grid;
- Develop quality standards for electricity generation equipment; and
- Address energy use in buildings.

[191] While this list covers the main areas of regulation, it is by no means exhaustive.

8.1.2 Other legislative amendments

It will also be necessary to introduce a range of amendments to existing legislation that is not directly related to the energy sector. Examples of such legislation are provided below, together with their relevance to future energy policy:

Bermuda National Parks Act 1986 – relevant to encouraging use of the railway trails by cyclists and pedestrians;

Building Act 1988 and Building Code Regulations 1991 – relevant to the amendment of building codes and building inspection procedures to encourage energy efficiency and renewable energy;

Clean Air Act 1991 – relevant to eliminating current requirements for renewable energy technologies to obtain operating licences related to air emissions;

Companies Act 1981 – relevant to the introduction of mandatory energy auditing for certain businesses;

Condominium Act 1986 – relevant to allocation of energy billing by landlords to their tenants;

Customs Tariff Act 1970 – relevant to the adjustment of Customs duty rates associated with imported fuels, renewable energy technologies and energy consuming products;

Government Fees Regulation 1976 – relevant to the adjustment of fees required for various Government application processes for renewable energy technologies;

Motor Car Act 1951 – relevant to the development of rules and incentives for energy efficient vehicles;

Motor Car (examination, licensing, and registration) Regulations 1952 – relevant to the introduction of licencing incentives to use more energy efficient vehicles;

National Occupational Certification Act 2004 – relevant to the introduction of mandatory certification for certain professionals in the energy industry;

Parking of vehicles (designated areas) Act 1973 – relevant to the allocation of addition parking space for motorcycles, cycles and electric vehicles;

Road Traffic Act 1947 – relevant to the development of traffic management policies to encourage the use of more efficient vehicles; and

The Development and Planning (General Development) Order 1999 – relevant to the creation of an expedited planning application process for small-scale renewable energy technologies.

8.2 Regulation of Energy in Bermuda

The Government is currently in the process of transferring regulation for the telecommunications industry from the Telecommunications Commission to an independent regulatory authority, which is yet to be formally established. Responsibility for the regulation of energy will also be transferred to this independent regulatory authority within the next few years. The existing Energy Commission and nascent regulatory authority will therefore be responsible for regulating the energy sector during a critical period of substantial change, when bold regulatory action is required for Bermuda to meet the various targets outlined in this white paper.

As outlined in 8.1.1, the Energy Act 2009 will be amended to provide the regulatory authority with the additional guidance and authority necessary to fulfil this role. The following sections provide greater insight into key elements of the energy sector that shall be regulated.[192]

8.2.1 Fuel distribution and retail sales

Some parts of the fuel distribution infrastructure between fuel importers, fuel retailers and the electric utility cross public land and form natural monopolies, yet operation of this network has not historically been regulated. Furthermore, retail prices have historically been regulated through a thirty year old agreement between the Government and petroleum importing companies, rather than a formal legal arrangement. The regulatory authority will therefore be given the authority necessary to ensure fair pricing and operation of fuel distribution and retail sales.

8.2.2 Electrical grid management, access and interconnection

The regulatory authority will be given specific authority to regulate interconnection between the operator of the electrical grid and independent power producers, as outlined in 4.1.6. This will ensure the electrical grid is open and affordable to independent power producers through the provision of fair and transparent interconnection agreements for generators ranging from the smallest domestic renewable energy systems up to utility-scale offshore wind farms.

8.2.3 Electricity pricing

Regulation of electricity pricing is a strong and far-reaching tool for aligning the incentives of the electric utility, independent power producers and energy consumers with the energy policy goals of the Government. Innovative pricing structures can encourage energy conservation and energy efficiency, and improve the economic viability of renewable energy technologies. Unfortunately, the rate structures traditionally employed by electric utilities often do not provide the flexibility required to develop suitable incentives. The preference for such rate structures may be attributed to the costs of running an electric utility, which are typically fixed and capital intensive. This creates a natural tendency for utilities to mitigate unpredictable variations in revenue by:

- Favouring the use of fixed monthly service charges in preference to kilowatt hour sales rates for electricity, which can vary depending on demand; and
- Adopting a cautious approach to technologies, policies and programmes which have the potential to reduce electricity sales.

