WORLD BANK GEF
Post-Implementation Impact Assessment

Jamaica Demand-Side Management Demonstration Project
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Post-Implementation Impact Assessment

JAMAICA DEMAND-SIDE MANAGEMENT DEMONSTRATION PROJECT

GLOBAL ENVIRONMENT FACILITY PROGRAM
THE WORLD BANK
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# Acronyms and Abbreviations

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<tr>
<th>Acronym</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>BSI</td>
<td>Bureau of Standards Jamaica</td>
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<tr>
<td>CFL</td>
<td>compact fluorescent lamp</td>
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<tr>
<td>CO₂</td>
<td>carbon dioxide</td>
</tr>
<tr>
<td>DSM</td>
<td>demand-side management</td>
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<tr>
<td>EAST</td>
<td>Environmental Audits for Sustainable Tourism</td>
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<tr>
<td>EE</td>
<td>energy efficiency</td>
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<tr>
<td>EEBC</td>
<td>Energy Efficiency Building Code</td>
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<tr>
<td>EECP</td>
<td>Energy Efficiency and Conservation Programme</td>
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<td>ESCo</td>
<td>energy service company</td>
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<td>ESMAP</td>
<td>Energy Sector Management Assistance Program</td>
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<td>GDP</td>
<td>gross domestic product</td>
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<td>GEF</td>
<td>Global Environment Facility</td>
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<td>GHG</td>
<td>greenhouse gas</td>
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<tr>
<td>GoJ</td>
<td>Government of Jamaica</td>
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<tr>
<td>GWh</td>
<td>gigawatt-hour</td>
</tr>
<tr>
<td>ICR</td>
<td>Implementation Completion Report</td>
</tr>
<tr>
<td>IDB</td>
<td>Inter-American Development Bank</td>
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<tr>
<td>JDSMDP</td>
<td>Jamaica Demand-Side Management Demonstration Project</td>
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<tr>
<td>JPS</td>
<td>Jamaica Public Service Company Ltd.</td>
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<tr>
<td>kg</td>
<td>kilogram</td>
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<tr>
<td>kt</td>
<td>kiloton</td>
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<tr>
<td>KW</td>
<td>kilowatt</td>
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<tr>
<td>KWh</td>
<td>kilowatt-hour</td>
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<tr>
<td>LRMC</td>
<td>long-range marginal cost</td>
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<tr>
<td>Abbreviation</td>
<td>Description</td>
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<tr>
<td>--------------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>MCST</td>
<td>Ministry of Commerce, Science and Technology</td>
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<tr>
<td>MW</td>
<td>megawatt</td>
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<tr>
<td>MWh</td>
<td>megawatt-hour</td>
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<tr>
<td>NEPA</td>
<td>National Environment Protection Agency</td>
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<tr>
<td>NGO</td>
<td>nongovernmental organization</td>
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<tr>
<td>NOx</td>
<td>nitrogen oxide</td>
</tr>
<tr>
<td>NPV</td>
<td>net present value</td>
</tr>
<tr>
<td>PCJ</td>
<td>Petroleum Corporation of Jamaica</td>
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<tr>
<td>PV</td>
<td>photovoltaic</td>
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<tr>
<td>RR</td>
<td>Rate of return</td>
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<tr>
<td>SO₂</td>
<td>sulfur dioxide</td>
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<td>SWH</td>
<td>solar water heater</td>
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<tr>
<td>UNDP</td>
<td>United Nations Development Programme</td>
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<td>USAID</td>
<td>United States Agency for International Development</td>
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EXECUTIVE SUMMARY

The World Bank/Global Environment Facility (GEF) team has conducted a series of post-implementation impact assessments in order to better understand the long-term impacts of GEF projects, the sustainability of the impacts, the replicability of the projects, and lessons learned.

Four climate change projects in the energy efficiency thematic area were selected for study: the Poland Efficient Lighting Project, Mexico High Efficiency Lighting Project, Thailand Promotion of Electricity Energy Efficiency Project, and Jamaica Demand-Side Management Demonstration Project (JDSMDP), which is the subject of this report.

The JDSMDP was approved for implementation by the World Bank, in conjunction with the GEF, in June 1994 and was completed in December 1999. The total cost was $9.85 million, with the Bank providing $3.8 million. The project involved the promotion of compact fluorescent lamps (CFLs) and solar water heaters (SWHs) in the residential sector, as well as a number of other technologies in the commercial and industrial sectors of Jamaica. It was implemented by the Demand-Side Management (DSM) Unit of the Jamaica Public Service Company Limited (JPS).

