IDENTIFICATION OF POLICY FRAMEWORK OPTIONS AND ELEMENTS FOR ENHANCED EFFICIENCY OF ENERGY USE IN THE OECS STATES

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PREFACE

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EXECUTIVE SUMMARY

1.0 BACKGROUND

In order to respond to Member State concerns regarding the cost and reliability of energy security, OECS-NRMU has undertaken a study to determine options and opportunities for improved energy efficiency and energy conservation in the sub-region. Data gathering, analysis and identification of options and opportunities has been undertaken with respect to these issues, including work in Montserrat, St. Lucia and Grenada to identify, illustrate and confirm issues and options that exist across the sub-region.

2.0 RECOMMENDATIONS

2.1 RECAP OF MAJOR OBSERVATIONS

Productive energy (electricity, motive and stationary engine and other fuels) in most OECS countries is supplied almost exclusively by fossil fuels, 100 percent of which must be imported. Energy consumers are spending an increasingly large percentage of their disposable income to pay for energy, without any assurance from governments or utilities that programmes or policies will be implemented to stabilise or reduce energy costs.

The investigation underlying this report confirms that the OECS economies can generate significant economic benefits through investments in energy efficiency and renewable energy. It is estimated that there is an economic potential for energy use reduction in the range of 10% to 20%. In effect, these opportunities represent the potential for the OECS to embark on a ? sustainable energy initiative? that would result in significant environmental and social benefits as well. As in the case of other countries, there is the opportunity to coordinate or integrate this initiative with efforts to foster cleaner production in industry and commerce. To summarize, the key observations emerging from this investigation are as follows:

.1 There is currently no structured energy management plan or policy in the OECS.
.2 There is general agreement among stakeholders of the need and importance of energy management.
.3 Energy costs in the OECS are, on average, 200 - 300 percent higher than North American averages.
.4 There is a general lack of awareness of energy management among energy consumers, building designers, and facility managers.
.5 The potential for renewable energy utilizing wind and solar systems is excellent.

2.2 SUSTAINABLE ENERGY PROGRAM

In view of the findings in this report, it is recommended that the OECS establish a multi-year **sustainable energy** program commitment. For the purposes of discussion, this program should have the following vision statement:

OECS Sustainable Energy Program-Vision Statement

Improvements to the efficiency with which energy is used in the OECS economies, as well as increased utilization of renewable forms of energy, are the two cornerstones of the OECS Sustainable Energy Program. The Program is a key component of the OECS commitment to Cleaner Production. The Program provides the resources and structure to effectively meet practical and realizable objectives. This is a long-term commitment to ensure effective capacity building and sustainablity.

The OECS Sustainable Energy Program should be implemented consistent with the following principles:

.1 *Long-term Commitment*: Resources should be committed for a minimum 5 years. The experience in other developing country jurisdictions indicates quite clearly that a commitment of this degree is necessary to build capacity among trade allies, institutional staff and establish other critical program elements.

.2 *Practical Solutions*: The program should be oriented to providing practical solutions in meeting reasonable goals. A key advantage of this approach is that a small number of large energy users can be singled out for a near-term focus of activities with high potential for significant and short-term results.

.3 *Addressing Key Barriers*: The Program should be designed to address the key barriers impeding accelerated market penetration of energy management actions.

.4 *Measurement, Monitoring and Reporting*: The Program should be supported by an ongoing measurement and monitoring system which is critical to reporting on results relative to stated objectives.

2.3 TIMING AND STRUCTURING OF THE PROGRAM

On the assumption that this will be initially a 5 year Program, it is recommended that the roll-out presented below be considered for development and implementation of the Program. The proposed Work Breakdown Structure for the Program involves three components. All three components should be implemented in parallel, but the first two components should receive the most focus in the short term.

2.4 PROGRAM COMPONENT # 1: BUILD AND MAINTAIN THE PROGRAM

The objective of this component should be to establish the foundation for Program success through development of the Program approach, identity, administration and professional capacity. This work component should focus on developing and maintaining the Program operation. To be effective the Program should achieve a professional capacity to deliver its services and develop an administrative regime to track and manage its budget. The work activities should include:

.1 *Complete program design*: This will require extensive consultations with key stakeholders in the OECS as well as externally.

.2 *Establish funding and structure*: There is a strong potential for the OECS to seek support from various international development banks and bilateral agencies for some co-funding of the Program. It will also be important to secure some funding from each OECS state in order to demonstrate commitment to the program prior to applying for funding.

.3 *Establish and maintain Program allies*: This will involve establishing a regular forum and structure for communication among key allies such as utilities, government agencies, and industry associations (e.g., Caribbean Association for Sustainable Tourism).

.4 *Develop internal capacity*: This will involve the design and implementation of a training curriculum for Program staff. To expedite this action and reduce costs , existing curriculum from other jurisdictions should be examined for their potential adaptability for use in the OECS.

.5 *Develop policy, legislative and regulatory proposals*: This will create the basis for the sustainability of the initiative.

.6 *Operate to initiate program*: The Program will assemble, negotiate and market projects designed to generate certified greenhouse gas emission reduction credits.

2.5 PROGRAM COMPONENT #2: EDUCATION AWARENESS AND CAPACITY BUILDING

The objectives of Program Component #2 should be to: increase awareness among large and small energy users and energy management (EM) trade allies of the economic and environmental benefits of energy management opportunities; demonstrate technologies, methods, and techniques necessary to implement successful EM projects; build capacity among the trade allies to deliver quality and reliable EM services and products; and reduce risk, in the short term, associated with energy management investments. This Program Component should comprise a range of activities designed to educate the market on energy management opportunities and create awareness as the basis for generating demand for EM products and services.

Some of the key program activities should be:

.1 Demonstrations (general and for the large users):

.2 Education and Awareness activities for the public
.3 Trade Ally Capacity Building

2.6 PROGRAM COMPONENT #3: TRANSFORMATION OF THE INSTITUTIONAL ENVIRONMENT

The objective of this Program Component should be to help develop the institutional environment and capacity necessary to catalyze and foster a sustainable energy management market.

This Program Component relates to the capacity among OECS institutions to introduce fundamental policy, legislative and other changes necessary to address several crosscutting barriers to EM. The recommended activities include:

.1 *Foster studies necessary to assess and offer solutions to key institutional barriers*; This would include the transportation sector, which traditionally has been the most difficult of the sectors in which to foster EM. This should also include establishment of a research chair in energy efficient design that can assist with the training of future leaders of energy management projects and programmes in the OECS.

.2 *Mandate testing of energy using products*. The focus would be on those products that represent the bulk of energy use and emissions (lighting, air conditioning, motors, boilers, domestic appliances, etc.) This testing would become the prelude to an eventual energy performance labelling initiative.

.3 *Revise national building codes*. This would include minimum standards for energy performance in new construction.

.4 *Impose a regulatory regime under which electric utilities would effect energy management*. Electric utilities would be required, and have financial leeway, to develop and implement EM programs.

.5 ***Remove or reduce import duties on EM products***. These products would include energy efficient products (high efficiency appliances, lamps) and renewable energy technologies such as DHW solar units, photovoltaic systems, and wind turbines.

1.0 INTRODUCTION

The energy sector in the Caribbean and Latin American region is very diverse, with large differences between countries and sub regions. These differences can be attributed to economic conditions in each country, energy policies of governments and financial institutions in each country, institutional capability relative to energy management, availability of indigenous energy strategies and infrastructure, level of energy consumption, and geographic isolation.

However, despite many barriers, many new energy strategies are being implemented throughout the region[1]. Also, governments throughout the region have been urged to develop energy policies designed to encourage efficiency and development of renewable technologies. Utilities in the region require a regulatory framework that will allow implementation of actions called for in such policies[2].

Many governments and industries, that were initially sceptical of the problem of global warming, are now agreeing with the increasing amount of scientific evidence corroborating the claims made during the Kyoto conference on global climatic change. With this change in attitude has come renewed interest in the environmental and financial benefits of progressive energy policies. For example, large North American industries are now accepting proposals from around the world for energy management initiatives that will lead to measurable reductions in greenhouse gas emissions. This method offers countries in the region a potential source of funding for their programmes; other potential funding sources may be available as well.

This report summarizes the results of an energy study of the OECS countries within the region,

1 The Latin America Report, The Multilateral Development Banks Energy Project, Institute del Tercer Mundo, 1997, Summary, p. 1.

2 Resolution and Model Energy Policy, Caribbean High level Workshop on Renewable Energy Technologies, 1994, p. 135.

which has just been completed by Lewis Engineering. The study examined current energy usage and policies, and developed recommendations for future energy management initiatives.

2.0 OBJECTIVES

The initial objective of this study was to conduct a review and determine of the current state of energy efficiency and conservation programs, policies, and projects in the OECS. This review, encompassing both existing documentation and personal interviews, provided a baseline overview of the energy sector in the OECS, with reference to regional trends and strategies. The study then identified opportunities for energy management initiatives in the region.

A review of relevant case studies of energy management initiatives in the region was used to analyse the lessons learned, and to determine their suitability for the OECS. The options available for enhancing energy efficiency in the OECS was then examined and discussed, along with perceived and actual barriers to implementing regional energy management programs. The final objective was to develop a set of recommendations that can serve as the framework for development of a regional energy management policy for the OECS.

3.0 BASELINE CONDITIONS

3.1 CURRENT ENERGY SITUATION

3.1.1 Energy Consumption

Electrical energy consumption, on an annual per capita basis, in the OECS ranges from a high of 2,026 kW.h in St. Kitts to a low of 495 kW.h in Dominica. These values are based on 1998 statistics. Figure 1, on the next page, shows graphically the relative difference in consumption between the OECS countries and also shows comparisons with Barbados, Jamaica, and Canada[3]. It is readily apparent that compared to Canada, none of these countries have a high level of energy consumption. The consumption levels in St. Kitts and BVI are comparable to the levels in Barbados and Jamaica, suggesting a higher level of development or industrialization compared to other countries of the OECS. Most large electrical appliances observed were low to medium efficiency.

Most light fixtures observed were low efficiency. Many light fixtures and appliances being sold in stores could not be legally sold in Canada or the U.S. because they do not meet the mandatory minimum efficiency standards in each country=s energy efficient appliances act.

Information from the St. Lucia Department of Statistics indicates that 32% of electrical energy production is consumed by the residential sector and 46% by the commercial sector, including hotels. The industrial sector is less than 5%, indicating a low level of industrialization, which is common throughout the OECS. 3.8% of the electrical energy production is for internal use within the utility and a surprising 12% of production is attributed to losses in transmission[4]. This high loss value suggests the transmission voltage is too low, and/or the energy is being stolen, and/or the revenue meters are improperly calibrated. Normal utility line losses in a small distribution system should be no higher than 3 - 4%.

Consumption of other energy, mostly motor fuels, is also low compared to Canada. Despite the fact

[3] http:www.worldskip.com

[4] http://www.stats.gov.lc

that there are a large number of private automobiles in each country, relative to population, the distances travelled are relatively short. This accounts for the difference of consumption. Liquified propane gas is used as cooking fuel in many commercial restaurants and larger hotels and homes. Exact consumption figures could not be obtained, but this does not represent a large portion of the overall energy consumption in any country of the OECS.

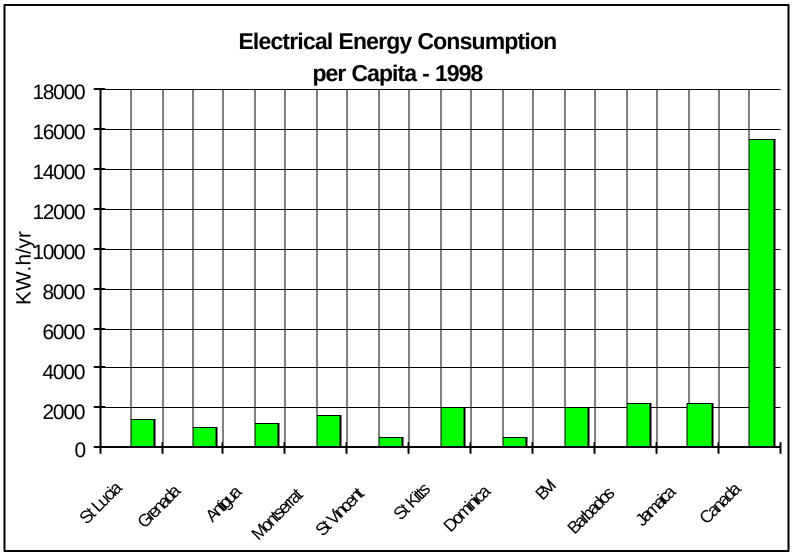
3.1.2 Energy Pricing

Electrical energy prices in the OECS countries visited ranged from $0.487/kW.h (E.C.) for small residential customers in St. Lucia to $0.68/kWh (E.C.) for commercial customers on Montserrat. These rates include a fuel surcharge amounting to between $0.14 and $0.17 per kW.h. This surcharge is based upon the price of fuel relative to a benchmark, and is calculated monthly in most countries. All pricing is based upon energy only, with no demand pricing. The energy is priced by sectors, typically residential, commercial, and industrial. Within the residential sector the first block of energy, typically 100 - 200 kWh, is priced 10 - 15% lower than the remaining energy. Other sectors have price structures based upon delivery voltage, with higher delivery voltage energy price being 10% less than low voltage energy. Some industrial sector rates require the customer to reduce load during the daily high demand period between 6:00 and 9:00 p.m.