It will therefore be essential for the regulatory authority to work with the Government, the electric utility and the renewable energy industry to develop robust and sustainable rate structures. Rates will generally serve to assure fair pricing for consumers and economic viability for power producers. They are likely to utilise a combination of some of the rate structures outlined below:

Avoided cost buyback – The electric utility would purchase electricity from designated generators such as wind or solar and would pay any costs which are avoided through use of this energy, such as fuel costs and certain operational costs.

[192] This also supports '*Action 4.1.B.1: Continuously reassess regulatory framework and fiscal burden*' from the Government's Sustainable Development Strategy & Implementation Plan.

Decoupling – Separates an electric utility's financial performance from its level of sales. This can motivate the utility to participate and assist in the development of energy conservation and efficiency measures and renewable energy technologies without concern of revenue reduction.

Demand reduction discounts – A form of time-of-use rate, discounts can be offered to customers who are able to reduce their demand below a certain level at specified times. This can reduce peak demand, increasing the electric utility's load factor and reducing the need for investment in plant which operates infrequently.

Efficiency / renewables surcharges – Charges could be added to account for external costs not typically reflected in a utility's rates. The revenue collected can be used to encourage the use of behaviours and technologies that have a lower external cost. Surcharges based on greenhouse gas emissions are a common example.

Feed-in-rates – A predetermined rate of electricity is paid to designated generators for each kilowatt hour exported to the electrical grid. Credit may be given to a customer generator by the electric utility if the balance at the end of a billing period is positive. The predetermined rate is often based on the avoided costs, with some mechanism to account for external costs such as greenhouse gas emissions.

Incentive regulation – The electric utility could be offered rewards for meeting specified goals such as renewable energy generation targets.

Inverted block rates – The costs of electricity rise as more is consumed. This provides an incentive to reduce energy consumption and allows consumers more effective control over their energy costs through reducing consumption.

Net metering – The retail rate of electricity is paid to designated generators for each kWh exported to the electrical grid. Credit may be given to a customer generator by the electric utility if the balance at the end of a billing period is positive.

Price cap regulation – Sets prices between two predetermined time periods based on an independent price index, which is adjusted by an additional calculation determined by the regulator to account for differences between the price index and energy price variations.

Rate-of-return regulation – Sets prices that would be appropriate in a competitive market if one existed for this service. Rates would be composed from the cost of efficiently producing electricity plus a market-determined rate. Permitting a greater return on renewable energy generation than fossil fuel generation could provide the utility with an incentive to adopt renewable generators.

Reduction of fixed charges – Recovering costs through energy sales rather than monthly facilities charges provides an incentive for efficiency and renewable energy technologies, as it increases the rate per kilowatt hour.

Separate cost allocation – This can account for generation, fuel, transmission, distribution, metering and other costs separately to provide consumers with varied incentives and more information on the cost of their electricity. Particular combinations of these costs can create greater incentives for efficiency.

Time-of-production rates – A rate paid for electricity that varies based on the time of production. This can encourage renewable energy technologies that produce energy at times of peak demand, such as solar photovoltaic systems.

Time-of-use rates – A rate charged for electricity that varies based on the time of use. This permits the price of purchasing electricity to more accurately reflect the costs of generation, which often provides an incentive to reduce peak demand.

8.2.4 Consumer protection

The Energy Act 2009 contains no specific provisions for the Energy Commission to address consumer protection, though the Act does require the Commission to have regard to the public interest when regulating variations in the price or charge for electric power. The development of more specific legislative authority regarding consumer protection is necessary to ensure the regulatory authority is able to protect consumer's interests. Key aspects of consumer protection likely to be addressed include protection of consumers from unsafe operation of small-scale generation systems, ensuring consumers are fairly represented in their relationship with energy providers and ensuring consumers have access to information on their energy consumption. The Government will therefore amend the Energy Act to provide clearer guidance to the regulatory authority regarding their role and authority in providing and maintaining consumer protection.