Framework and Approach

The study assessed the success, sustainability, and attribution of the following outcomes and impacts:

- **Project Outcomes**: demonstration of technical and financial feasibility, increase in institutional capacity, development of replicable model
- **Intermediate Outcomes**: replication of the model, additional increase in institutional capacity, consumer preference influenced, improvement in capacity and confidence of distributors and retailers
- **Ultimate Outcomes**: transformation of the Jamaican energy efficiency markets
- **Impact**: energy savings, greenhouse gas (GHG) reductions, reductions in air pollutants of local concern, capacity savings, financial benefits

To identify and attribute impacts, three scenarios were developed: one representing actual and forecast sales of energy-efficient equipment (with JDSMDP) and two counterfactual scenarios representing low and high ranges of how sales would have evolved in the absence of JDSMDP.

**Project Outcomes**

In addition to the direct impacts of sales during the program, JDSMDP attempted to demonstrate the technical and financial feasibility of the technologies and to establish an approach and model for future programs.

The residential program was relatively successful and led to substantial sales of CFLs and SWHs. The key features of this model were bulk purchases, sales in local JPS offices, installment payments on the electric bill, and subsidized prices. The commercial and industrial programs were not successful, mainly due to lack of financing.

Institutional capacity for energy efficiency was established in the form of trained experts and the establishment of a revolving fund within JPS.

**Intermediate Outcomes**

A key factor in the sustainability of the project outcomes and the achievement of intermediate and ultimate outcomes was the 2001 privatization of JPS. Following this, the energy efficiency mandate was transferred to the Petroleum Corporation of Jamaica (PCJ), a state-owned enterprise that implements programs on behalf of the Ministry of Commerce, Science and Technology (MCST).

Our assessment concluded that the most successful feature of JDSMDP was the sales of CFLs. Replication of this sales program has resulted in large-scale acceptance of the product and its benefits by the general public. The program begun by the project was replicated first by PCJ and then grew to the point where CFLs are available today to consumers in most retail outlets throughout the island. Sales of SWHs were also relatively successful and replicated by PCJ. None of the other JDSMDP programs have been replicated. This is partly due to the lessons learned during JDSMDP and partly due to the lack of incentives, which results from the policy vacuum created by the privatization of JPS. There has been no known replication of JDSMDP programs outside Jamaica.

Public awareness of energy efficiency grew greatly as a result of the project. Thanks to the JDSMDP and the subsequent PCJ/MCST Energy Efficiency and Conservation Programme (EECP) in 2001, consumers are generally aware of the energy savings potential of CFLs.
and SWHs and have confidence in the technology. Even with the energy savings potential, however, initial cost is a significant barrier for most investments other than CFLs. While there is a high level of awareness within industry of the medium- and longer-term benefits of EE technologies, short-term financial considerations are preventing their adoption.

The project resulted in the development of significant institutional capacity for energy efficiency within JPS. Some of this capacity is still found there but it is underused due to the utility’s focus on energy sales, not energy conservation. Little capacity was transferred from JPS to the government at the close of the project; as a result, most of it was lost. Capacity is some specialized areas was developed in agencies such as the Bureau of Standards Jamaica and the National Environmental Protection Agency, and this capacity has survived.

With respect to the industry, there are now many CFL distributors and retailers and several SWH distributors, most of whom got their start during the time of the JDSMDP. But limited capacity was developed within the energy service industry.

Ultimate Outcomes
The key outcome has been transformation of the Jamaican residential lighting market (and, to a lesser extent, the domestic water heater market). When JDSMDP began, CFLs were expensive and hard to find; sales volumes were very low. Today they are affordable, they are visible in most retail outlets, and they have a growing share of the market.

- Prices for CFLs dropped from a range of $12–15 to around $3–5. JDSMDP played a moderate role in this change. Prices for SWHs have stayed relatively constant at approximately $1,200 for a typical 50-gallon residential unit and have not been significantly influenced by the project.
- Both CFLs and SWHs are readily available, largely due to the project.
- Annual CFL sales in Jamaica have risen from approximately 5,000 prior to 1995 to 85,000 in 2004 and are expected to reach some 130,000 by 2010. Annual sales of SWHs have doubled from approximately 400 in 1995 to 800 in 2004 and are expected to surpass 1,200 by 2010. The increase in sales was driven primarily by higher electricity costs but also by the greater availability, consumer awareness and confidence, and lower relative prices for the technology. JDSMDP had a significant impact on most of these factors, except for electricity prices.

JDSMDP has not had a significant impact on the mainstreaming of energy efficiency or global environmental issues in the policies of the government of Jamaica.

Sustainability
The greatest level of sustainability can be seen with the CFL component of the project.
Sales and use of CFLs have become common in Jamaica residential and commercial environments. To a lesser extent, SWH sales seem sustainable, though at much lower levels than CFLs. The photovoltaic initiatives were not sustained.

There is limited evidence of institutional sustainability of the project, particularly around energy audits and resulting measures implemented. This can be traced directly to the effects of the privatization of the Jamaica Public Service Company. The project had been focused on the utility, and it was assumed that the utility would carry on with project activities at its completion. This did not happen, as the newly privatized organization reengineered to concentrate on marketing electricity. Some limited institutional sustainability can be seen in the work of the Energy Efficiency Unit at PCJ. Unfortunately, the Unit did not benefit from the JDSMDP infrastructure and corporate memory that was left at project completion.