Despite electricity prices that are four or five times higher than average rates in Canada, we learned that electricity rates in most of the OECS countries are still heavily subsidized by government. In Montserrat, the electric utility received its diesel fuel for a subsidized price that is less than half the retail price. Despite this, the utility is still falling short of covering its production costs by 15% per year. Without any means to make a profit, the government owned utilities cannot establish any reserve funds to cover infrastructure upgrades and expansion. They must, instead, ask government for special funding to cover this work. The only exception to this that we observed, was in Grenada where the utility, privatized for five (5) years, has been profitable and is investing in new diesel generating units and new metering technology.

Figure 1. Energy Consumption per Capita in Selected Countries 1998 figures

Country	Population	Annual Electrical Energy Consumption (GW.h/yr)	per Capita Consumption (KW.h/yr)
St Lucia	138000	199	1442
Grenada	97000	98	1010
Antigua	69000	84	1217
Montserrat	5500	9	1636
St Vincent	110000	60	545
St Kitts	39000	79	2026
Dominica	74700	37	495
BVI	19500	39	2000
Barbados	274540	625	2276
Jamaica	2652689	5939	2239
Canada	31281092	484515	15489



Other energy sources in OECS countries typically consist of motor fuels, fuels for stationary engines and boilers, and cooking fuels. Gasoline prices in the OECS countries visited averaged $1.43 E.C. per litre, which is roughly equivalent to the price today in Canada and much lower than Europe. This price, as well, was reported to be heavily subsidized.

An end to government energy price subsidies, while distressing to consumers in the short term, will provide governments with additional working capital to invest in energy management initiatives, and the higher energy prices will be the incentive consumers need to participate in conservation and efficiency programs.

3.1.3 Energy Supply

All countries of the OECS, with the exception of Dominica and St. Vincent, rely exclusively on diesel engines to generate electricity. Hydro power on Dominica and St. Vincent accounts for 10-20% of total capacity, with the remainder provided by diesel generation. Some exploration of other sources such as wind, geothermal, hydro, photovoltaic, and solar thermal systems has been undertaken, but we were unable to discover any commercial installations that are currently operating.

Fuels for electrical generation as well as motor, industrial, and cooking fuels are imported to each country in bulk, and distributed to industrial customers, wholesalers, and retail outlets. There are no gas or oil reserves under exploration or development in any OECS countries at this time. However, a great deal of petroleum reserves exist in the region, principally in Venezuela, Trinidad, and Mexico; the region contains over 12% of the world's known oil reserves[5].

Both oil and natural gas production in the region has increased in recent years. Compressed natural gas (CNG) is now transported via tankers from the region to overseas markets. Within the region, CNG terminals have been set up to handle and distribute CNG to utilities and industry. Puerto Rico has recently completed construction of a CNG terminal and CNG fired power plant. None of the OECS countries, however, have sufficient energy demand to justify the large cost of developing

5 OrganizacPon Latinoamericana de EnergPa (OLADE) website: http://www.olade.org.ec/idiomas/ingles

CNG facilities.

Combustion of fossil fuels releases large amounts of greenhouse gases into the atmosphere and contributes to the overall warming of the planet. Global warming should be of particular concern to small island states such as those in the OECS due to the damaging potential of rising ocean levels attributed to global warming. In the OECS each year , over 120,000 tonnes of diesel fuel is burned to generate electricity. This generates over 350,000 tonnes of carbon dioxide emissions into the atmosphere as well as emissions of sulphur dioxide and nitrogen dioxide which contribute to global warming and air pollution. Motor vehicles contribute a similarly large amount of pollutants each year. Reduction of energy consumption through conservation and increased efficiency can have a major beneficial impact upon the environment by reducing emissions from power plants and motor vehicles.

3.2 CURRENT ECONOMIC AND INSTITUTIONAL SITUATION

The OECS countries all have much lower per capita income and per capita GDP than more developed countries in the region such as Barbados or Trinidad. Each country has a large annual trade deficit due to the fact that each country is so reliant upon imports to provide the everyday needs of its citizens. Most countries are reliant upon tourism, bananas, and sugar for the majority of the capital flowing into each country. This situation results in a small taxbase, and limits each country's government from raising sufficient revenues to embark upon new programs. Most institutional strengthening, particularly within the health, education, and transportation sectors, is dependent upon foreign assistance.

Region-wide, there have only been a select few initiatives of energy efficiency or energy conservation such as demand side management. These efforts are largely localized, with no large-scale centralized programs in effect. Of these, many of the successful programs have been implemented by non-governmental organizations or small companies.

The Inter-American Development Bank (IDB) and the World Bank (WB) are the two international financing institutions most actively involved in development projects in the region. Although they

have energy efficiency and energy conservation programs that they promote and finance, it appears that such projects in the region have received little attention from these institutions.

With regard to the IDB's financing of energy generation projects in recent years, ten are in support of coal, oil and natural gas, and nine support renewables (geothermal, wind and hydroelectricity). There are no IDB loans for solar, biomass or mini-hydro projects. The IDB has had five projects that contain energy efficiency elements in recent years[6].

During 1993 - 1997 the WB funded three projects on renewables involving hydroelectric and biomass sources. The WB portfolio shows no recent funding for solar, geothermal, mini-hydro or wind projects. The Global Environment Facility within the WB implemented one renewable project in recent years in the whole region. This was the 1992 Tejona Wind Power project in Costa Rica. With regard to energy efficiency, in the same time period the WB financed one project with an energy conservation component and one project with a demand-side management program[7].

In recent years the WB International Finance Corporation (IFC) supported nine hydrocarbon projects, two hydroelectric, one wind, and one bagasse project[8]. However, in February, 2000, the IFC launched a new program called the Renewable Energy and Energy Efficiency Fund (REEF) for Emerging Markets, which could be applicable to future energy projects in the region, and may provide the incentive for more renewable energy and energy management projects to proceed.

Overall, energy efficiency programs have received little attention in the region. It is estimated that 10% to 20% of current energy consumption could be saved through more efficient energy use throughout the region. During the period 1980 - 1995, there is evidence of a net decrease in energy efficiency in the whole region, as reflected in the energy consumption / Gross National Product (GNP) indicator. Only Jamaica, Uruguay, and Guyana improved their energy efficiency situation

6 The Latin America Report, The Multilateral Development Banks Energy Project, Instituto del Tercer Mundo, 1997, Summary, p.5-8

7 IBID

8 IBID

during this time[9]. This net decrease in energy efficiency in the region as a whole can most likely be attributed to the predominant development model, which fosters urban growth and consumerism[10].

Some commercial organizations such as the Caribbean Hotel Association (CHA) have sponsored educational programs in energy management. These courses were offered to members and non-members of the CHA at a nominal cost. Response has been described as poor to fair in the countries in which the program has been offered.

3.3 CURRENT GOVERNMENT AND UTILITY PROGRAMS AND POLICIES

With regard to energy conservation or efficiency programs currently offered by governments or utilities in the OECS, we were unable to find many examples. In the countries visited, it was mentioned that import duties and consumption taxes on energy conserving products such as solar water heaters or windmills would be waived or reduced. We were unable, however, to obtain written confirmation of this policy being legislated.

There is a long history in this region of discussing policies and procedures for energy management and renewable energy technologies. Official policies and studies have been developed by several organizations including the Caribbean Association for Suitable Tourism, Caribbean Council on Science and Technology, and the Centre for Environment and Development at the University of the West Indies. The general consensus reached by these groups is that energy management is a worthwhile achievable goal that will pay large dividends to the countries that choose to implement a program.

In Grenada the electric utility is private, and it has been negotiating with some of its largest customers about implementing some demand side management strategies in order to reduce the daily system demand spike. These strategies have included an education campaign for customers on demand side management and load shifting. The ultimate objective is to install electronic demand

[9] IBID

[10] IBID

metering for their largest customers that will allow these customers to have access to their consumption records and profiles via the Internet.

The Caribbean region has several examples of successful government and utility sponsored energy management programs. Section 5 of this report describes programs in Barbados, Bermuda, Jamaica, Guadalupe, and Martinique. The success of each one demonstrates that the energy consumers of the region will gladly participate in these programs when these customers are properly informed and sufficiently motivated.

4.0 OPPORTUNITIES FOR ENERGY MANAGEMENT

4.1 NEW TECHNOLOGY APPLICATIONS

4.1.1 Residential Sector

Figure 2 shows typical consumption figures and efficiency opportunities for a typical residence in the OECS. Energy use is not large. Most residences, including the one in this example, are not air conditioned, and rely instead upon shading and natural ventilation to keep them comfortable. The major energy uses are the kitchen appliances. Replacement of a home refrigerator with a higher efficiency model does not appear to have a good payback, but installation of high efficiency lights and a solar hot water heater show good potential. The residence example in Figure 2 uses an electric stove for cooking, which explains the high percentage of consumption attributed to this activity. Some residences and most hotels use propane gas for cooking. The use of solar energy for cooking was not observed and is not considered practical for most homeowners.

Installation of photovoltaic panels to supply a small residential load has been demonstrated in rural areas of Jamaica that were currently not grid connected. When the cost of grid expansion is factored in, the photovoltaic option appeared viable in the demonstration. Since very few residences in the OECS are not grid connected, there seems to be limited opportunity for the technology and its current cost. Our analysis suggested that over a ten (10) year lifespan, the photovoltaic system would supply a small residence at roughly 10% above the current residential electric rate. This analysis indicates that, with continued technical improvements and price reductions, photovoltaics may be viable even in grid supplied areas in a few years.

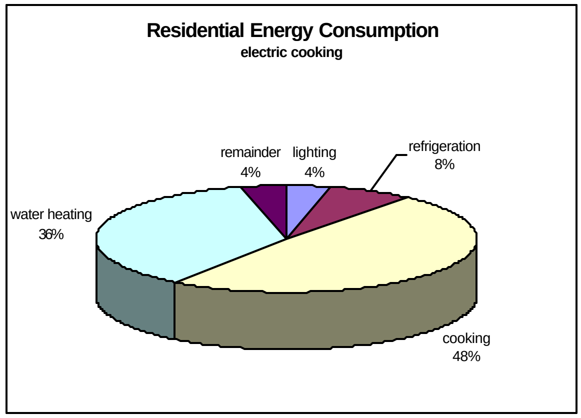
4.1.2 Commercial Sector

This sector is dominated in most OECS countries by the hospitality business, comprised mostly of hotels, guesthouses, and restaurants. Figures 3 and 4 show the typical energy use breakdown for a six (6) guestroom hotel or guesthouse and for a 100 room hotel. The largest energy users are air conditioning and hot water production.

Figure 2. Typical Residence

Residential Electrical Consumption

lighting	3.50%
refrigeration	7.50%
cooking	49%
water heating	36%
remainder	4%



Potential Energy Improvements

Item	Installed Cost ($EC)	Annual Savings ($EC)	Payback (yrs)
replace incandescent bulbs with CFL's	464	99	4.7
replace refrigerator with high eff model	1800	160	11.2
replace electric water heater with solar heater	3622	1432	2.5

Notes:

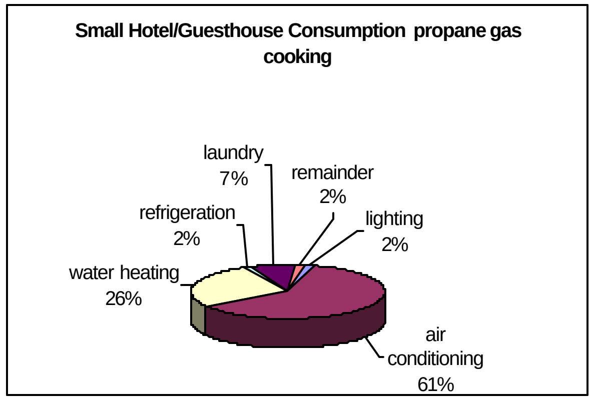
- all costs are in EC$
- calculations are based on energy pricing supplied by LUCELEC

Figure 3. Typical Small Hotel/Guesthouse

- 6 guest rooms

Electrical Consumption

lighting	1.70%
air conditioning	61.70%
water heating	26.30%
refrigeration	1.50%
laundry	7.10%
remainder	1.70%



Potential Energy Improvements

Item	Installed Cost ($EC)	Annual Savings ($EC)	Payback (yrs)
replace incandescent bulbs with CFL's	2204	561	3.9
replace refrigerators with high eff models	2800	320	8.8
replace electric water heater with solar heater	10278	11900	0.9
install high eff air conditioners (EER 11)	15600	7609	2.1
insulate attic above conditioned spaces	3000	4360	0.7

Notes:

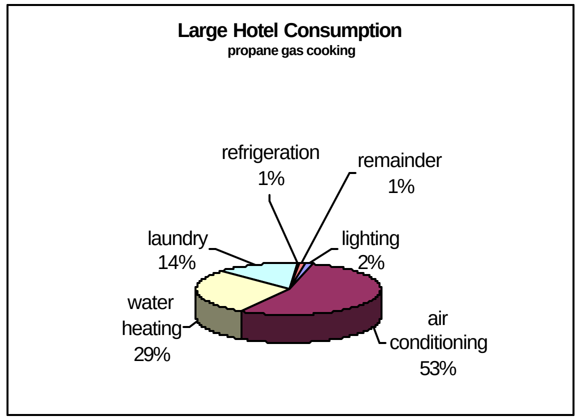
- all costs are in EC$
- calculations are based on energy pricing supplied by LUCELEC

Figure 4. Typical Large Hotel

- 100 guest rooms

Large Hotel Electrical Consumption

lighting	1.60%
air conditioning	54.20%
water heating	28.60%
laundry	14.30%
refrigeration	0.50%
remainder	0.80%



Potential Energy Improvements

Item	Installed Cost ($EC)	Annual Savings ($EC)	Payback (yrs)
replace incandescent bulbs with CFL's	25520	6832	3.7
replace a.c. units with central chiller and fan coils	1018000	190000	5.4
replace electric water heaters with solar heaters	105000	179100	0.6
install high eff air conditioners (EER 11)	203000	99000	2.1
insulate attic above conditioned spaces	8000	11300	0.7
install digital control system	70000	34000	2.1

Notes:

- all costs are in EC$
- calculations are based on energy pricing supplied by LUCELEC

Other major users are lighting and laundry appliances. As demonstrated in Figures 3 and 4, the application of new technologies can result in rapid investment recovery. The two best examples are attic or roof insulation above conditioned spaces, and replacement of electric hot water heaters with solar units.