8.2.5 Reporting

Monitoring greenhouse gas emissions will require the energy industry to routinely submit data on fossil fuel consumption to the Government. Appropriate and effective regulation of electrical power pricing will also require the submission of detailed data from both the electric utility and independent power producers. The Energy Act 2009 currently provides sufficient authority for both the Energy Commission and the Minister responsible for Energy to obtain this data.[193]

8.2.6 Competition regulation

Working in conjunction with the regulatory authority, the Government shall encourage the creation of a more open, competitive market environment for electricity generation through regulation that generally discourages anti-competitive practices, such as:

- Discriminatory Government subsidies;
- Overcomplicated regulation that presents a barrier to market entry;
- Discriminatory access to the electrical grid;
- Exclusive dealing;
- Selling products at a loss to force competitors out of the market;
- Price fixing;
- Dividing territories to avoid competition;
- Pricing intended to restrict new businesses to enter a market;
- Absorption of competitors;
- General abuse of market power/monopoly position; and
- Cross-subsidisation.

8.2.7 Safety

Any company holding an electrical generation licence shall be required to comply with the Occupational Safety and Health Regulations 2009. These regulations have been recently updated to represent best practices in occupational health and safety from various countries and aspects relevant to electrical energy production and distribution have been taken into account.

[193] The Energy Act 2009 provides the authority necessary for the Energy Commission to obtain data from businesses specified in the Act through the submission of periodic reports, and for the Minister responsible for Energy to obtain a wide range of information on energy related goods.

Large electric generation projects will be required to contact the Occupational Safety and Health Office of the Department of Health prior to commencing a project and the Department is likely to request a full safety and health plan for review to ensure compliance with existing regulations. If these regulations are not appropriate for a particular project, the Energy Commission or future regulatory authority may consult with the Department of Health to recommend relevant international standards that should apply to the project in question.

The regulatory authority shall also be involved with ensuring safety is maintained, primarily through regulation of interconnection standards for independent power producers. Both the electric utility and the Department of Planning will also participate in ensuring the safe development of renewable energy systems through inspections prior to system activation.

8.2.8 Quality of service

Presently there are no legislative requirements for energy providers to submit quality of service data to the Energy Commission. It is however important for the Energy Commission and future regulatory authority to have access to data regarding quality of service, as this will be essential to properly address the following:

- Resolution of disputes between electrical generators;
- Anti-competitive practices derived from arguments regarding quality of service;
- Monitoring of market development;
- Generation licence compliance;
- Quality of service complaints;
- Impact of competition on quality of service; and
- Development and effect of regulatory policies.

The Energy Act 2009 created the authority for the Minister responsible for Energy to require specified businesses to submit quality of service data; obligations to submit such data will therefore be included in conjunction with other reporting requirements, as outlined in 8.2.5.

8.2.9 Foreign direct investment

Foreign Direct Investment is currently governed by the Companies Act 1981, which allows a maximum 40% foreign ownership. The Government shall maintain this rule for companies operating in energy related industries, though may consider exemptions if absolutely necessary.

Appendices

Appendix 1: Public Consultation Process

Appendix 2: Sankey Diagram of Estimated Energy Flows in 2007/8

Appendix 3: Features of Successful Policies Identified in the Energy Green Paper 2009

Appendix 4: Five Steps to Effective Energy Management

Appendix 5: The Bermuda Image

Appendix 1: Public Consultation Process

1.0 Introduction

Public consultations inform the Government's decision making process and will form an essential part of developing the legislative and regulatory framework for the energy industry. This document is designed to ensure industry stakeholders understand the processes by which public consultations are conducted. To this end, future consultations shall generally be conducted in a manner that:

- Involves as many stakeholders as is practical;
- Gathers as much information as is practical;
- Gives interested parties an opportunity to fully express their views;
- Encourages transparency;
- Avoids lengthy delays; and
- Is as efficient as possible.

2.0 Public Consultation Process

2.1 Preparation of a public consultation

Where appropriate and practicable, the Department of Energy[194] may hold informal talks with people and organizations before announcing a consultation to determine their views on issues to be addressed through the consultation process.

2.2 Announcement & publication of consultation document

The Department will set up a list of stakeholders who wish to be notified when a consultation is issued so they can be kept informed. Consultations shall generally be announced through a combination of e-mail, regular mail, telephone notification and notices posted on the Department's website, www.energy.gov.bm.

Where issues under consultation are of immediate consequence to the general public, a notice shall also be published in the Official Gazette, stating the availability of the consultation paper, the topic being consulted on, the closing date for responses and contact details within the Department.

Public hearings may also be held and are open to all interested parties should they wish to express their views in person. Hearings will generally be announced through various means of communication, as outlined above.