Since the end of the project, the policy environment has not facilitated market transformation. With the privatization of JPS, there was no entity that could provide incentives (such as lower tariffs or low-cost financing) to purchase EE technologies or undertake retrofit projects. The market transformation that did take place in the CFL market was mainly due to the relative low cost measures and the public awareness generated by JDSMDP.

Although PCJ followed up with the EECP, energy efficiency has not been a high priority of the government of Jamaica.

The supply channel for distribution of EE technologies was established during JDSMDP and continues today (particularly for CFLs and SWHs).

**Impacts**

The total sales and the associated increase in stock of CFLs and SWHs (from all sources) are estimated to have produced energy savings of approximately 28 gigawatts (GWh) in 2004 and associated GHG emission reductions of 34 kilotons (Kt). In the period 1995–2004, GHG emission reductions of 176 Kt were achieved and a further reduction of 325 Kt is expected to 2010.

The following range of impacts is attributed specifically to the JDSMDP:

- Energy savings of 12.5–18.4 GWh in 2004
- GHG emission reductions of 14.8–22.1 Kt in 2004
- GHG emission reductions of 100–120 Kt between 1995 and 2004 and a further 125–175 Kt by 2010
- NOx emission reductions of 625–750 tons between 1995 and 2004 and a further 790–1,100 tons in the period by 2010
- SO₂ emission reductions of 375–450 tons between 1995 and 2004 and a further 475–655 tons by 2010
• Capacity savings of 4–8 megawatts in 2003 (the last year of capacity constraint)
• Total resource net benefits of $4–4.6 million in the period 1995–2010 (approximately half the original investment)
• Total net benefits to consumer participants of $6–7.6 million in the period 1995–2010
• Total net costs to the utility of $2.1–3.4 million in the period 1995–2010

Lessons Learned

Our assessment suggests a number of lessons to be applied both in future programs and, more broadly, in developing approaches to energy efficiency.

• Privatized utilities cannot be expected to implement DSM programs unless there are regulatory incentives. Other government agencies can implement DSM programs, but they need appropriate resources and policy support. Privatizations should not go ahead without addressing these issues.
• Subsidies can be effective in jump-starting markets for EE technologies. The sale of EE technologies through established service outlets also provides an important incentive.
• Not all EE opportunities will be viable. By pursuing modest pilot programs, it is possible to identify which are most likely to be successful in wider application.
• The availability of financing is a major barrier in countries like Jamaica. Programs that depend on significant capital investments need to be designed to overcome this barrier.
• Public education is an important aspect of the success of DSM programs.
• Although most consumers are able to invest in low-cost, short payback, measures (such as CFLs), most of them (whether residential, commercial, or industrial) need additional assistance (such as low-cost financing) for larger investments.
• Capacity development efforts need to consider the possibility of institutional changes, such as privatization. This requires a broad reach and a risk management strategy to ensure capacity is preserved under all plausible scenarios.
• It is important to align program objectives with organizational ones. In this case, the objectives of JPS ultimately diverged from those of the program, and the capacity was lost.
• Ultimately, government has the greatest influence on the development of energy efficiency policy. Consequently, government entities (ministries and agencies) should be primary targets for capacity building.
The World Bank’s Global Environment Facility (GEF) Coordination Team has identified the need to assess post-implementation results of projects, especially in terms of longer-term impacts, sustainability, replicability, and lessons learned. In particular, there is a need to focus on lessons learned to better understand the extent of impacts and benefits, and the sustainability of these impacts, in order to determine how Bank-GEF operational programs’ long-term goals are being addressed.

This study was designed to support the Bank’s Monitoring and Evaluation policy (OD 10.70), which recommends that major impact studies be conducted on a selective basis several years after a project is completed to measure changes brought about by the project.

Four climate change projects in the energy efficiency (EE) thematic area were selected for study in 2004–5: the Poland Efficient Lighting Project; Mexico High Efficiency Lighting Project; Thailand Promotion of Electricity Energy Efficiency; and Jamaica Demand-Side Management Demonstration Project (JDSMDP). This report deals with the Jamaica project. The results will contribute toward learning lessons not only for the specific project and country but more significantly for the thematic area.