In the large hotel scenario, replacement of standard efficiency room air conditioners (EER8) with high efficiency units (EER11) offers a more attractive payback than the option of installing a central chilled water system and distribution piping. The chilled water system is more efficient and offers a higher EER (18), but is not as attractive due to the higher cost of installing the distribution piping in an existing building. For new construction where the total cooling load exceeds 350 kW, a central chilled water system will prove to be the most cost effective solution over the expected life of the building.

Digital control systems in large hotels are also a good investment. These refer to an automated system of room sensors that automatically reduce power consumption in guestrooms that are unoccupied. These systems are typically activated by an electronic room key that will switch the room from >unoccupied= to >occupied= mode. These systems typically offer the flexibility of shutting off all or part of the rooms electric circuits powering such things as lights, television, air conditioners, and radio.

Lighting represents less of the total load in hotels than it does in office buildings (Figure 5), but the usage is significant enough that retrofitting of existing light fixtures with high efficiency fixtures offers a reasonably attractive payback. For interior applications, T8 fluorescent tubes and compact fluorescent lamps offer the best savings with minimum fixture modifications. For exterior lighting, compact fluorescent, metal halide, and high pressure sodium lamps will provide good energy savings, compared to the current standard of incandescent and mercury vapour lamps.

The hospitality industry also uses large amounts of energy for cooking and laundry. The use of electric dryers in the laundry represents the largest portion of the load. Dryers that use other energy sources to provide the drying heat are cheaper to operate. These include propane and steam heated dryers. Solar heating can also be used to provide the heat source for drying, although in larger

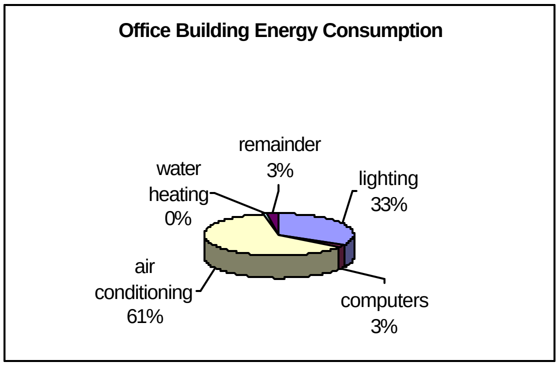
hotels with large laundry demands, it may not be able to provide the high

Figure 5. Typical Large Office Building

- 5 floors @ 10000 sq ft per floor
- 50 hours per week normal operating hours

Office Building Electrical Energy Consumption

lighting	32.70%
computers	2.80%
air conditioning	61.20%
water heating	0.40%
remainder	2.90%



Potential Energy Improvements

Item	Installed Cost ($EC)	Annual Savings ($EC)	Payback (yrs)
replace 40 watt fluorescent tubes with high eff 34 watt	33750	21150	1.6
replace air conditioners with central chiller and fan coils	1240000	139300	8.9
replace electric water heaters with solar heaters	3622	1791	2
install high eff air conditioners (EER 11)	312000	48800	6.4
insulate roof	30000	16169	1.9
install digital control system	40000	26800	1.5
replace 40 w task lights with 15 w CFL's	5800	1490	3.9

Notes:

- all costs are in EC$
- calculations are based on energy pricing supplied by LUCELEC

heat that allows rapid drying required by busy hotels. A recent European dryer design has a mixture condensing core and recirculates the air in the dryer, eliminating the need for an external vent, and improving energy efficiency greatly. These units, however, are slower than conventional electric dryers, and are not yet available in commercial sizes. Commercial dishwashers that include heat recovery on the wastewater are readily available and many existing dishwashers can be retrofitted with wastewater heat recovery systems. Depending upon the amount of use the dishwasher gets, these systems can offer good paybacks.

4.2 ENERGY CONSERVATION MEASURES

4.2.1 Commercial Sector

During discussions with owners and managers of commercial properties in St. Lucia, Grenada, and Montserrat, the overriding concern about implementing energy conservation measures was initial capital cost. Many commercial establishments find it difficult and/or expensive to raise money for capital improvement projects.

However, there are examples of conservation programs in commercial buildings achieving significant savings with very little investment required. A government office building in St. Lucia was able to reduce its annual electrical energy consumption by close to 15% through a staff energy awareness program. That program educated employees in the building to be vigilant about switching off energy using appliances within their workspace when not in use. Lighting levels in most open office areas were reduced with no complaint from workers about lack of sufficient ambient light. Building cleaning and security staff were instructed to ensure that all air conditioning equipment was switched off after hours, and only a minimum number of lights left on to allow cleaning and security patrols. The initial 15% saving has fluctuated over the years, as staffing levels and building operating hours have changed, but the underlying approach is still valid, to empower people to control energy use to suit their own requirements.

In the hospitality industry, it is not as practical to ask guests to switch off unnecessary appliances when not in use. One campaign with hotel guests that has been successful is voluntary reuse of

towels and bedding without daily laundering. Guests are asked to place a card on the bed if they do not require fresh bedding. The bed is then made without changing and laundering the sheets. Similarly guests are asked to place towels they want replaced on the floor or in the bathtub. Other towels will be hung back on the towel rack for reuse. This measure costs the hotels very little but saves thousands of litres of water annually, as well as the energy required to heat laundry water and to wash and dry that laundry. This program would have a doubly beneficial effect in OECS countries, due to the high cost of supplying both potable water and electricity.

One potential method of funding more expensive energy conservation measures, such as installation of solar hot water heaters, more efficient air conditioning systems, or digital control systems is using an Energy Services Company (ESCO). An ESCO is a company that offers services to implement energy conservation measures in a facility at no up front cost to the customers. The ESCO recovers its investment by receiving a portion of the savings from the facilities utility bill over a contracted period of time. The ESCO business has been successfully operating in North America for over twenty (20) years and has now been spreading to other parts of the world. This concept was mentioned during discussions with commercial facility owners and managers in St. Lucia, Montserrat, and Grenada and there was a high level of interest. Table 4.6 provides a summary of the energy conservation measures (ECM) undertaken at four Jamaican hotels by an ESCO business based in Jamaica.

4.2.2 Residential Sector

Opportunities in the residential sector are, as mentioned earlier, concentrated in lighting, appliances, and hot water production. Capital investment in improved technology for efficiency gains will be difficult for many homeowners. A residential solar hot water program in Barbados has been very successful in converting residential hot water production form electric to solar. One reason for this success was that the government provided up front financing for the units, and allowed homeowners to defer repayment until the following year. This financial incentive coupled with a good public relations and marketing campaign, has resulted in the installation of solar units on approximately 1/3 of the residences in Barbados. Most homeowners have seen paybacks of 2.5 years.

Table 4.6
Summary of ECM Undertaken at Jamaican Hotels

ECM	Annual Savings				Payback in Years	Return on Investment
	KW.h	% Total Savings	kW	Cost (US$)		
80 gallon/day retrofit solar water heating system	3,964	96%	9	540	2.0	42%
ASensorstat≅ guest room occupancy sensor controller	339,187	30%	-	39,919	1.6	57%
Replaced mini-split with water cooled hi-efficiency 100 ton screw chiller	198,000	31%	44	22,980	3.3	24%
Roof insulation with spray applied polyurethane foam	23,350	72%	-	21,780	1.7	52%
Install 100 ton air conditioner retrofit heat exchanger to produce hot water	108,308	8%	-	11,914	0.4	241%

The solar fraction throughout the OECS is similar to Barbados, and energy costs are as high or higher, so there is no reason to believe that a similar program could not succeed in some or all of the OECS.

ESCO involvement in the residential sector would be difficult due to the small loads and large numbers of potential customers. A better solution likely lies with government or utility sponsored incentive programs to encourage homeowners to purchase energy conserving products. An energy efficient appliance act, similar to Canada or the United States, would mandate minimum efficiency standards for household appliances that could be sold in the country. A public awareness campaign run at the school, business, and household level would be designed to educate people about the value of energy, and of the importance and financial benefits of conserving.

A great deal of new residential construction is also ongoing in most countries of the OECS. This presents an opportunity to ensure that newly constructed homes will be more energy efficient than

older homes. To achieve this, the building code should be amended to include energy efficiency as one of the design criteria. The most common mistakes seen in new construction were improper orientation or siting to take advantage of natural ventilation from prevailing winds, inadequate shading from direct sun, a lack of solar hot water heating, and lack of roof insulation. The adaptation of energy provisions in the building code will also require a program of training and certification for builders in order to ensure that they are qualified to construct buildings to the new code standard.

4.2.3 Transportation Sector

As mentioned previously, most transportation in OECS countries is by private motor vehicle. There was no evidence found of regularly scheduled public transportation or alternate energy vehicles. Most of the urban areas observed were not designed with the automobile in mind. Most streets are narrow, with little room for on street parking or sidewalks. The large number of vehicles on these narrow streets results in traffic congestion with many vehicles idling in traffic using up valuable petroleum resources without getting anywhere. Building larger roads is not a practical solution in these densely populated urban areas when available land is scarce and expensive.

A much better alternative is to encourage people to use public transportation for the majority of their short distance trips. None of the countries visited had a public transportation system, and bus and mini bus operators do not frequently cooperate to provide regular reliable scheduled service. For this reason, all the buses tend to be on the streets during morning and evening rush hours, and the remainder of the time they are difficult to find. People will only be convinced to leave their cars at home and use public transportation if the service is reliable, convenient, safe, and provides good value. Further encouragement to use the service could be achieved through increased motor fuel taxes, vehicle registration fees, and reducing the number of parking spaces in urban centres. The benefits of such a program will be not only reduced energy consumption in the sector, but also reduced levels of air pollution and freeing up space to make urban centres more pedestrian friendly. This last factor has proven to be important in improving tourist traffic and commercial development in urban centres.

Other approaches in this sector could include encouragement for the use of zero emission vehicles such as bicycles and electric cars. Traffic patterns could be altered on some streets to give priority to zero emission vehicles and public transportation vehicles. Government or utilities could implement a pilot project by converting some or all of its vehicle fleet to electric vehicles. Once people see these vehicles on the street, they will see that they can function quite well. Tax incentives and reductions in import tariffs for zero emission vehicles will also assist in encouraging people to consider alternate methods of transportation.

The fishing industry in the OECS relies heavily on outboard motors for most small boats. Table 4.7 shows a much higher number of outboards used rather than inboards. Outboards are available in smaller sizes and can provide propulsion for even very small craft. Inboard engines are much more fuel efficient and reliable, but are generally available only in larger sizes. The large discrepancy toward outboards is more indicative of the size of most of the fishing vessels than a deliberate decision not to use inboards. Opportunities for conservation here most likely requires reducing the number of small fishing boats and standardization on larger, more efficient vessels.

4.3 APPLICATION OF ENERGY EFFICIENT PROCEDURES

4.3.1 Commercial Sector

As previously mentioned, opportunities for reducing energy consumption in commercial facilities need not involve large capital investments in newer, more efficient technology. A well structured program can allow significant reductions through better control of a facility's energy use. Energy efficiency can mean the efficient use of existing energy appliances and systems. Some common procedures that can improve efficiency include:

.1 Raise the temperature in air conditioned spaces. Many people in these spaces complain about being too cold. For a lightly clothed person performing light work, 80EF and 50% r.h. is quite comfortable and will require considerably less energy than maintaining a space at 75EF and 50% r.h.