The consultation paper or papers will generally be made available on the Department's website, www.energy.gov.bm, and the offices of the Department.

2.3 Design of the consultation document

The Department will aim to follow a consistent approach in designing each consultation document. The contents will vary depending on the subject, but will generally include:

- A front cover with the name of the consultation and the closing deadline for responses;
- A page listing the contents;
- An executive summary;
- The main body of the document;
- Contact details of where responses should be sent; and
- A glossary and appendices as necessary.

[194] Also referred to as 'the Department' in this document

Some of the issues explored in consultations may be technically complicated; however the Department will always try to make formal consultation documents concise and easy to understand. Where possible, the Department will publish self-contained documents to avoid the need for respondents to refer to other papers. The background of the consultation will be included in the document and will explain why the Department is consulting on a particular subject, setting out the events and issues that have triggered the consultation.

Consultations will generally state whether the consultation in any way interrelates with other issues on the regulatory agenda such as:

- Other consultations;
- Decisions or policies under preparation by the Department; and
- Interdependencies with past decisions.

2.3 Timescales

Consultations will typically cover a period of between two and six weeks, however length of the consultation period may be affected by a variety of factors such as:

- The complexity of the issues addressed;
- The range of stakeholders who respond to the paper;
- Concurrent consultations involving the same stakeholders;
- Legislative development;
- The urgency of the issue and the timing for any final decision; and
- Holiday periods.

2.4 Responses

Stakeholders must direct all responses in writing, either by email to energy@gov.bm with the title of the consultation document in the subject line, or in hard copy (letter or fax) to the offices of the Department of Energy.

During the consultation period, the Department may use other informal means of gathering additional information or clarifying the information it receives; the means include, but are not limited to, seminars, workshops and public hearings.

2.5 Publication of responses

The Department will publish all responses, except for those it considers to contain inappropriate material. Responses shall be published on the Department's website, www.energy.gov.bm, and will also be available from the offices of the Department. At the end of the consultation period, respondents will be given a further two weeks to comment on each other's responses.

It should be noted that the Department will not automatically grant a request for an entire response to be kept confidential. The Department considers that it may be appropriate to respect a claim for confidentiality if the information is:

- A trade secret;
- Of a financial, commercial, scientific or technical nature and is normally treated as confidential;
- If disclosed, reasonably certain to result in significant financial loss or gain;
- If disclosed, likely to result in significant prejudice to competitive position; and
- If disclosed, affect confidential liabilities.