The impact study was intended to respond to the need for long-term impact assessment. It will contribute to the identification of factors that determine the sustainability of project outcomes and bring lessons to light that should help improve the design and implementation of Bank-GEF projects. The evaluation issues addressed included the following:

- The project’s overall results at the outcome level
- The project’s impacts on global environmental benefits
The project’s impacts on institutional development
- The project’s impacts on beneficiaries (such as livelihoods)
- Lessons learned for the sustainability of project impacts
- Replicability of outcomes achieved and catalytic effect of the project
- Lessons for improving the design and management of future activities and answering the question of how we can do them better
- The extent to which the project contributed to mainstreaming global environment concerns in the country’s national development and sector policies

The study also attempted to separate project-specific impacts from those due to other sources, including follow-up projects.
The Jamaica Demand-Side Management Demonstration Project was approved for implementation by the World Bank, in conjunction with the GEF, in June 1994. The project was originally scheduled for four years but was extended for one year and was completed in December 1999. The total original value of the project was $12.5 million, with a Bank/GEF grant of $3.8 million, an Inter-American Development Bank (IDB) loan of $4 million, a Rockefeller grant of $240,000, a Canadian grant of $150,000, and parallel financing by the Jamaica Public Service Company Limited (JPS) of $4.31 million. Actual costs were $9.85 million, with the reduction due to a reallocation by JPS and IDB of project-designated funds to repair a power plant damaged in an explosion.

The JDSMDP had two main objectives:

- Demonstrate, on a pilot scale and over five years, the potential for electricity savings to reduce fossil fuel requirements for electricity generation, with corresponding reductions in CO₂, NOₓ, and SO₂ emissions
- Strengthen the institutional capacity of the electricity sector and other relevant public and nonpublic agencies to engage in energy efficiency enhancement, implement the savings programs developed through the project on a larger scale, and develop a framework for broadening the program on a countrywide scale

In addition, the broader objective was to develop the basis for expanding the scope of the program, on a Jamaica-wide basis, and for having electric utilities in other developing countries establish similar programs.

The project was implemented by the Demand-Side Management (DSM) Unit of the Jamaica Public Service Company Limited.
The main components of the project were:

- Residential program (including compact fluorescent lamp (CFL) and solar water heater (SWH) elements)
- Commercial program (including SWH element, energy audits, and retrofits and new construction elements)
- Industrial program (focused on assessments of potential energy savings)
- Pilot photovoltaic (PV) electricity program for rural villages
- Program monitoring, evaluation, and quality control
- Institutional development of the DSM Unit
- Institutional development of related entities in the Government of Jamaica (GoJ) and others.

According to the Implementation Completion Report (ICR) prepared by the World Bank, the project was considered moderately satisfactory in achieving its objectives. While achievement of quantified targets fell about 50 percent short, the project did demonstrate the potential for electricity savings. Project results were most evident in the residential subsector, with results in the commercial and industrial subsectors (the largest electricity users) far below expectations. However, considerable gains were thought to have made in developing institutional expertise and public awareness. Project results in broadening the program were disappointing due to inadequate commitment by government and the diversion of JPS attention and resources.
3 Project Assessment Framework and Approach

3.1 Logical Framework

The Jamaica project was initiated prior to the adoption of results-based management tools, so no explicit logical framework was developed at that time. Fortunately, the project objectives and the context in which the project was designed and implemented provided enough of an understanding of the results logic to retrofit a logical framework. (See Figure 3.1.)

Figure 3.1 highlights the key “deliverables” or outputs of the project: the installation of CFLs; the installation of SWHs; the provision of commercial/industrial energy audits and the subsequent measure implementations; and the provision of training, assistance, and advice.

3.2 Results Framework

Table 3.1 presents the results framework for the key impact threads. This framework provided the basis for the design of the study instruments, including identification of sources and development of interview protocols.

3.3 Attribution

Sales of CFLs and other energy efficiency technologies introduced by JDSMDP were minuscule before the project started (at least an order of magnitude smaller than they were in 2004). Without objective data, it is difficult to determine how much of the growth was due to JDSMDP and how much was due to worldwide market transformation and other factors such as the cycles triggered by economic ups and downs. Nonetheless, using multiple lines of evidence, it is possible to assess the contribution of JDSMDP to various changes in the Jamaica market.

The indicators in Table 3.1 provide a way to describe the changes that have occurred since JDSMDP. The changes and the way in which JDSMDP had a role in each of these are quantified or described in later chapters.
To calculate the impact of JDSMDP on energy use and emissions, we needed to know what has actually happened since the program (and what is projected to happen in the near term), as well as what would have happened in the absence of JDSMDP (the counter-factual scenario). The difference between these two cases constitutes the incremental impact of JDSMDP. Unfortunately, historical and projected sales data are hard to obtain for Jamaica. Furthermore, no other countries in the region are similar enough to provide a credible proxy for sales in Jamaica. Nevertheless, in the interest of illustrating the quantitative implications of the assessment, the impacts were estimated using three subjective scenarios:

- A With JDSMDP scenario that incorporates all the available data on energy-efficient
Table 3.2. Results Framework for Jamaica Demand Side Management Demonstration Project Impact Study