Table 4.7

Propulsion Systems Used by Commercial Fishing Boats in the OECS - 1997

Location	Outboards	Inboards	Note
St. Vincent	311	18	95% of outboards < 75 hp 80% of inboards > 100 hp
St. Lucia	798	6	98% of outboards < 75 hp 100% of inboards > 100 hp
St. Kitts	133	34	90% of outboards < 50 hp 85% of inboards > 75 hp
Antigua	330	135	75% of outboards < 100 hp 85% of inboards > 100 hp
Montserrat	24	7	95% of outboards < 50 hp 85% of inboards > 75 hp
Grenada	734	81	90% of outboards < 100 hp 100% of inboards > 100 hp
Dominica	576	2	90% of outboards < 75 hp 100% of inboards > 100 hp
British Virgin Islands	74	36	69% of outboards < 100 hp 95% of inboards > 100 hp

.2 Use operable windows, window blinds and shades, and ceiling or portable fans to keep building interior comfortable without the need for as much, or any air conditioning. Moving air increases evaporative cooling from people=s skin.

.3 Ensure all non-essential energy using appliances are shut off when not in use.

.4 Shut off unnecessary lights, especially those close to windows during the day, and those in

occupied areas (occupancy sensors could be used for this). Use task lights for reading or other work requiring additional light.

.5 Use cold water for laundry. Use laundry detergents specifically formulated for cold water use.

.6 Instruct staff in the proper efficient use of all energy using appliances.

.7 Offer hotel guests the option of two (2) day laundry cycles instead of daily for bedding and towels.

.8 Keep refrigerators and freezers full, and shut off units not required.

4.3.2 Residential Sector

Many of the items previously mentioned for the commercial sector will also be applicable in this sector. The majority of properties in this sector use much less energy per capita than the commercial sector, however, so the savings associated with many of these procedures will not be as significant. The size and growth of the sector, however, make even small savings per residence significant if applied to the entire sector.

The electrical utilities interviewed during our site investigation all had a similar daily demand profile. It showed a reasonably consistent load from 9:00 a.m. to 5:00 p.m., followed by a sharp increase to a peak occurring between 7:00 p.m. and 9:00 p.m., followed by a gradual decrease to an overnight low between 2:00 a.m. and 6:00 a.m., then an increase back to the daily load plateau at 9:00 a.m. The daily load plateau is attributed to commercial, institutional, and industrial loads, as well as residential. It usually does not present a capacity problem for utilities.

The evening demand spike, however, is attributed mainly to the residential sector. People coming home from work and school begin turning on lights, television, kitchen appliances, and using hot water. It is this spike that utilities must provide additional generating capacity to satisfy, and this additional generating capacity is otherwise under utilized. As overall system capacity grows, utilities

are forced to invest in new generating capacity sooner to meet this peak. They have, therefore, acknowledged that it is in their best business interest to encourage conservation and efficient energy use procedures, especially during the peak use periods.

A consumer awareness campaign has been started in Grenada using pamphlets distributed to customers when they pay their bills. These pamphlets describe the various components associated with determining the price of electricity and instruct people of the importance of not using electricity unnecessarily. Further education attempts should be targeted to the schools, since children are more attentive to the message delivered and they can take that message home and apply it.

4.4 NEW GENERATION OPPORTUNITIES

4.4.1 Renewable Energy Generation

From a renewable energy perspective, the countries of the OECS are in a very favourable position. Abundant sunshine and consistent winds are common on all islands. Geothermal and hydro power potential exists on some islands. Some islands also produce sufficient levels of agricultural residue to make biomass generation possible. One need look no further than the many old windmills on Antigua, no longer functional, that once formed the backbone of the sugarcane processing industry. Entrepreneurs in the 18th and 19th centuries were able to utilize renewable energy for their benefit; the same should be true in the 21st century.

With the exception of some hydroelectric power developments in St. Vincent and Dominica, the OECS countries have no commercial scale renewable energy generation facilities. Some of the technologies that may be applicable in the OECS are as follows:

4.4.1.1 Solar Photovoltaic Systems (PV)

Used mainly in small remote power and small-scale residential applications, the PV market is increasing by about 1,500 systems each year in Latin American countries. These systems have an average installed capacity in the range of 30 to 50 W, which provides adequate electricity for some

domestic use. PV systems require minimum maintenance, are well suited for remote locations, and are less expensive than present alternatives[11]. Countries demonstrating a successful PV market include Jamaica, Honduras and the Dominican Republic.

4.4.1.2 Solar Thermal Devices

Solar water heaters can provide hot water to domestic users, as well as in health centres, schools, and other rural community facilities, and in small industries in hybrid systems. Costs of solar thermal systems vary depending upon the size of the system, however, the operating cost of the system is basically zero, and hence the investment cost will be rewarded throughout life long use of the system[12].

4.4.1.3 Stand Alone Wind Turbines

In the Latin American regions, the use of wind as an energy source is at a very preliminary stage. Although successful in other areas of the world, small wind systems that provide energy for village electrification, water pumping, battery charging, and small industrial uses are currently at a preliminary feasibility study stage by the National Rural Electrification Cooperatives Association and the American Wind Energy Association. Old style wind systems with multi-blade mills on wind farms are under operation in Guatemala and Costa Rica, mainly for water pumping. Wind energy studies and demonstration generation projects have taken place on St. Lucia and Montserrat. In Antigua there are many old windmills, no longer in operation, that once were used to grind sugar cane.

4.4.1.4 Wind/PV-Diesel Gas Hybrid Units

Hybrid units offer enhanced reliability, with reduced fossil fuel use. They show potential promise for rural off-grid regions. These units could be used in communications systems or as electricity supply

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11 J. Goldemberg and T.B. Johansson, (Editors) Energy As An Instrument for Socio-Economic Development, United Nations Development Program, 1995, Chapter 6, p.4-5.

12 IBID

to villages, or to individual households[13]. This system is promising for many countries in the Latin American region.

4.4.1.5 Micro and Mini Hydro

This technology is developing in many Latin American countries due to the geographic and climatic conditions throughout the region; it has great potential since hydro power is a significant energy source in Paraguay, Costa Rica, Uruguay, Brazil, Honduras, and Peru. The environmental and social consequences of large dams is now recognized, and funding institutions will typically now not support these projects, but are encouraging mini-hydro, "run-of-the-river", power projects[14].

Dominica and St. Vincent are the only two (2) countries in the OECS with hydro generation. These plants are small and represent only a small portion of each country's energy load. In most OECS countries, fresh water is a scarce and valuable commodity.

4.4.1.6 Biomass Based Cogeneration

This is a larger scale technology used in plant facilities often with another power source that typically involves combustion of a biomass product (wood waste, sugar cane bagasse, etc.) to produce electricity and steam via a steam turbine generator. Biomass generation utilizing sugarcane bagasse is the third most widespread renewable energy source in the region, with a rising share of final energy demand. Countries incorporating this technology include Guyana, Cuba, Barbados, Brazil, and Jamaica[15].

During discussions with officials in the OECS countries, visited during the study the question of biomass fired generation was raised. Concerns about deforestation and the cost of transportation

13 J. Goldemberg and T.B. Johansson, (Editors) Energy As An Instrument for Socio-Economic Development, United Nations Development Program, 1995, Chapter 6, p.6-7.

14 IBID

15 The Latin America Report, The Multilateral Development Banks Energy Project, Instituto del Tercer Mundo, 1997, Summary, p.3-4.

of the resource to a generation facility was an obstacle to previous development attempts. In an effort to reduce the transportation cost problem , small scale biomass generation projects producing less than 500 Kw could be explored for areas currently underserved by the national grid.

4.4.1.7 Geothermal

Also a larger scale technology used in plant facilities, geothermal energy supply is slowly gaining ground in the region. The share of geothermal energy in primary energy supply is very low, however, it is an important source used along with electric power in Costa Rica, El Salvador, and Nicaragua, which are countries that have a high share of geothermal energy in their primary energy supply. In 1998, it accounted for 25%, and 11% of primary energy supply in Costa Rica and El Salvador[16].

Geothermal potential has been explored in both St. Lucia and Montserrat. Additional foreign investment will be required to overcome technical challenged and develop these resources.

Overall, it appears that there have not been any major leaps into renewable energy uses in the region. There are numerous existing cases in some countries, but they are isolated and marginal when considered in the overall energy balance[17].

4.4.2 Conventional Generation

Within the context of this report, the term "conventional generation" may tend to mislead, since it is associated with the current situation, which has been described as inefficient and old fashioned. However, conventional generation, from an efficiency improvement perspective, may have application to the OECS energy regime.

[16] Organizacion Latinoamericana de Energia (OLADE)Website: http://www.olade.org.ec/idiomas/ingles/varios/sectorEnerg+(c)ticoCap3.htm\

[17] The Latin America Report, The Multilateral Development Banks Energy Project, Instituto del Tercer Mundo, 1997, Summary, p.7.

Diesel engine technology has improved immensely in the past twenty (20) years. Modern stationary diesel engines have achieved thermal efficiencies well in excess of 40% in a simple cycle arrangement. Most utility diesels in use in OECS countries are not new, so an average efficiency of 36% is considered a reasonable estimate of the current generation. Efficiency enhancements to diesel plants can be achieved by recovering the waste exhaust heat from the engines and using it for generating additional energy. This is called a combined cycle arrangement and involves the installation of a waste heat recovery boiler, steam turbine, generator, and associated equipment.

On a typical 3 MW diesel unit equipped with this additional equipment, an extra 800 kW or 27% could be generated with only 3% increase in fuel consumption. This system would raise the overall system thermal efficiency from approximately 36% to over 55%. For a base loaded unit running 8,100 hours per year, this installation would provide a simple payback of just over two (2) years based on the current average cost of diesel fuel in the OECS. Our analysis suggests that this technology is feasible for units of 2,500 kW and larger, operating for 7,000 hours per year or more.

Additional efficiency improvements in conventional generating plants can be gained through use of variable frequency drives on variable load units, high efficiency transformers, and digital controls.

A cost of service study should be completed at all utilities so that they know exactly where their inefficiencies are and how to go about addressing them. This study will also allow an accurate determination of each utility's marginal cost of production, which is important when determining the purchase price for power provided to private generators.

5.0 INTERNATIONAL APPROACHES RELEVANT TO THE OECS SITUATION

This section profiles some international approaches to energy management that offer lessons learned and techniques that have some merit for consideration in the formation of the OECS policy framework. With one exception, the focus of the case examples is on initiatives that have been applied in the Caribbean region. There is an interesting array of energy management initiatives in the region, that range from a primarily private sector thrust in a small market niche to a large multi-year program supported by the World Bank.

As is further elaborated, there really is no one single "model" that applies wholly to the OECS context. Energy management initiatives, as applied to newly developing countries, have been continually evolving with much of this evolution being a function of the donor-recipient relationship between the development banks and individual recipient countries or regions. What is important in examining these approaches is whether they have indeed helped to establish the "foundation" for an eventual transformation of the energy management market, which is considered to be the necessary outcome of an energy efficiency policy and supporting initiatives.

A market transformation refers to a concept that has been at the centre of institutional energy planning (i.e., government and utilities) for roughly the past ten years. It has been characterized as a "many-faceted strategy aimed at changing the structure or function of the market or the behaviour of market participants to prompt the adoption of energy efficient products, services and practices."[18] In other words, the sought after outcome of a successful market transformation is that the demand for and supply of energy efficient products, services etc., becomes the norm rather than the exception. One of the best examples continues to be the electric motors initiative developed by B.C. Hydro, which resulted in the annual sales of high efficiency 1-200 HP AC polyphase motors changing from 20% to 80%. Emerging from this experience is that several key conditions must be in place for a transformation to occur:

∃ A champion with a long-term commitment.

[18] Dan York, Energy Centre of Wisconsin, A Discussion and Critique of Market Transformation, 2000

∃ Energy prices and energy price structure that sends the appropriate signals to the market.

Specifically, this section profiles the following initiatives:

.1 *The Jamaica Demand Side Management Pilot Program:* This is a case example of a donor bank's long-term commitment to support capacity in a country to develop and deliver DSM.

.2 *The Bermuda Energy Service Company model:* This is a case example of how a proven North American model has been applied to a small energy management market.

.3 *The Barbados DSM and solar DHW initiatives:* This case example illustrates the challenge of moving from the study to implementation phase for DSM and also comments on the experience of the country's solar DHW initiative.

.4 *The compact fluorescent lighting initiative in Guadeloupe and Martinique:* This case example illustrates how a concerted effort by one utility can help foster some limited market transformation.

5.1 CASE STUDY #1: JAMAICA PUBLIC SERVICE COMPANY DEMAND SIDE MANAGEMENT DEMONSTRATION PROJECT

5.1.1 Introduction

The Jamaica Public Service Company (JPSCo) is a crown owned electric utility company serving all sectors of the Jamaican economy. Since 1994, JPSCo has been implementing a DSM demonstration project designed to establish the foundation in Jamaica for sustainable and successful energy efficiency initiatives. This profile highlights the key aspects of the project, the outcomes and lessons learned.