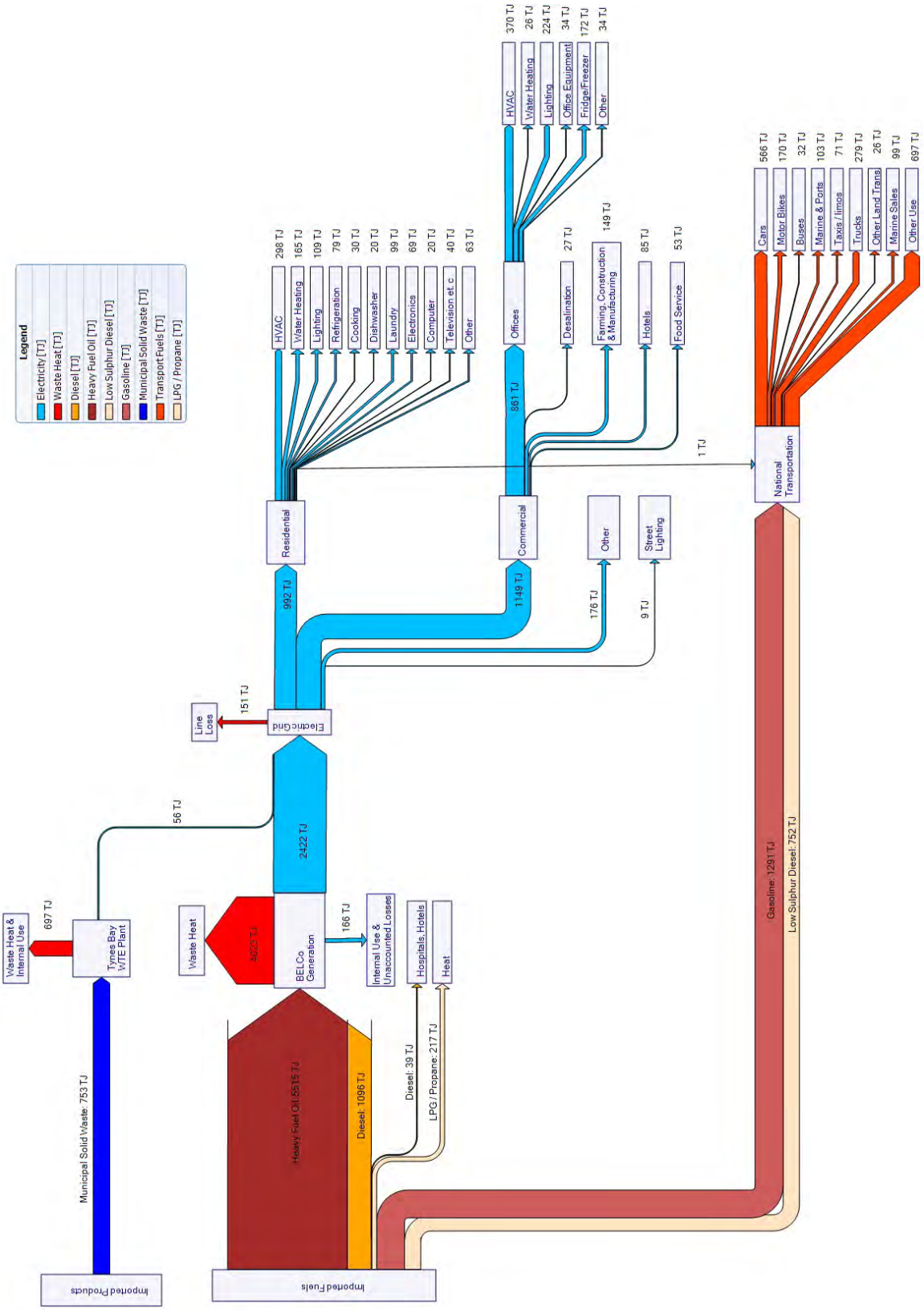
All responses must be accompanied by the cover sheet contained within the appendix of the consultation document. Respondents who submit confidential information in their responses must ensure they complete the confidentiality section on the cover sheet. They must also submit a redacted version of their response that will preserve the document's confidentiality.

The Department may, if it considers it in the public interest, or if legally bound to do so, publish information marked as confidential, after consulting with the individual respondents and informing them of the Department's intention to publish the information.

2.6 Publication of final decision

Following the closing date for replies to the published responses, the Department will review and consider all initial and responsive submissions before arriving at a decision. The Decision, which also serves as a report on the consultation, shall provide a general review of the submissions; it will detail the Department's response and will provide reasons for its decision. The Decision will then be published on the Department's website, www.energy.gov.bm and may also be obtained from the offices of the Department.

Appendix 2: Sankey Diagram of Estimated Energy Flows in 2007/8



Appendix 3: Features of Successful Policies Identified in the Energy Green Paper 2009

1.0 Well defined objectives

The objectives of an energy policy should be clear in order that they may best achieve their goal. For instance, are the objectives for Bermuda to reduce fossil fuel dependency, diversify our generation mix, lower the price of energy, to reduce greenhouse gas emissions, or any combination of these? Having defined these objectives, a policy framework should be designed to deliver a well defined set of national goals as they provide:

- Incentives to create legislation;
- Reasons to review existing legislation; and
- Assurance against obstructive legislation.

2.0 Making informed decisions

Effective policies must be based on the realities and limitations of the Bermudian environment. This requires informed decisions with regard to:

- Renewable energy resources, which must be well understood;
- Physical spaces available for development;
- Environmental impacts of developing particular technologies;
- Social aspects of prospective developments;
- Infrastructure limitations (road access etc.); and
- Grid access for alternative/renewable electricity projects.

3.0 Transparency and clear national policy

It is essential that the policy framework be clear enough that it may be used as the basis for obtaining funding from investors for alternative/renewable energy projects. By designing a framework to satisfy the financial realities of such projects they will have a much better chance of succeeding. Germany, for example, has used clearly defined rate structures based on the source of energy and has provided clear cut-off dates for these rates, which exceed the project lifetime. Transparent policies are also likely to attract more attention, particularly from foreign investors.