<table>
<thead>
<tr>
<th>Result Statement</th>
<th>Indicators</th>
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<tbody>
<tr>
<td>Output: CFL installations</td>
<td>Units installed during program</td>
</tr>
<tr>
<td>Output: SWH installations</td>
<td>Units installed during program</td>
</tr>
<tr>
<td>Output: Commercial/industrial audits and measure implementations</td>
<td>Number of audits and scope of EE measures undertaken during program</td>
</tr>
<tr>
<td>Output: Training, assistance, and advice assistance or advice</td>
<td>Number of JPS staff and others to have received training, experience gained by JPS staff and others</td>
</tr>
<tr>
<td>Project Outcome: Residential, commercial, industrial program replication frameworks</td>
<td>Applicability of program frameworks to rest of Jamaica</td>
</tr>
<tr>
<td>Project Outcome: Demonstration of feasibility</td>
<td>CFLs: quality, life, grid compatibility, rate of return; SWH: quality, reliability, life, RR; Other EE measures: equipment and installation and quality, life, RR</td>
</tr>
<tr>
<td>Project Outcome: Capacity development</td>
<td>Lessons learned by JPS and other institutions; Experience gained by staff at JPS and in other institutions; Level of confidence of key players to undertake similar savings initiatives at the end of JDSMDP</td>
</tr>
<tr>
<td>Intermediate Outcome: CFL replication in Jamaica</td>
<td>Number, scope, and scale of similar programs since JDSMDP</td>
</tr>
<tr>
<td>Intermediate Outcome: SWH replication in Jamaica</td>
<td>Number, scope, and scale of similar programs since JDSMDP</td>
</tr>
<tr>
<td>Intermediate Outcome: Commercial/industrial program replication in Jamaica</td>
<td>Number, scope, and scale of similar programs since JDSMDP</td>
</tr>
<tr>
<td>Intermediate Outcome: Government policy</td>
<td>Natures of new policies since JDSMDP; Existence of appropriate institutional structures and incentives</td>
</tr>
<tr>
<td>Intermediate Outcome: Replication in other countries</td>
<td>Number, scope, and scale of similar programs since JDSMDP</td>
</tr>
<tr>
<td>Intermediate Outcome: Consumer preference influenced</td>
<td>Level of consumer awareness of CFLs, SWH, other EE measures; Level of consumer confidence in CFLs, SWH, other EE measures; Consumer purchasing intentions; Consumer attitudes to price premiums; Replacement rates</td>
</tr>
<tr>
<td>Intermediate Outcome: Trade ally capacity and confidence improved</td>
<td>Expertise of key groups; Professionals trained; Number of equipment suppliers, contractors, and engineers; Stocking practices, product quality ratings, levels of investment in production and distribution; Development of marketing networks, channels of supply and distribution</td>
</tr>
<tr>
<td>Ultimate Outcome: Lighting market transformation</td>
<td>Availability; Change in CFL prices; Sales</td>
</tr>
<tr>
<td>Ultimate Outcome: Solar water heater market transformation</td>
<td>Availability; Change in SWH prices; Sales</td>
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(continued on next page)
installations and extrapolates these data to provide a complete time series of sales from the start of JDSMDP until 2010 (chosen because it provides a reasonable period of time to allow for the differences between the scenarios to become evident)

- A No JDSMDP — High Baseline scenario that sets a higher boundary of the range of estimates of CFL and SWH installations that would have happened in the absence of JDSMDP and hence represents the lower boundary of the range of estimates of the incremental impact of JDSMDP
- A No JDSMDP — Low Baseline scenario that sets a lower boundary of the range of estimates of CFL and SWH installations that would have happened in the absence of JDSMDP and hence represents the higher boundary of the range of estimates of the incremental impact of JDSMDP

Although these scenarios — particularly the two counter-factual ones — were necessarily based on “educated best guesses” and many assumptions, we expected that by using a wide range of scenarios, as well as conservative assumptions, there could be reasonable confidence in the credibility of the results.

### 3.4 Methodology

The methodology involved the following tasks:

- **Preliminary Documentation Review**: The JDSMDP ICR was reviewed and a literature review was carried out in order to understand project activities, objectives, outputs, and immediate outcomes. See Appendix A for a list of references.
- **Development of Draft Study Plan**: Based on the available information, an initial version of the logical framework, results indicators, and preliminary list of desired documents and potential informants to interview were prepared. A preliminary interview protocol was also developed.
- **Logistical Arrangements for Field Mission**: With the help of the Petroleum Corporation of Jamaica (PCJ) and the Ministry of Lands and Environment, contact was established with the key individuals in-

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<th>Table 3.2. Results Framework for Jamaica Demand Side Management Demonstration Project Impact Study (continued)</th>
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<tr>
<td><strong>Result Statement</strong></td>
</tr>
<tr>
<td>Ultimate Outcome: Commercial/industrial energy services market transformation</td>
</tr>
<tr>
<td>Impact: Fuel and energy savings and greenhouse gas (GHG) emissions reductions</td>
</tr>
<tr>
<td>Impact: Local and environmental benefits</td>
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<td>Impact: Financial benefits</td>
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volved in energy efficiency, and meetings were arranged with individuals within the utility, government departments and agencies, supply firms, trade allies, and nongovernmental organizations (NGOs). The list of interviewees is provided in Appendix B.