This project was financed primarily by the Global Environment Trust Facility (GEF) of the World Bank and the Inter-American Development Bank, along with some funding from the Rockefeller Foundation and the Canadian Trust Facility. The World Bank has been the main institution involved in the project, and considered the conditions in Jamaica to be suitable for demonstration of a full scale, multi-faceted initiative. Indeed, at the time this program was launched, perhaps with one exception, it was the most ambitious energy efficiency initiative in a developing country. A total of $3.8 million in grant funds was provided to the program by GEF of the World Bank, with a remaining $8.7 million in loans and grants from the other financing organisations[19].

Prior to the DSM initiative, there had not been any significant gain in energy efficiency in Jamaica in over twenty years. Indeed, Jamaica had a relatively high-energy intensity compared to similar economies at roughly the same standard of living, such as Tunisia, Turkey, Colombia and Thailand. JPSCo considered DSM as a possible means to offset the growing demand for electricity, without incurring large investments to new generation and transmission and distribution capacity. JPSCo had to deal with the high marginal costs of supplying electricity; Jamaica imports all of its primary fuel so there was a significant foreign exchange element to JPSCo's operations[20]. Moreover, the utility was also incurring a high percentage of line losses.

5.1.2 Key Aspects of the Project

The project targeted all sectors: residential, commercial/institutional and industrial but mainly focussed on the first two sectors. The project fostered investments in energy retrofits, equipment replacement and commercial new construction opportunities. There was also an element of the project that focussed on renewable energy forms, notably solar domestic hot water (DHW) and photovoltaic power (PV) applications.[21] Underlying the development of sector specific activities

[19] Martinot, E. and O. McDoom. Promoting Energy Efficiency and Renewable Energy. Global Environment Facility. p.71.

[20] Harris, H. Jamaica Public Service Company. "Energy Efficiency and the Jamaica Public Service Company" presentation, Roundtable on Energy Efficiency, 1997, Kingston, Jamaica.

[21] IBID

were three key "cross-cutting" initiatives:

∃ Internal Capacity Building: This refers to ongoing training and capacity building of the JPSCo staff assigned to the DSM program. An independent DSM unit was established and staff received both management and technical training and support.

∃ External Capacity Building: JPSCo facilitated a variety of training and awareness activities directed to what would have been considered to be a potential energy management industry (i.e., distributors, retailers, contractors, engineering community).

∃ Awareness Building: Considerable resources were allocated to establishing and then raising awareness among all sectors of the economy of DSM as a solution to questions of energy cost, reliability and quality.

At the sector level, the key program initiatives and results were as follows:

5.1.2.1 Residential Sector: DSM Package

The activities targeted to the residential sector were designed to generate an environment in which households would undertake actions with the expectation that the investments would pay off and that the trade allies would support the program. The focus was on lighting and hot water usage using a package approach.

Initially, under a pilot phase, compact fluorescent lamps (CFL's), low flow showerheads, faucet/sink aerators and refrigerator gaskets were provided at no cost to 100 participants. JPSCo initiated a school based publicity strategy, generating press coverage and contact with students, teachers, and parents regarding awareness of energy usage patterns of appliances and other household products. Phase I provided a strong foundation for implementation of a more ambitious program. An evaluation found that energy savings and peak demand reduction from the pilot exceeded the projected impact[22]. Survey results found very high levels of customer satisfaction with

[22] Harris, H. Jamaica Public Service Company. "Energy Efficiency and the Jamaica Public Service Company"

the products and services received.

This second phase of the residential program involved approximately 38 thousand customers island-wide, selected at random and representing about 10% of the total residential customer base. This phase offered customers the choice of one of three packages at a 50% discounted price (JPSCo shared the other half): i) 3 compact fluorescent lamps (CFL's), ii) 3 CFL's and a low flow shower head and iii) a home energy audit and direct installation of energy efficient equipment, including up to 5 CFL's and the energy efficiency actions included in the Phase I program. The program piloted a new distribution mechanism, since the CFL's were sold through local utility offices where customers could get more information directly from JPSCo staff. Customers had the option of a direct, up-front purchase at a discounted price or purchase with repayment through the monthly utility bill[23].

Follow up impact evaluation studies in 1995 and 1996 showed energy savings of higher than expected results for Phase I[24], as well as for Phase II[25]:

Table 5.1 Energy Savings Resulting from the Residential Program of the Jamaica DSM Project

Phase I	**Energy**	**Expected Savings**	**Actual Savings**
	Annual Energy Use	18000 kW.h	58021 kW.h
	Peak Reduction	2 kW	5.2 kW
Phase II	Annual Energy Use	4,393 MWh	5,437 MWh
	Peak Reduction	1.0 MW	1.67 MW

presentation, Roundtable on Energy Efficiency, 1997, Kingston, Jamaica.

23 Harris, H. Jamaica Public Service Company. "Energy Efficiency and the Jamaica Public Service Company" presentation, Roundtable on Energy Efficiency, 1997, Kingston, Jamaica.

24 IBID

25 Harris, H. personal communication. August 20, 2000.

The program evaluations show the residential pilot to have been successful from both a cost and awareness standpoint. Indeed, from the JPSCo perspective, the analysis showed a Benefit/Cost (B/C) ratio of 4.0 (avoided cost savings to the utility of US$5.66 million); from the societal stand-point, the B/C ratio was 6.3. For customers, the B/C ratio was 7.0 reflecting the rapid paybacks from purchase of CFLs (less than 2 years). A survey of customers showed that the top motivation for most participants was to save money on their monthly bills.[26]

The program also made inroads in the energy management infrastructure. Retailers began stocking eligible products and, over time, the price of products such as CFLs declined with increasing volumes. For example, the price of CFLs declined from Jm$800-$900 per unit to about $460 per unit.

5.1.2.2 Residential Sector: Renewables

A solar DHW initiative was implemented to demonstrate the technical and cost performance of such applications. More than 300 units have been installed in the residential sector. JPSCo solicited bids internationally to supply the solar DHW systems and an Israeli supplier was selected. The 200 and 300 litre units cost $730 (U.S.$) and $1065 (US$) respectively, generating paybacks of 4-5 years. A key aspect of the solar DHW initiative was the establishment of a revolving fund. Customer payments through their utility bills are allocated to a revolving fund for future utility investments in solar DHW installations[27].

JPSCo also launched a PV pilot to demonstrate the performance of such applications to off-grid communities. "Solarex" panels with AC inverters were installed in 2 villages at a cost of about $1000 (US$)/unit. JPSCo has estimated a 15 year simple payback on the installations[28].

5.1.2.3 Commercial/Institutional Sector: Retrofits

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[26] Harris, H. Personal communication. August 20, 2000.

[27] Harris, H. Personal communication, August 30, 2000.

[28] IBID

JPSCo implemented retrofit initiatives in both the large and small commercial/industrial (C/I) sectors. In the large C/I segment, initially the utility had hoped to secure third party financing support from the Jamaican banking community, but ultimately most of the DSM investments in the large C/I segment were self-financed. JPSCo financed approximately 17 energy audits to identify energy efficiency measures deemed to be most cost-effective at each facility. Facilities were selected based on a review of applications and ranking against the following criteria: high potential for energy savings; visibility; facility type; occupancy types; and, an existing maintenance program. Of these 17 customers, to date 6 have proceeded with retrofits. The retrofits targeted upgrades in lighting (energy efficient lamps and ballasts), refrigeration, air conditioning and ventilation systems[29].

In the small C/I segment, JPSCo financed the full retrofit up-front with customer repayment through the utility bill. A total of 10 facilities implemented retrofits under this initiative[30].

5.1.2.4 Commercial/Institutional Sector: Solar DHW

JPSCo also launched a limited solar DHW pilot in the C/I segment, with a specific focus on the hotel sector with a 25-hotel Pilot. There are over 177 hotels on the island, and prior to this initiative, only 22 of them were using some form of solar water heating. The program was designed to demonstrate the technical performance, reliability and cost effectiveness of solar water heating in the hotel sector as a pilot example. It involves complete installation and maintenance for five years, while the customer/hotel operator repays the cost from the savings on their electricity bill. This results in lower operation forecasts for the facilities and demand management for the utility[31]. To date, 13 hotels have taken advantage of the program, bringing the total number of hotels using solar water heating to 35[32].

29 Jamaica Public Service Company Website: http://www.jpsco.com/press/dgedisave.htm

30 Harris, H. Personal communication, August 30, 2000.

31 IBID

32 Harris, H. Personal Communication, August 20, 2000.

Box 5.1.1: Case Example of Commercial Retrofit Program[33],[34]

As one element of the commercial retrofit program, JPSCo's head office underwent a building retrofit as a DSM Demonstration Pilot. The retrofit included air conditioning equipment including air handling units, chillers and control systems, building interior and exterior lighting including sensor controls, and a computerized energy management system. The following table demonstrates the changes in energy consumption realized from these retrofits.

JPSCo Head Office DSM Project - Change in Energy Consumption (kWh)

	Lighting	HVAC	Total
Before	909,260	1,402,887	2,598,642
After	239,946	575,765	1,102,206
Savings	669,314	827,122	1,496,436
% Reduction	74%	59%	58%

The installation cost of this was $630,000, with an estimated payback time of 3.1 years. Energy costs of 33% have been realized as a result of these retrofits.

5.1.2.5 Industrial Sector

Despite initial efforts to develop a comprehensive DSM initiative in the industrial sector, JPSCo's efforts in this sector were more limited than in the other two sectors. The "Economic Development Incentive" (EDI) offered companies an off-peak rate to induce them to shift loads. Companies using more than 1500 kVA per month were eligible to apply for the EDI. Those who increase their off-peak electricity use by 3 percent in the first six-months on the program and attain increased levels of 5 percent in a year will reap the benefits of significant savings on their electricity bills[35]. For companies that are able to shift loads, an incentive of this nature can pay off. One local brewery has saved over $2.4 Million[36].

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33 Harris, H. "Energy Efficiency and the Jamaica Public Service Company" presentation, Roundtable on Energy Efficiency, Dec, 1997, Kingston, Jamaica.

34 Harris, H. "An Overview of the Jamaica DSM Project" presentation, Symposium on Sustainable Energy Options for Small Island States, 1998, New York, US.

35 Jamaica Public Service Company Website: http://www.jpsco.com/press/dgedisave.htm

36 Jamaica Public Service Company Website: http://www.jpsco.com/press/dgedisave.htm

Table 5.2. Number of Facilities Involved in Each Program of the DSM Project[37]

Program	Number of Facilities
Residential Phase I	100
Residential Phase II	30004
Cogeneration	1
Head Office Retrofit	1
Large Commercial Retrofit	5
Large Commercial New	1
Small Commercial Direct Installation	7

5.1.3 Status and Lessons Learned

The JPSCo DSM program is at a crossroads, mainly because there is great uncertainty as to whether the utility will continue with a serious DSM mandate. In the past two years, there has been a general winding-down of the program, as World Bank funding was phased out and utility commitment declined. JPSCo management has been focussed on improving the overall financial position of the company, with the goal of privatizing the operations. In such an environment, the prospect of lost revenue (without rate basing the DSM costs) has weighed against competing arguments of avoided or deferred investments in new generation capacity and other infrastructure costs.

Scale is also an influencing factor. There is the view that the size of the DSM impact must be large enough to avoid or defer new infrastructure investments. The reality is that it takes many years to scale up a DSM program and, even then, DSM may never achieve the 25 to 50 MW reduction commensurate with the minimum size for new generation plants[38].

37 Harris, Hugh. Personal Communication, August 20, 2000.

38 Harris, Hugh. Personal Communication, August 30, 2000.

5.1.3.1 Key Lessons Learned

.1 *Institutional Commitment over the Long-term:* The current uncertainty of the JPSCo DSM program serves to highlight the importance of long-term institutional commitment as a key factor for success. In particular, the experience from North America shows quite clearly that the most successful DSM programs were those where the utility was involved for the long-run. It simply takes time to develop internal capacity and, at the same time, build the external awareness, infrastructure and alliances to ensure that sector specific initiatives will succeed.

In the JSPCo case, a critical part of the institutional commitment was the financial and other support provided by the World Bank. To its credit, the Bank recognized that establishing a strong foundation for DSM in Jamaica would take time and require resources for training and capacity building. The Bank also showed flexibility insofar as they were willing to live with adjustments to the scope and timing of specific DSM initiatives under the program. This is an important attribute because no one really knows how some aspects of a multi-faceted DSM program will fare in a largely new market for energy management.

.2 *Balancing Market Transformation With Short-Term Actions:* The JPSCo experience also illustrates the challenges of applying proven North American DSM concepts to a less developed economy with no real energy management experience. From the outset of the program, there was a focus on market transformation, to help ensure market demand for more energy efficient products and services while increasing the willingness of suppliers to produce them. This focus necessitates action on many fronts in that the utility must necessarily deal with the whole supply infrastructure as well as building awareness among various customer groups. The JPSCo experience does suggest that the DSM activities were starting to affect a market transformation. For instance, retail prices of some products began to decline as distribution channels started to respond to increased demand by increasing their stocks of the products.