National policies will provide a clear and solid foundation on which to base a more detailed policy framework.

4.0 Accessibility

Policies should create opportunities that are equally accessible to all parties by carefully selecting criteria that will allow newcomers time to develop business strategies, and also by avoiding preferential treatment of any particular businesses. In the long-term, this should lead to a fair and competitive energy sector.

5.0 Encouraging a diverse market

Markets with more competitors are more likely to result in lower costs therefore creating policy that encourages competition between many individual entities is highly desirable. It also reduces the possibility of over-reliance on several large providers and ultimately creates a more robust market.

6.0 Duration

Many alternative and renewable energy projects have lifetimes of twenty or more years, so creating short term policies may lead to rushes of investment while the economics are favourable, followed by a flat market once the figures no longer favour a return on investment, or may lead to little if any investment at all. For example, if the rate paid for renewable energy was only guaranteed for five years, it would support wind over solar, as solar has a longer payback period. It would also favour projects that got off the ground within a year or so of the incentive, while discouraging latecomers

Policies should also be designed with the future development of alternative/renewable energy industries in mind, as opposed to simply focusing on meeting particular targets. This will inherently create policies that should serve to encourage the development of a stable industry. They should also take into account the eventual removal of support for particular technologies as they become competitive.

7.0 Consistency

Policies should be consistent with each other and with national policy objectives. Currently in Bermuda, wind turbines attract a duty rate of 33.5%, while solar photovoltaic panels have a duty rate of 0%; this is an example of an inconsistent policy.

Policy across different areas of government that influence the alternative and renewable energy sector must also be consistent in order to provide a secure environment for investors. In the UK, for example, there has been central government support for renewable energy, but progress has been delayed by regional planning departments refusing planning permission for developments. By ensuring consistency in policy across government, the risk of policies being undermined is minimized.

8.0 Periodic policy review: flexible yet stable

A certain degree of flexibility is important so that policies can be reviewed to ensure that their objectives are being achieved. Also, as technologies progress and developmental technologies reach the market, the level of support required is likely to change.

Spain and Germany for example, have both adjusted the rates paid for electricity generated from renewable energy to reflect a reduction in the costs associated with certain technologies. While this represents a change in policy, it has been designed to directly account for a separate change to market conditions, thus the overall economics of renewable energy projects should not be significantly affected and the overall policy on supporting renewable power generation remains stable, despite the change.

9.0 Appropriately supported technologies

It is desirable to design energy policies around Bermuda's indigenous resources, and the technologies that may effectively utilize them. The desired policy objectives may be specifically targeted with an appropriate combination of technology specific and technology neutral policy.

There will be some benefit in adopting technology neutral policies, such as open grid access independent of the technology. This would help to meet the objective of diversifying supply and encouraging competition in the marketplace. Technology neutral policies are also a more natural market-based mechanism, with the aim of adopting the most cost effective solution through market competition. Technology neutrality also has disadvantages:

- Companies may be able to take advantage of these policies to sell technologies that may not represent good value to the consumer;

- Natural market development may lead to an inappropriate mix of technologies as it may be desirable to have certain proportions of each technology for a stable energy infrastructure; and

- Certain developmental technologies may require additional support to become established.

Flexibility is essential when adopting technology specific policy, in order to react appropriately to new technologies as they emerge.

10.0 Policy support to match industry size

Policies should be designed to recognize that it may be harder for small, new technologies to penetrate an existing market, dominated by existing large industry players. Large existing companies may be able to internally support alternative/renewable energy projects at much lower rates of return than are required by small newcomers to the market. If the same support is offered to all, the larger existing players are likely to consume a large part of the resources allocated for the new technologies, which defeats the objective of encouraging uptake of these technologies to create a competitive market.

11.0 Recognition of questionable technologies

Certain technologies have been associated with environmentally unsustainable practices, such as the large-scale adoption of certain bio-fuels and hydroelectric schemes that involve the flooding of huge areas of land. It is important to recognize these technologies and to ensure that appropriate safeguards are in place so they may be developed in a sustainable manner.

12.0 Policies adequate for industry start-up

Jump-starting new renewable energy markets may require policies structured to help get the industry off the ground. This may not be economically efficient in the short term, but with clear objectives, it could accelerate the development of this new industry leading to long term self sufficiency.