- **Field Mission**: The field mission was conducted February 13–18, 2005. The Study Team consisted of Richard Patterson and Dr. Ron Titus. They were joined by Samuel Wedderburn of the World Bank for much of the mission. Interviews were conducted in small group sessions and with individuals, and additional documentation was collected.

- **Analysis**: Upon completion of the field mission, observations were compiled and additional documents were reviewed to determine findings, including quantitative assessments of key indicators. Interview notes were reviewed in order to estimate attribution, and calculations were made of the various impacts.

- **Reporting**: A first draft report was prepared for review by the World Bank. This final report incorporates reviewers’ comments and suggestions.
Project outputs and outcomes were assessed shortly after project completion, as reported in the Implementation Completion Report. This section summarizes the key findings of that report and adds some observations from the impact assessment team’s inquiries. In the Jamaican context, the project was innovative and risky, as there was no prior institutional capacity to carry out DSM programs, and end users had not been previously exposed to an energy-saving program. According to the ICR, several factors affected project outputs and outcomes: low international petroleum prices at the time of project implementation; macroeconomic deterioration and attendant financial crises; lack of GoJ and JPS support for energy efficiency measures; lack of involvement of large commercial energy users; and a reduction in project budget, with JPS reducing its contribution substantially. Despite the negative effects these factors had on project implementation, the ICR indicated that the project had substantially achieved many of its objectives and demonstrated considerable potential for saving electricity.

4.1 Compact Fluorescent Lights

The promotion of CFL use was aimed at the residential subsector and exceeded expected project results. By the end of the project, more than 32,000 households participated in the CFL program and almost 100,000 CFLs, costing about $1 million, had been sold to about 10 percent of JPS customers. It was estimated that this cut peak demand by about 1.7 megawatts (MW). After an initial rough start due to poor consumer response and quality problems with some CFLs, the program became popular with consumers, satisfaction was high, and a base was established for replication on a larger scale.

4.2 Solar Water Heaters

The SWH program had a commercial component and a residential component. The commercial component involved the supply, installation, and maintenance of SWH
systems in 12 large and small hotels as well as the student residences at the University of the West Indies (participants repaid the cost through their electricity bills over three years). The residential program involved the installation of SWH systems in 300 households (in this case, the repayment was over two years). Due to the later completion of the SWH program, few data on its results were included in the ICR. However, the team’s enquiries indicated that the program met its targets and that this resulted in a 0.6-MW reduction in peak demand from the 300 SWHs installed in residential households. The program also included a revolving fund to help ensure its sustainability.

4.3 Photovoltaic Equipment

The PV program used solar technology to provide energy to isolated rural villages as a complement to traditional grid expansion. It involved the installation of PV equipment in 42 homes in two villages, as well as training members of the community on the proper maintenance and operation of the systems. Each residence received the system (including installation), consisting of two 60-watt PV panels (a total of 120 watts), batteries, inverters, and circuit panels, at a cost of $1,700 per household, which provided for the operation of three fluorescent light bulbs, a small television set, and a radio at the same time. Beneficiaries were required to pay JPS a monthly fee of J$500 to be amortized over 10 years. JPS abandoned the maintenance and support services and the collection arrange-

ment on the grounds that the transaction costs exceeded the collections from the user fees. The systems subsequently fell into disrepair and were abandoned by their owners. PCJ has indicated that it is in the process of rehabilitating the PV installation in the 42 homes.

4.4 Energy Audits

JPS undertook energy audits in 15 large-volume commercial operations. Six of the organizations implemented the recommended energy efficiency measures. The commercial program of the project could not be implemented on a broader scale due to lack of low-cost funding, weakness of the Jamaican economy, and the inability of firms to self-finance. However, the program is estimated to have produced energy savings of 3,700 megawatt-hours (MWh) per year and 0.2 MW of peak demand reduction. In addition, funding from Canada provided for energy audits of 19 large industrial energy users. There was no investment follow-up by these users.

4.5 Training and Capacity Development

The DSM Unit at JPS developed into a valuable resource of experienced and well-trained staff. The project also provided training to a number of other individuals from such organizations as the Jamaica Environmental Trust and the National Consumers League who developed skills and knowledge that they use today for public awareness campaigns to promote energy conservation. Through this involvement of NGOs, the project enhanced public awareness of energy conservation and
the environmental impacts of fossil-fuel-based electricity generation. The ICR indicates that the project’s institutional development objective was met through creating an indigenous capacity for DSM activities both within JPS and among major energy consumers, NGOs, and educational institutions. Further, the report states that JPS’s acceptance in principle of the DSM Unit’s business plan and the establishment of a revolving fund for financing energy-efficiency-related expenditures provides some certainty that these achievements are sustainable.