On the other hand, JPSCo officials believe in retrospect, that program did not allocate sufficient resources to short-term demonstrations with which awareness and acceptance of new techniques and technologies might have been hastened.

.3 *Addressing the First-Cost Barrier:* As elaborated in section 6, the first-cost barrier continues to be a major impediment to customer investments in energy management. The JPSCo program was able to begin addressing the problem by subsidizing the initial cost and then offering participants the opportunity to repay the investment through the utility billing mechanism. Just as importantly, the incoming customer payments were allocated to a "revolving fund" structure dedicated to future utility DSM investments. Many of the commercial consumers bought into the energy efficient measures with credit provided by the utility, suggesting that the high-first cost barrier is quite a significant hurdle[39].

.4 *Training Investment:* As previously noted, the program allocated considerable resources to in-house capacity building. JPSCo believes this investment has paid off with a capacity to develop and deliver DSM programs and services.

.5 *Establish an Understanding of the Market:* The JSPCo program experienced growing levels of awareness of DSM opportunities in the target markets, coupled with energy efficiency investments that paid off with significant economic benefits. The program evaluations suggest that activities designed to better understand the market contributed to this success. These activities included market research on i) customer needs and awareness, ii) product distribution channels, and iii) product and service availability and quality. The phasing of specific DSM activities also enabled the utility to test DSM approaches and concepts (e.g., the phasing of the residential package).

.6 *Product Testing and Labelling:* The effectiveness of the DSM program was enhanced by the presence of an effective appliance testing and labelling program in Jamaica. Through the

[39] Martinot, E. & O. McDoom. Promoting Energy Efficiency and Renewable Energy: GEF Climate Change Projects and Impacts. Global Environment Facility (GEF) of the World Bank. October 1999. p.99.

Jamaica Bureau of Standards (JBS), the program requires all appliances sold in the country to undergo energy performance testing.

5.2 CASE STUDY #2: BARBADOS

5.2.1 Domestic Hot Water Heater Program

5.2.1.1 Introduction

In Barbados, since 1992 households have been implementing solar domestic hot water heaters (DHW) to address the high cost of providing DHW services through electric power. The development of this initiative was a collaborative effort between the Energy Unit of the Ministry of Environment and Energy and an energy services company (ESCO).

There were two critical elements to the program development and implementation.

.1 First, there was the issue of sourcing solar DHW systems that would operate reliably and cost-effectively in the Barbados conditions. This requirement was addressed by examining the existing technologies in use on the island - households have been gradually implementing DHW systems for almost twenty years. This narrowed down the type of DHW system that would operate optimally on the island. The materials for the system components are imported and then assembled in Barbados by 3 companies. The key factor that secured the buy-in from these companies was a government tax incentive to the private sector to manufacture the units[40].

.2 Next, there was the issue of customer ability to pay the up-front costs. The 60-gallon (240 litre) capacity units used in this program cost in the range of U.S. $2000 - $3000. The government offered customers re-payment of the investment from their income tax return the following year.

[40] Ince, David. Energy Department of Barbados. Personal Communication, September, 2000.

5.2.1.2 Results

The program began in 1992 with the installation of 11,000 units. As of 1999, it is estimated that there are about 31,000 units in operation, representing approximately a third of the residential DHW market. This program has achieved such a significant success rate due its attractive financing plan, relatively short payback period, and the high costs of alternative electric heating sources on the island. Payback from investment in the units is estimated at only 2.5 years[41].

5.2.1.3 Key Elements

The key elements of this program include:

∃ Technical assistance via an ESCO

∃ Technology transfer

∃ Technology promotion

∃ Financing incentives.

5.2.2 Demand Side Management Plan

5.2.2.1 Introduction

Barbados Light and Power is a public company providing power to all sectors in Barbados, roughly 92,000 customers. Growing peak demand in some key sectors of the economy had prompted the utility to consider investments in new capacity. The utility was able to obtain a loan from the European Development Bank. However, one of the conditions of the loan was that BLP had to invest the equivalent of its interest payments on a DSM feasibility study.

[41] Ince, David. Energy Department of Barbados. Personal Communication, September, 2000.

The DSM feasibility study was one of the most comprehensive assessments of energy management potential undertaken in the region, and provides some useful indicators for other countries in the region. Both technical and economic potentials were determined in the industrial, C/I and residential sectors, with the threshold for the economic potential based on the utility's avoided cost of generation capacity. In addition, the study also included a characterization of possible DSM initiatives that would be suitable to the estimated potential. A comprehensive benefit cost analysis was conducted of the DSM initiatives.

5.2.2.2 Results and Status

Overall, the study showed that there is significant cost-effective potential for DSM in all three target sectors. Moreover, the analysis indicated that a well-designed and strategic set of initiatives would also generate net economic benefits, to the utility, the customer participants, and to society as a whole. Following completion of the DSM study, BLP conducted an in-house analysis of the system cost implications of delivering possible DSM programs. The thinking at the time was that, together, all of the analytical work would be used to make the case to the Public Utilities Board (PUB) to support the utility's investment in DSM.

At the present time, there has been no follow-up on the DSM plan. The BLP Managing Director has not yet made a decision of how the DSM costs should be treated, i.e., rate based or capitalized. At the same time, there has been a delay due to the transition in mandate of the PUB to that of a new organization, the "Fair Trading Commission".

The Barbados DSM experience underscores the challenges and risks in carrying through from the study to implementation phases. Certainly, the study phase was very useful, because it provides a quantitative basis for decision-making, which, in turn, establishes credibility with BLP senior staff and board, the PUB and other stakeholders among customers and trade allies. The study phase was also important to help increase the awareness of key stakeholders of what DSM constitutes and the financial benefits it can reap.

However, on the other hand, a study of this nature establishes a momentum and expectations that can serve to undermine the success of future, follow-up DSM activities. Companies, organizations and institutions in the industrial and C/I sectors were consulted and cooperated with data and access to their facilities for surveys and energy audits. Their engagement in the process also served to increase their expectations that BLP would proceed with a reasonably ambitious DSM program. It has been more than eight (8) months since the study was concluded and since final presentations on results were made and, yet, no follow-up action. In particular, there are two sectors where this lack of follow-up is likely to be of most significance, industry and the commercial sector.

At the time when the DSM study was conducted, several industrial companies had opted to self-generate power using diesel gen-sets; they concluded this to be a less expensive option than purchasing power from BLP. However, the prospect of the utility offering some DSM support generated some genuine interest among these companies, and possibly a means with which the utility could get them to opt back into the grid. If there is no near-term follow-up, this may confirm the views of these and other companies that the utility is not really listening to their concerns.

The commercial sector had been exhibiting rapid growth, particularly in the hotel and office sectors. This presented the utility with an opportunity to foster energy efficient designs into the new developments. Again, failure to act quickly will result in significant "lost opportunities".

To summarize, the DSM study resulted in the following key outputs:

.1 At a median annual demand growth rate, the analysis estimated a technical potential for energy management, by 2010, of 29% and 30% respectively, for energy and peak demand.

.2 At the same growth rate, the analysis estimated an economic potential of 23% and 25%, again for energy and demand savings respectively. Of particular note is that there was only a small difference between the technical and economic potentials, indicating that most actions are cost-effective against the utility's estimates of avoided cost of new generation capacity.

.3 DSM programs were characterized and assessed for all three sectors. The programs are designed to foster market penetration of the EM actions generating the best savings and as well as being cost-effective. All three sector programs would have a strong awareness component, but particularly focussed on the residential sector. There is also a strong "cross-cutting" element focussed on working with the trade allies to ensure supply of quality EM products and services.

.4 All of the programs were assessed to be beneficial positive from society's perspective, as well as those from the utility and the participants, generating positive B/C ratios. The overall B/C ratio from the ratepayer perspective was only marginally below 1 indicating that rate impacts would be marginal.

5.3 CASE STUDY #3: THE ESCO EXPERIENCE IN BERMUDA

5.3.1 Introduction

Energy Service Companies (ESCOs) offer turn-key energy management services, primarily through energy performance contracting (EPC) which can also include project financing. EPC is a successful business in North America reaching in the hundreds of millions in annual sales. This case study profiles how this private sector approach has taken hold in the Bermuda market.

BESCO was formed in 1995 as a non-regulated subsidiary of the Bermuda Electric Light Company Ltd. (BELCO). The ESCO option emerged following some initial load research and DSM planning conducted by a consulting firm for BELCO. The utility determined that, as an unregulated subsidiary, energy management services could be offered to its customers without having the costs of such an operation rate based (there have been no rate increases in the past five (5) years, with the exception of a fuel adjustment clause).

BESCO services include: energy audits, energy master plans, turn-key project implementation, control system design, lighting design, project/construction management, commissioning and

financing. They also provide power protection and control system design services for smaller commercial operations and households. To date, BESCO has focussed on the C/I market, primarily on institutional buildings.

5.3.2 Key Activities and Results

BESCO is now firmly established in the Bermuda energy management market and has developed a strong in-house capability to develop and implement projects and services. BESCO has made significant inroads in its target market and, as a consequence, is looking to expand operations off the island to other countries in the Caribbean. The company estimates that approximately 70% of its target market has been penetrated.

Some key aspects of the BESCO experience are summarized as follows[42]:

.1 Investment in project development: BESCO recognized early on that the company had to invest considerable resources to generate customer awareness and demand for their services. This investment not only included extensive and well targeted marketing but was also embedded in the company's service offering. Initially, BESCO provided the up-front energy audits and master plans at little or no cost to the customer (the company now charges for these services).

.2 Develop Solid In-House Capacity: BESCO believes that its initial investment in development of in-house capacity is now paying off with efficient and effective technical and management capability, a capability that has served to make the company largely independent from outside engineering consultants. At the same time, the connection to BELCO has also helped as BESCO has been able to share some of the utility's in-house resources such as purchasing, CAD and retail outlets.

[42] Kevin Janzen, BESCO. Personal Communication, August 30, 2000.

.3 Customized Marketing: In a small market environment, BESCO quickly recognized the need to customize its marketing efforts to the individual needs and characteristics of the large C/I customer prospects. A focus on CEO and senior level officials has paid off for the company. This focus has been particularly key to the challenge of working within the constraints of the government procurement rules and regulations. BESCO has been able to sell projects to government clients within these constraints because effective consultations have convinced decision-makers of the benefits of the projects. In fact, on more than one occasion the government has been convinced to allow BESCO to forgo payment on import duties for energy efficient products, thereby reducing the overall project costs.

.4 Project Financing and Life Cycle Analysis: In part to combat the up-front financing barrier, BESCO decided early on to market the financial benefits of the project opportunities using a lifecycle cost approach. Although more effort has been expended in the marketing phase, it has paid off with a greater understanding and awareness among their customers. Coupled with this marketing approach has been the company's financing offerings, sourced either from equity or third party sources (off-shore). Interestingly, about 35% of the company's customers have chosen to self-finance the projects.

.5 Energy Management Actions That Work: Since the start of the BESCO operations, the company has expanded and diversified its service and product offerings. The actions with the best financial performance, which have been most frequently implemented, include lighting equipment replacement, lighting design and redesign, and air conditioning replacement and design with paybacks of less than 5 years. Control system installation and management is also proving to be an important application for the company. BESCO is starting to pursue other forms of energy supply, including combined heat and power, fuel cells, wind and electric vehicles.

.6 Barriers: Despite the success of the company, there continue to be key barriers to market penetration: i) lack of access to up-front project financing, ii) lack of awareness among key decision-makers in the target markets, and iii) the high cost of doing business, primarily due

to the product costs (with the effects of transportation and duties).

5.4 CASE STUDY #4: OPERATION LAMPE BASSE CONSOMMATION: GUADELOUPE AND MARTINIQUE

5.4.1 Introduction

Operation "Lampe Basse Consommation" (LBC) was a successful compact fluorescent lamp (CFL) leasing program implemented jointly by Électricité de France (EDF) and L'Agencie de l'Environment et de la Maîtrise de l'énergie (ADEME) in the French Caribbean islands of Guadeloupe and Martinique. EDF provides electric power services to these countries.

In the late 1980's Guadeloupe's oil-fired power plant was nearing maximum capacity due to an increase in tourism on the island. ADEME considered alternatives to building a new plant or expanding capacity of the existing one. The utility was extremely interested in the possibility of electricity conservation on the island because the retail electricity price of 0.6
French Francs (FF)/per kWh (approximately 11 US cents/kWh) is less than half of the actual production cost. This situation translates into an annual loss of about FF 500 million per year for EDF (approximately US$ 93 million)[43]. Electric usage studies were conducted as part of this process, and it was determined that residential lighting was a significant share of evening peak demand. Further market studies were done to determine alternatives for lowering peak demand, and CFLs were identified as an excellent prospect. However, ADEME realised that customer education would be necessary to endorse the program[44].