13.0 Sustainability

To avoid boom and bust cycles, any resources allocated to support policy should be sustainable in the long term and take into account industry growth. The UK low carbon buildings program, for example, is the UK's principal means of supporting small-scale renewable energy technologies. The funding required to support the level of interest generated by this program was not initially designed in a manner that could meet demand, and the fund was quickly used up leaving start up businesses with few customers.

14.0 Energy market reform

Various aspects of energy markets will need to be reformed to facilitate the entry of new players. Market based systems involve more uncertainty and risk, which may increase the cost of investment, though eventually lower energy costs may be achieved through market dynamics.

Certification and licensing requirements will have to be designed with some degree of technology specificity in mind. The requirements for a utility-scale wind farm, for example, would differ significantly from the requirements for a rooftop turbine.

As most alternative and renewable energy technologies consist of many smaller generators, relative to conventional energy production, it is not appropriate to negotiate infrastructure access on a case by case basis. Instead, it is essential to have a streamlined and consistent policy, which allows energy producers access to consumers who wish to purchase their energy. The costs of connection and the use of infrastructure should be standardized and fair. If infrastructure upgrades are necessary for alternative/renewable technologies, the cost of these upgrades should be fairly distributed to encourage the uptake of these technologies.

Since the fuel for most renewable energy technologies is free, both in terms of economical and environmental costs, and it is usually not possible to store this energy, it is desirable to prioritize the use of energy from these technologies over the use of conventional technologies.

15.0 Well identified development zones

Allocating land and sea for the development of alternative/renewable energy technologies can occur prior to the actual development of any projects and link national targets to individual developments. This removes uncertainty related to locating these technologies and saves time during project design and planning. It also encourages forward thinking with regard to energy infrastructure development.

16.0 Informed stakeholder consultation

It is essential to involve all key stakeholders during the formation of policy to initiate and maintain communication between stakeholders. This communication will lead to the sharing of information, which in some cases will be vital to policy development. It will also offer a better understanding of stakeholder requirements, to ensure that stakeholder interests are properly accounted for.

17.0 Facilitating local ownership

Individuals are more likely to accept new technologies if they are able to invest in these technologies themselves and play a part in their development. Policies should be designed to encourage local ownership of new energy sources. Locally owned alternative and renewable energy technologies will ease the financial burden of increasing energy costs, which will also keep tens of millions of dollars in the local economy through the use of indigenous energy sources.

18.0 Administrative efficiency

It is important that for incentives to be effective, they should have a high level of administrative efficiency. Grants for renewable energy projects have often lead to short-term inundation of their respective departments in countries such as Germany and the UK.

Tax based incentives are often easier to administer than other forms of incentives because the knowledge, systems, and government organizations needed are often already in existence. As an example, in Bermuda, the Customs Officers are familiar with the application of various duty rates depending on the characteristics of the goods. Therefore it would be relatively straightforward to amend the Customs Tariff to support alternative/renewable energy and conservation/efficiency, without requiring additional staff support.

19.0 Informed consumers

It is essential that consumers are well informed about relevant policy, legislation and incentives as they hold the spending power to effect change. Informing consumers helps them make the decision to purchase the equipment or systems sooner than they might otherwise do so.

A study of technology deployment in Egypt, Ghana, and Zimbabwe found that information and awareness of technologies was one of two significant barriers towards implementation. However, the need for greater information on alternative/renewable technologies and incentives is not unique to developing countries. In the US, studies have shown that consumers who were interested in installing these systems and equipment in their homes and businesses were not fully aware of all the available incentives.

Appendix 4: Five Steps to Effective Energy Management

1.0 Get commitment

In order for energy management to be effective, there must be a commitment from the highest level of the organization. This commitment should be full and will need to establish clear accountability with managers/directors to ensure they implement recommended measures and are responsible for meeting targets. An official and written energy policy, signed off by senior management is a key requirement.

2.0 Understand your organisation and quantify energy use

The energy management matrix provided on the next page offers a means to assess how your organization deals with issues relating to energy management. Each column addresses a different organizational issue, while the five tiers indicate the level to which each issue has been addressed. To complete the matrix, work across one column at a time and check off the tier that is most appropriate for your organisation. A completed matrix offers an insight into how well balanced your energy management structure is and where there may be room for improvement. It is anticipated that many organizations in Bermuda fall into the lower tiers, which offers much potential for improving energy management.