4.6 Demonstration

The JDSMDP was designed as a pilot project to demonstrate the positive results of undertaking energy efficiency measures as a basis for larger DSM programs, both in Jamaica and elsewhere. By demonstrating significant potential for saving electricity in some sectors, the project substantially achieved many of its objectives. In the residential sector, JDSMDP showed significant potential for additional savings at low cost related to the use of energy-efficient lighting and solar water heaters. In the commercial sector, JDSMDP

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### Key Features of Residential Program

Through the residential component of the project, called the Power Saving Plan, JPS offered a 50 percent discount on incremental costs of three consumer packages. This gave an emerging technology a “jump start” into the market. As the market grew, the economies of scale allowed CFL prices to decrease, and the need for the subsidy diminished. The three packages were:

- Three CFLs
- Three CFLs and a low-flow shower head
- A home energy audit and direct installation of energy-efficient equipment, including up to five CFLs, low-flow shower heads, faucet/sink aerators, and refrigerator gaskets

Contact was made with customers directly at JPS commercial offices, where they came to pay their utility bills. The aim was to solicit participation from customers through the customer service offices islandwide. JPS customers who took advantage of the offer were able to pay for their purchases over time as part of their monthly utility bill. The original savings targets for the program were exceeded, with actual savings of 1.67 MW and 5,437 MWh. The key to this success was, first, the face-to-face contact between the promoter (JPS office staff) and the customer. This allowed customers to get answers to their more detailed questions on energy conservation and how the program worked. A previous attempt at gaining participation had involved a mailing that provided coupons and program information with the customer’s utility bill. The second successful characteristic was the ability of the customer to pay for the EE technologies on a time plan through their monthly utility bill. Also important was the ability to obtain CFLs at reasonable prices through bulk purchases and the control of CFL quality (although there were initial problems).
**Key Features of Commercial Program**

The commercial component was called the Power Plus Program. It was an energy audit and retrofit program for existing small and large energy consumers. Facilities were selected based on a review of applications and ranking against several criteria: high potential for energy savings, visibility, facility type, occupancy type, and an existing maintenance program. The program design involved the provision of financial incentives for the implementation of energy efficiency measures, which were identified through energy audits.

was meant to demonstrate the value of conducting energy audits and implementing retrofits. Due to the lack of low-cost funding, the weakness of the Jamaican economy, and the inability of firms to self-finance the necessary investments, however, substantial energy savings were not demonstrated by the project in the commercial sector.
This chapter provides an overview of the historical energy programs and of the economic and energy context for demand-side management in Jamaica.²

5.1 Historical Context

Since the oil shock of the 1970s, Jamaica has incorporated energy conservation and energy efficiency as important components of national energy policy, but the nation has had difficulty in achieving lasting positive results. Several initiatives to improve energy efficiency in both the public and the private sector have been undertaken by the former Ministry of Mining and Energy, the Petroleum Corporation of Jamaica, the Jamaica Public Service Company, and, more recently, the Ministry of Commerce, Science and Technology (MCST).

Energy Sector Assistance Project of 1981

The first major initiative of this kind was the $30-million U.S. Agency for International Development (USAID) Energy Sector Assistance Project, which was authorized in 1981 and lasted until 1985. Its main goal at the time was economic: to reduce Jamaica’s dependence on imported petroleum products and to free up scarce foreign exchange resources. Phase 1 provided technical assistance and training and offered grants for public sector energy conservation and alternative energy schemes, while Phase 2 provided loans to the private sector to support energy conservation. Phase 2 was later reduced by $4 million, as the private sector failed to take up the loans, which were set at commercial market rates. Major components included institution building to carry out energy audits in private firms, technology transfer, and public education and awareness. The project also dealt with electricity and energy policy reforms designed to reflect liberalization of the petroleum industry and the introduction of cost-based electricity and oil pricing.
Energy Efficiency Project of 1987

Following recommendations from a World Bank Energy Assessment report in 1985, another energy efficiency project was launched in 1987 by the Energy Sector Management Assistance Programme (ESMAP), with Canadian International Development Agency funding covering energy conservation and institution building in the energy sector. For this project, ESMAP worked with the Bureau of Standards Jamaica (BSJ) to develop an Energy Efficiency Building Code (EEBC) for new construction and improvements in commercial, institutional, and public buildings. A total of $80,000 was allocated to EEBC implementation, covering the development of the code, publication of handbooks, energy audits of six government buildings, and compliance reviews of about five buildings. An appliance testing and labeling program was also established at the BSJ, and an energy efficiency test laboratory for refrigerators and freezers was installed.

By the end of the project implementation period, the economic framework had improved. Petroleum products were liberalized and prices based on import parity were introduced. Electricity prices increased to reflect long-run marginal cost, with an increase of 37 percent in April 1990. Previously, prices had been based on the declining block structure, which did not reflect the cost of expanding generating capacity. The principle of “costs pass through” was introduced to reflect monthly changes in fuel prices and exchange rates.