[43] The International Association for Energy-Efficient Lighting (IAEEL) website: http://www.iaeel.org/IAEEL/NEWSL/1992/tva1992/PrN_b_2_92.html

[44] The Results Centre Website: http://www.crest.org/efficiency/irt/119.htm

The objective of this residential DSM initiative was to reduce evening peak electricity demand arising from residential and small commercial use of incandescent lamps. A key aspect of the program was an innovative leasing scheme designed to address the high first cost of the CFL units. Customers were allowed up to 10 CFL units at no initial cost on the condition that they lease the units over a prescribed period of time. The payments were through the utility bills. Lease payments were designed to be roughly the same or less than projected monthly energy and bill savings[45].

5.4.2 Key Activities and Results

The LBC program has been very successful with a peak load reduction of 7 MW on each island, to date. In Guadeloupe, roughly 350,000 CFLs were installed, resulting in energy savings of about 29,927 MWh. The success on Guadeloupe prompted the implementation of Operation LBC on the island of Martinique the following year. In just a few months of program implementation in Martinique, 345,000 CFLs were distributed via the leasing arrangements. To date, over 700,000 CFLs were leased by residential customers of EDF on both islands[46]. Prior to this program, only about 1,000 CFLs were sold annually on the island[47].

Some key aspects of the LBC experience are summarized as follows[48]:

.1 Marketing Campaign: In 1992, ADEME and EDF launched an extensive media campaign to raise awareness of the program among residents of Guadeloupe. The campaign involved television, radio, and print awareness via coupons in the mail to every customer, which allowed 10 CFLs at no initial cost.

.2 Product Placement: EDF and ADEME solicited bids from CFL manufacturers to supply

45 IBID

46 IBID

47 The International Association for Energy-Efficient Lighting (IAEEL) website: http://www.iaeel.org/IAEEL/NEWSL/1992/tva1992/PrN_b_2_92.html

48 The Results Centre Website: http://www.crest.org/efficiency/irt/119.htm

the product for the program in Guadeloupe. A CFL manufacturing company, Osram, won the bid for Guadeloupe since they could supply the CFLs in the timeliest manner. At the same time, there was extensive consultation with local retailers to ensure their participation stock and sell the product. Initially, over 100,000 15-watt CFLs were installed in 80 retail stores. In the first day and a half, over 12,000 households redeemed their rebate coupons good for up to 10 CFLs at a price of FF 89 each (approximately US$ 16.5). The special price was about 1/3 of the prevailing retail price, 240 French francs. An additional 32,000 households placed orders for 250,000 more units, which had to be imported quickly. Overall, the Guadeloupe program achieved a response rate of 34% of all households on the island redeeming their coupons, which was an average uptake of 7.8 CFLs each. One month after the initial round of rebates, a telephone survey of 400 households found that 80% of the CFLs had been installed[49].

Philips' French subsidiary Mazda, who sells the Philips electronic CFL under the product name Eureka 2, won the bid for the second phase of the program in Martinique. About half of Martinique's 110 000 households responded to the offer. Each household could use their coupons to get two, four, or six lamps from retailers on the island. Virtually every responding household chose to buy the maximum of six lamps. A total of 350 000 lamps were sold through the second phase of the LBC program[50].

.3 Product Financing: The innovative leasing arrangement created a revenue-neutral or even positive cash flow situation for participants on both islands, which allowed customers to overcome the up front cost barrier. The rebate mechanism allowed consumers to spread the payment for their CFLs over 6 sequential utility bills (18 months). The payment amount was set so that the value of energy savings for lamps used four hours/day or longer would be greater than the lamp payment. In addition, shop-owners received a rebate of FF 5 per CFL sold[51].

49 The International Association for Energy-Efficient Lighting (IAEEL) website: http://www.iaeel.org/IAEEL/NEWSL/1992/tva1992/PrN_b_2_92.html

50 The International Association for Energy-Efficient Lighting (IAEEL) website: http://www.iaeel.org/IAEEL/NEWSL/1992/tva1992/PrN_b_2_92.html

51 IBID

.4 Scale: This was the largest and most effective CFL leasing program ever undertaken by a utility; the program's success is remarkable given this large scale.

.5 Impacts: The CFLs sold in the first phase of the program in Guadeloupe saved EDF 19 million French francs/year (approximately US$ 3.5 million) of otherwise lost revenue for a cost of FF 2.5 million (approximately US$ 460 000) for the first phase of the program. The total cost per kilowatt-hour saved is about one-eighth of EDF's cost of producing electricity on the island.

6.0 BARRIERS ASSESSMENT

Notwithstanding the potential for energy management in the OECS, there are several critical market barriers, which will continue to impede take-up of cost-effective energy management actions. The OECS is not unique in having to consider energy management market barriers. These barriers are common in most less developed countries, and also existed in the developed countries for many years until government and utilities intervened in the market.

To understand the energy management (EM) barriers in the OECS, it is necessary to turn to the concept of the sustainable EM market, which is further discussed in Section 7.0. The sustained activity of EM investments and supply in the OECS requires a transformation at both ends of the market equation. The energy users in the commercial, industrial and residential sectors must generate a sustained demand for EM products and services. In turn, there must be a capacity in the OECS for quality EM products and services to be delivered. Hence, the barriers analysis is designed to distinguish among barriers that pertain to each of these market elements. In some cases, however, there are barriers that cut across the market as a whole.

6.1 CROSS-CUTTING BARRIERS

6.1.1 Power Quality

Voltage fluctuations, specifically under voltage or voltage sags, are problems reported by industry in the region. Most industrial, institutional, and large commercial customers maintain onsite emergency generators to guard against power outages. The high tech sector reported problems with voltage fluctuations during meetings in St. Lucia. It was also reported to be a concern to the telecommunications industry. A great deal of future job prospects are in communications and information technology, both of which require consistent power supplies to run their computer networks. An economic growth model based upon attracting and retaining well-educated people to locate high tech firms in the OECS will be hampered, if the problem of reliable power supplies are not addressed.

6.1.2 Electric Rate Structure

Electric rate structures, whether from the government or private utilities, do not provide many incentives to encourage energy conservation. All rates are based solely upon energy consumption. No demand metering of large customers is done, even though it has been proven to be a very effective incentive for demand management. Time-of-day rates are also not available, which could encourage users to implement load shifting. Discussions held with utilities and large customers confirmed the lack of any incentives in the rate structures.

6.1.3 Access to Affordable Financing

6.1.3.1 Overview

This is a critical barrier to EM, as is the case in most less developed countries (and was a key barrier in North America for many years). At the present time, project financing in the OECS is more expensive and subject to more restrictive amortization periods than similar projects in North America. Commercial loans at interest rates of between 15 and 20% are common. For energy management, this situation is exacerbated by a very limited understanding among the OECS financing institutions of energy management, in terms of the type of measures, the nature of the transaction, the benefits to the bottom line, investment potential and how risk can be managed. We know from the BESCO experience in Bermuda, for example, that the ESCO is using offshore financing to develop some of the EM projects.

Energy management is a one-time, up-front investment in which the benefits are expressed as a stream of savings over some period of time. Hence, the project financiers must have confidence that there is some form of recourse, most commonly through collateralization, but potentially through a recognition that the EM investment will generate a regular savings stream to offset monthly financing costs. The OECS macro-economic situation has created an environment where the financial community is understandably very careful about project financing. The financial community in the OECS appears to exist to a greater degree to service offshore investors seeking

tax relief than in serving as a vehicle for development. Most major projects are owned and financed offshore, so the local community has little knowledge or involvement with the bulk of the larger businesses, which could benefit most from an EM program.

6.1.3.2 Cost and Terms of Project Financing

The present conditions for project financing in the OECS serve as a major impediment to EM. For private companies, the cost of borrowing is high, more than 20%/annum if borrowing in local currency. However, there are likely to be conditions under which OECS companies are able to borrow at much lower rates using U.S. dollars.

Funding could also possibly be found through programs established by several large North American utilities such as PG & E, Enron, and TransAlta. They will provide project financing in exchange for transfer of greenhouse gas emissions credits arising from the project. This method of financing is quite new and only a few examples currently exist. They are mostly in renewable energy fields, such as wind and solar power, which are the two most abundant renewable energy sources in the OECS.

Other funds may be available through the Caribbean Development Bank, InterAmerican Development Bank (bilateral departments such as the SMSE group, and the International Investment Corporation), World Bank ESMAP group and/or the International Finance Corporation REEF Fund. We have contacted each of these organizations during the study and, while much interest exists, funding for program planning and development seems to be quite limited, however, there is potential for this. Funding for specific projects, however, is much more probable, via the IDB IIC group and the IFC. This needs to be investigated further, and will require some dedicated effort and meetings with these IFIs.

6.1.3.3 Categorization of Possible Energy Management Investors

The market research reveals that there are three typical categories of energy management investors in the OECS. Financing packages need to be designed to meet the specific circumstances of each

of these groups.

.1 *Multi-National Companies*: This refers to companies that are part of multi-national operations, including firms in the hotel and, to a lesser degree, manufacturing sectors. These companies are likely to be able to access U.S. or other low cost financing, either as debt or equity. These companies typically must adhere to corporate wide financial, operational and environmental standards and, therefore, they would potentially respond more favourably, and faster, to possible EM investments. Discussions held with representatives of several international hotel chains with properties in the OECS indicated that most larger properties have already begun some modest type of energy management program although they admitted that it is usually at an individual property level and without much corporate support.

.2 *Large OECS Owned Operations*: This refers to OECS companies that may be in a position to finance projects from equity or, conversely access lower cost U.S. $ financing.

.3 *Small to Medium Sized Companies:* This final category of investor has limited capital and many of these operations may have to borrow project funds solely in local currency. Moreover, they have more limited technical know-how than the other investor categories and, therefore, are likely to be significantly less responsive to EM investments.

6.1.4 Lack of Product Testing and Performance Labelling

There are presently no regulations in the OECS requiring the testing of energy using products for their energy performance, nor mandatory performance labelling. Such regulations are common in most developed countries. The lack of such requirements poses a considerable challenge to the market penetration of energy efficient products, as transactions for such products will continue to be based on current performance levels.

6.2 BARRIERS AFFECTING DEMAND FOR ENERGY MANAGEMENT

Energy management decision-making is a process starting initially with an understanding of the need for the opportunity, and then potentially moving ahead to making choices about the EM measures, product/service availability and financing. It appears that in the OECS there are barriers at each stage of this EM investment process, which together generate an overall perception of high risk that often overshadows the tangible investment returns from the actions. This situation is further exacerbated by the fact that in the productive sectors, as well as among institutional organizations, EM is ancillary to their day-to-day operations. Together with the fact that there is currently a lack of interest in, and general knowledge of, energy efficiency makes the EM investment process a significant challenge. This lack of awareness and action exists despite the fact that OECS electricity prices are high, generally 200 % higher than that of the U.S., for example.

More specifically, the specific barriers affecting demand for EM can be summarized as follows:

.1 *Lack of Awareness of the benefits of EM:* The productive sector, institutions and households do not fully realize the financial benefits of EM investments, both in terms of reducing operating costs and improving performance. Contributing to this problem is the fact that many companies do not appear to fully understand costs within their operations. Most also do not appreciate the environmental benefits associated with reduced energy consumption.

.2 *Awareness of the EM opportunities:* The different sectors of the OECS economy also are not fully aware of the EM opportunities within their operations. This does not only include large capital intensive measures, but also no- and low-cost actions. There are two critical factors involved in the issue of awareness:

- *Focus on first cost:* As is common in many less developed countries, the productive sector follows outdated equipment purchase and maintenance practices that work against EM. Together, these practices reflect a general purchase attitude that focuses almost entirely on lowest first cost, rather than the cost-effectiveness of the purchase over the useful life of the equipment. These practices include, for

instance: purchase of used/reconditioned equipment, rebuilding of equipment on-site, and a lack of maintenance of equipment.

- *Transaction Cost:* For an energy user, the decision to invest in energy management requires a transition from being a relatively passive player, to becoming quite active in the selection and purchasing process. The purchase decision requires the energy user to acquire information on product and service suppliers, a significant effort often referred to as “transaction cost”.

6.3 BARRIERS AFFECTING THE SUPPLY OF ENERGY MANAGEMENT

There does not appear to be a capacity in the OECS to deliver quality, sustained energy management services to the productive sector. This lack of capacity falls into three main categories of deficiency: i) lack of properly trained professionals to design, spec, manage and service energy management applications, and ii) lack of a domestic distribution network for energy management products, and iii) building design-build practices that impede innovation.

6.3.1 Lack of Properly Trained Energy Management Professionals and Tradespersons

6.3.1.1 Lack of Properly Trained Energy Management Professionals

Many engineering professionals, both mechanical and electrical, lack applied training in the field of energy efficiency and knowledge of technologies. There also appears a widespread tendency to move away from analytical methods to perform designs, a tendency which is particularly acute in the commercial sector.

6.3.1.2 Lack of Qualified Technicians/Installers

There is a lack of qualified and trained tradespeople (refrigeration technicians, steam fitters, boiler technicians and others), which is a critical problem partly accounting for the widespread practice of “breakdown” maintenance as opposed to preventive maintenance. This lack of qualified staff

creates a related barrier, where distributors are reluctant to offer higher efficiency or more sophisticated equipment due to their inability to maintain or repair it.