Energy cannot be managed if it cannot be monitored. Therefore quantifying energy use with an energy audit is an essential next step in the process, and needs to address the following questions:

- Where is energy used;
- When is energy used;
- What type of energy is used; and
- How much energy is used?

Answering these questions should immediately highlight potential for savings. For example, it may be discovered that 20% of energy use occurs during evenings and weekends when the organization is not functional.

3.0 Plan and organise

This involves developing a realistic timeframe for achievable targets and prioritizing the actions by which they may be accomplished. It is important at this stage to tailor the plan specifically to the organization, taking advantage of its strengths while avoiding areas which will require excessive resource allocation. Energy management should at this stage be integrated into the existing management structure, allocating well defined roles and responsibilities to appropriate individuals.

4.0 Implementation

Initially undertaking low or zero cost measures helps to establish credibility for energy management and the potential for savings, whilst testing the previously established monitoring systems. As the full potential for these measures is reached, more capital intensive measures may be adopted to further enhance savings

By integrating energy management into general management systems, it merges with the other daily functions of the business and avoids it from being dismissed in the face of other priorities.

Energy savings may become tools for both internal and external public relations initiatives, thus gaining recognition for the results achieved. This is important as it will help to achieve sustained support from senior management.

5.0 Monitor energy management and update targets

Progress in the management of energy should be reported at regular intervals, this will allow for targets to be modified in light of any changes. By continually monitoring the effectiveness and having a floating target structure, savings can be maximized.

	Policy	Organising	Training	Performance measurement	Communicating	Investment
4	Energy policy action plan and regular review have active commitment of top management ☐	Fully integrated into management structure with clear accountability for energy consumption ☐	Appropriate and comprehensive staff training tailored to identified needs, with evaluation ☐	Comprehensive performance measurement against targets with effective management reporting ☐	Extensive communication of energy issues within and outside organisation ☐	Resources routinely committed to energy efficiency in support of business objectives ☐
3	Formal policy but not active commitment from top ☐	Clear line management accountability for consumption and responsibility for improvement ☐	Energy training targeted at major users following training needs analysis ☐	Weekly performance measurement for each process, unit or building ☐	Regular staff briefings, performance reporting and energy promotion ☐	Same appraisal criteria used as for other cost reduction projects ☐
2	Unadopted policy ☐	Some delegation of responsibility but line management and authority unclear ☐	Ad-hoc internal training for selected people as required ☐	Monthly monitoring by fuel type ☐	Some use of company communication mechanisms to promote energy efficiency ☐	Low or medium cost measures considered if short payback period ☐
1	Unwritten set of guidelines ☐	Informal mainly focused on energy supply ☐	Technical staff occasionally attend specialist courses ☐	Invoice checking only ☐	Ad-hoc informal contacts used to promote energy efficiency ☐	Only low or no-cost measures taken ☐
0	No explicit energy policy ☐	No delegation of responsibility for managing energy ☐	No energy related staff training provided ☐	No measurement of energy costs or consumption ☐	No communication or promotion of energy issues ☐	No investment in improving energy efficiency ☐

The Energy Management Matrix
(Reproduced from *'CTV022 – Energy management strategy'* with kind permission from The Carbon Trust)

Appendix 5: The Bermuda Image

"The Bermuda Image"[195] means the appearance of Bermuda resulting from a harmonious mix of natural features and man-made elements which produce a visual quality and a character of development which are distinctively Bermudian, including:

(a) a scale and massing of building which are compatible with the landform and a building design which sits comfortably in its setting;

(b) the balance and proportions of the traditional building form as exemplified in sturdy residential structures with white pitched roofs, and features and embellishments which distinguish local architecture;

(c) the use of traditional and natural building materials;

(d) plentiful, lush and colourful sub-tropical vegetation;

(e) gently rolling hillsides and dense vegetation which effectively blend to screen development and to maintain the illusion of open space and a natural appearance;

(f) Bermuda stone walls, rendered and painted stone walls, weathered rock cuts, hedging and planting alongside roads; and

(g) natural coves, bays, beaches, rocky coastline and islands, with views and glimpses of vividly coloured waters and the ocean.

[195] Government of Bermuda Department of Planning, (2010). *The Bermuda Plan 2008 Planning Statement.* Bermuda.