6.3.2 Lack of Domestic Distribution Network

There is no mature EM distribution network in the OECS today, meaning that there are very few wholesalers and retailers supplying advanced performance EM equipment. In the few instances where suppliers profess to offer such equipment, the energy performance is still far below what can be found in the North American markets. Equipment suppliers interviewed said they receive their products directly from wholesalers in Europe or the U.S. No wholesaler of electrical equipment either exists in the OECS, or is not considered to provide any useful benefit to retailers.

Retailers mentioned that many light fixtures imported from North America require conversion to allow them to operate at the OECS standard of 220v 50hz. Some energy efficient light fixtures were observed for sale, but their price was over three times the price for a similar fixture in North America. They were not prominently featured in any stores, and two retailers mentioned that they represent less than 2% of their total lighting sales. T12 40 watt fluorescent lamps are still the predominant light fixture in most public buildings, although in North America they are no longer sold, due to incompliance with energy efficiency regulations. The current North American standard T8 32 watt lamp was found for sale in one store, but we were told they did not sell well and were not being reordered.

6.4 SUMMARY OF BARRIERS

Table 6.1 summarizes the main barriers to energy management investment under the three categories discussed above.

Table 6.1

Summary of Barriers Affecting EM Investment

Type	Nature of Barrier
Cross- Cutting	• Access to financing • Lack of EE Standards/Labelling • Power quality
Demand	• Awareness of benefits of Energy Efficiency • Awareness of EE opportunities • Focus on first cost • Transaction cost (product/suppliers information)
Supply	• Lack of qualified tradespeople • Lack of a distribution network • Lack of trained professionals • Design-built practices

7.0 RECOMMENDATIONS

7.1 RECAP OF MAJOR OBSERVATIONS

The investigation underlying this report confirms that the OECS economies can generate significant economic and environmental benefits through investments in energy efficiency and renewable energy. Using estimates from similar studies in other jurisdictions, there appears to be an economic potential for energy use reduction in the range of 10% to 20%. This could result in an emissions reduction of 35-70000 tonnes per year of CO_2 from the electrical utilities alone. These 'credits' could then be sold on the world market. In effect, these opportunities represent the potential for the OECS to embark on a 'sustainable energy initiative' that would result in significant environmental and social benefits as well. As in the case of other countries, there is the opportunity to coordinate or integrate this initiative with efforts to foster cleaner production in industry and commerce. To summarize, the key observations emerging from this investigation are as follows:

.1 There is currently no structured energy management plan or policy in the OECS.

.2 There is general agreement among stakeholders of the need and importance of energy management.

.3 Energy costs in the OECS are, on average, 200 to 300% higher than North American averages.

.4 There is a general lack of awareness of energy management among energy consumers, building designers, and facility managers.

.5 The potential for renewable energy utilizing wind and solar systems is excellent.

7.2 SUSTAINABLE ENERGY PROGRAM

In view of the findings in this report, it is recommended that the OECS establish a multi-year **sustainable energy** program commitment. For the purposes of discussion, this program will have the following vision statement:

OECS Sustainable Energy Program-Vision Statement

Improvements to the efficiency with which energy is used in the OECS economies, as well as increased utilization of renewable forms of energy are the two cornerstones of the OECS Sustainable Energy Program. The Program is a key component of the OECS commitment to Cleaner Production. The Program provides the resources and structure to effectively meet practical and realizable objectives. This is a long-term commitment to ensure effective capacity building and sustainablity.

The OECS Sustainable Energy Program will be implemented consistent with the following principles:

.1 Long-term Commitment: Resources should be committed for a minimum 5 years. The experience in other developing country jurisdictions indicates quite clearly that a commitment of this degree is necessary to build capacity among trade allies, institutional staff and establish other critical program elements (e.g., demonstration projects and product testing).

.2 Practical Solutions: The program should be oriented to providing practical solutions in meeting reasonable goals. This means that the program approach should be to take advantage of the OECS energy management market characteristics, rather than to try and create a 'model' that doesn't really apply to the circumstances of the region. One of the key advantages is that a small number of large energy users can be singled out for a near-term focus of activities, such as energy audits of each energy user followed by a plan to

implement energy management recommendations from the audits. These users could become the demonstration models required to launch a public awareness campaign.

.3 Addressing Key Barriers: The Program will be designed to address the key barriers impeding accelerated market penetration of energy management actions.

.4 Measurement, Monitoring and Reporting: The Program should be supported by an ongoing measurement and monitoring system which is critical to reporting on results relative to stated objectives. As indicated in the findings of this report, there are some significant energy data gaps in the OECS. The absence of acceptable data will serve to undermine the Program because there will always be doubt as to the validity of results.

7.3 TIMING AND STRUCTURING OF THE PROGRAM

On the assumption that this will be initially a 5 year Program, it is recommended that the roll-out presented below be considered for development and implementation of the Program. The proposed Work Breakdown Structure for the Program involves three components. All three components will be implemented in parallel, but the first two components will receive the most focus in the short term and contain the items considered to be first steps.

7.4 PROGRAM COMPONENT # 1: BUILD AND MAINTAIN THE PROGRAM

7.4.1 Objective

To establish the foundation for Program success through development of the Program approach, identity, administration and professional capacity.

7.4.2 Overview

This work component will focus on developing and maintaining the Program operation. To be effective the Program will have to achieve a professional capacity to deliver its services and develop an administrative regime to track and manage its budget. The work activities would include:

.1 Complete program design: This would require extensive consultations with key stakeholders in the OECS as well as externally, among the development banks, for instance (see below). Clearly, the electric utilities are a key ally here and there are important questions to be addressed in terms of the nature of their involvement, and the means by which their participation can be financed under current regulatory and accounting circumstances.

.2 Establish Funding and Structure: There is a strong potential for the OECS to seek support from various international development banks and bilateral agencies for some co-funding of the Program. The World Bank continues to be a leading proponent of energy management and provides support through various channels including Official Development Assistance, the IFC and the GEF. The Inter-American Development Bank and Caribbean Development Bank are also possible allies.

.3 Establish and maintain Program allies: This will involve establishing a regular forum and structure for communication among key allies such as utilities, government agencies, and industry associations (e.g., Caribbean Association for Sustainable Tourism).

.4 Develop internal capacity: This will involve the design and implementation of a training curriculum for Program staff. This training must take into account efficiency and conservation opportunities in the transportation sector as well as the building and industrial sectors.

.5 Develop policy, legislative and regulatory proposals (see Program Component # 3).

.6 Operate as the institution to assemble, negotiate and market projects designed to generate certified GHG emission reduction credits.

7.5 PROGRAM COMPONENT #2: EDUCATION AWARENESS AND CAPACITY BUILDING

7.5.1 Objectives

The objectives of Program Component #2 are:

∃ To increase awareness among energy users and energy management (EM) trade allies of economic and environmental opportunities and benefits.

∃ To demonstrate technologies, methods, and techniques necessary to implement successful EM projects.

∃ To demonstrate how EM planning can be implemented into disaster preparedness management and planning.

∃ To build capacity among the trade allies to deliver quality and reliable EM services and products.

∃ To reduce risk, in the short term, associated with energy management investments.

7.5.2 Barriers Addressed

The barriers addressed by Program Component #2 are:

∃ Lack of awareness and understanding of energy management opportunities and benefits.

∃ Perception of risk associated with EM investments.

∃ Difficulties in accessing affordable equipment. Import duties on energy efficient products range as high as 60% in some OECS countries. This drives the price of even small items like compact fluorescent light bulbs beyond the means of many consumers. Lower efficiency products produced in Caricom nations are not subject to the same levels of duty.

7.5.3 Overview

This Program Component would comprise a range of activities designed to educate the market on energy management opportunities and create awareness as the basis for generating demand for EM products and services. It is important to note that this type of effort must be coordinated carefully in conjunction with the other components designed to establish the capacity to supply EM and the institutional changes necessary to address other critical barriers. In effect, this Program Component would constitute four main thrusts: i) project demonstrations, iii) a 'key accounts initiative' iii) specific education and awareness activities, and iv) trade ally capacity building.

The facilitation of demonstration projects is an effective means of showing the market that EM does pay off with financial, environmental, and other benefits. Demonstrations also show trade allies and the financial community that this is a legitimate source of business revenue. Technologies and applications appropriate to the conditions of the OECS would be the focus of the initiative, both commercially available (e.g., efficient lighting and cooling options) and leading edge (solar DHW, electric vehicles, fuel cells, small scale biomass generation) technologies. One important purpose of the demonstrations is to show EM working at a local level as opposed to a national or regional level. Small scale demonstrations managed at the local level may get greater interest from people if the projects are considered to be more relevant to their own situation.

The recommendation to develop a key accounts initiative is based on the recognition that within the OECS economies there are a relatively small number of large energy consumers. The concept then would be for the Program to work closely with these energy users to develop customized approaches to EM. One opportunity could be to work with BESCO, the Bermudan Energy Service Company highlighted in the case examples section of the report, to foster some commercial

transactions of EM investments. BESCO is looking to move beyond the Bermudan market.

Some of the key program activities would be:

.1 Demonstrations (general and for the Key Accounts):

- ∃ Market the activity and identify suitable candidates.
- ∃ Develop terms and conditions for project submissions, selection etc.
- ∃ Develop a portfolio of qualified suppliers.
- ∃ Manage feasibility assessments.
- ∃ Facilitate project development.
- ∃ Monitor and verify energy savings and emission reductions.

.2 Education and Awareness

- ∃ Ensure all public education campaigns include the environmental benefits of improved energy management, including reductions in GHG emissions.
- ∃ Encourage utilities to begin public education programs to make energy consumers aware of energy saving technology and procedures.
- ∃ Begin an electric vehicle promotion campaign by converting a fleet of government or utility vehicles to electric. Provide frequent public updates about the progress of the program highlighting the amount of fuel saved and the amount of pollution avoided.

- ∃ Establish energy conservation programs in schools and have students participate in the planning, implementation, and monitoring of the programs. Set up friendly competitions between schools to see which can achieve the largest savings.

.3 Trade Ally Capacity Building

- ∃ Establish a chair in energy efficiency at UWI, encompassing efficient building design, clean production, and supporting tools and techniques. Sponsor students from the OECS to study and conduct research. Use results to enhance codes and regulations and develop training courses (e.g., people in the construction industry including designers, builders, and suppliers).

7.6 PROGRAM COMPONENT #3: TRANSFORMATION OF THE INSTITUTIONAL ENVIRONMENT

7.6.1 Objective

The objective is to help develop the institutional environment and capacity necessary to catalyze and foster a sustainable energy management market.

7.6.2 Barriers Addressed

Program Component #3 addresses the following barriers:

- ∃ Weak policy, regulatory and legislative framework that discourages EM.
- ∃ Lack of information on credible solutions to the foregoing barriers.
- ∃ Energy pricing disincentives to EM.

7.6.3 Overview

This program component relates to the capacity among OECS institutions to introduce fundamental policy, legislative and other changes necessary to address several crosscutting barriers to EM. The recommended activities include:

.1 Foster studies necessary to assess and offer solutions to key institutional barriers.

This would include the transportation sector, which traditionally has been the most difficult of the sectors in which to foster EM. There appears to be EM opportunities, for instance, through improved traffic circulation in urban areas. Follow-up could include traffic flow studies investigating such schemes as creation of more one way streets, elimination of on-street parking on narrow streets, and designation of some streets, or portions thereof, with bicycles/scooters designation only. These studies should also investigate the feasibility of using various financial and tax instruments to foster EM investments.

.2 Mandate testing of energy using products. The focus would be on those products that represent the bulk of energy use and emissions (lighting, air conditioning, motors, boilers, domestic appliances, etc.) This testing would become the prelude to an eventual energy performance labelling initiative. The Jamaica Bureau of Standards could be called upon to assist with testing services.

.3 Revise national building codes to include minimum standards for energy performance in new construction. This would have to be carefully phased in to take account of the need to demonstrate design approaches and techniques, and to build capacity to provide effective designs. The research work developed by the recommended chair in energy efficiency at UWI could provide valuable assistance in assessing the effectiveness of new design techniques. Code revisions should also incorporate a greater degree of disaster preparedness into design by making buildings less reliant on outside sources of energy for their entire energy needs.

.4 Impose a regulatory regime under which electric utilities would be required to, and have the financial leeway to, develop and implement EM programs. Currently, most utilities are

government subsidized as far as pricing structure is concerned but this structure also inhibits the utilities' ability to generate profits to use for development and implementation of the type of EM projects discussed here.

The regulators must have legislative powers to force utilities to consider EM plans and actions, including submission of integrated resource plans. For instance, utilities in the region have an opportunity to revise their tariff structures as a tool to provide greater incentives for consumers to manage their energy demand and consumption. Examples include preferential time of day rates and demand metering of larger customers. The regulatory regime would also be the appropriate environment to push for better power reliability and quality, both necessary pre-conditions to EM success (e.g., develop plans for region wide voltage and frequency standardization).

.5 Remove or reduce import duties on EM products, including energy efficient products (high efficiency appliances, lamps) and renewable energy technologies such as DHW solar units, photovoltaic systems, and wind turbines.