USAID Environmental Audits for Sustainable Tourism

Environmental Audits for Sustainable Tourism (EAST) were initiated by USAID in 1997 (and are still in operation), with the main objective being the promotion of sustainable tourism. The EAST Project provides technical support for conducting environmental audits, including energy audits in the hotel and manufacturing sectors, as part of a wider environmental sustainability program. These audits focus on energy use, water use, wastewater generation, solid waste generation, and use of chemicals. More than 50 audits had been carried out in the hotel sector by 2003. EAST also extended the audit exercise: 25 manufacturing audits were conducted, as well as an audit of the University Hospital of the West Indies.

The EAST project does not finance the implementation of the measures recommended by the audits. The hotels and the manufacturing firms are expected to follow through with the implementation measures. The two major factors inhibiting investments in energy efficiency measures in Jamaica are absence of development finance and absence of an attractive financial incentive package. EAST has hired PA Consulting Group of the United States to manage the project through a local office, and they believe that when the costs of funds are in excess of 13 percent, the private sector is not motivated to follow through with implementation measures. So far, implementation activities have been con-
fined to those carrying short payback periods (one to two years) and are mainly financed from internally generated cash flows. The result is that high levels of investments have not taken place.

One of the major limitations to moving forward with the energy efficiency program that PCJ’s Energy Efficiency Unit has encountered is the absence of energy service companies (ESCos), despite the significant levels of investments in the training of energy auditors locally and overseas since the 1980s. Currently, only two local firms have developed the required capabilities to carry out audits and implement the recommended measures. A few other firms have the specialized skills in particular fields, such as air conditioning retrofitting and the installation of power factor correction devices.

One important lesson of the EAST project is the need to fully involve private sector enterprises in the tourism and manufacturing sectors and the need to increase public awareness among senior management in these sectors.

5.2 Macroeconomic Context

The Jamaican economy grew by 1.7 percent in 2001, following 0.7 percent growth in 2000 and four consecutive years of economic decline (1996–9). The economy is heavily dependent on services, which now account for 70 percent of gross domestic product (GDP). The country continues to derive most of its foreign exchange from tourism, remittances, and bauxite/alumina. The economy continued to grow moderately in 2003, with one of the best tourist seasons on record. But Jamaica faces serious long-term problems: high interest rates; increased foreign competition; a pressured, sometimes sliding, exchange rate; a sizable merchandise trade deficit; large-scale unemployment; and a growing internal debt, the result of government bailouts to ailing sectors of the economy. The ratio of debt to GDP is close to 150 percent. Inflation, previously a bright spot, is expected to remain in the double digits. Depressed economic conditions have led to increased civil unrest, including gang violence fueled by the drug trade. In 2004, the government faced the difficult prospect of having to achieve fiscal discipline in order to maintain debt payments while simultaneously attacking a serious and growing crime problem that was hampering economic growth.

5.3 Energy Sector Context

Jamaica’s per capita consumption of electricity and energy is one the highest in developing countries. A policy report done by the Organizacion Latinoamericana de Energia, based on data between 1993 and 2000, concluded that the energy intensity in Jamaica had increased substantially and that this situation is not sustainable. Despite the economic decline during 1996–9, the demand for electricity grew by an annual average of 5 percent.
Jamaica depends on imported fuel to meet about 94 percent of its energy needs. Current petroleum consumption is about 25 million barrels annually. The total cost of imported oil increased from $344 million in 1998 to $937 million in 2005. Over 95 percent of power is generated from imported fuel oil. JPS has a current capacity of 664 MW, with present peak demand of about 540 MW. Approximately 510 MW (about 77 percent of the total) is produced by JPS. The rest is available through agreement with private power companies and the alumina/bauxite company JAMALCO. JPS recently installed a new 120-MW combined-cycle generating facility at the Bogue generating facility in Montego Bay. As of 2004, all rights to new generating capacity will be subject to a competitive tender.

During the latter part of the 1990s, crude oil prices on the international market continued to decline, reducing the incentive to conserve and also reducing the government’s interest in the JDSMDP. The sharp decline in the economic and business climate and the financial crisis of the mid-1990s also reduced the willingness and ability of industrial and commercial consumers to follow up with the investment programs recommended by the energy audits. Annual GDP growth was projected at 3.5 percent for the project period (1996–9), but instead the economy experienced stagnation and even decline. Despite this sluggishness in the performance of the economy, the demand for electricity grew by an annual average of 5 percent.

Interest rates in Jamaica at the time were considered too high; combined with the absence of low-cost development financing and tax relief, this proved to be a major deterrent to energy efficiency investments. JPS had initially committed $4.3 million in local currency to the project finance, but the implementation period coincided with a freeze of electricity tariff, plunging JPS into a state of financial crisis in 1995–6. Under these circumstances, JPS severely reduced its financial commitments to the JDSMDP as well as senior management involvement.

5.4 Energy Policy Context

In March 2001, 80 percent of the GoJ’s shares in the Jamaica Public Service Company were sold to Mirant Energy Inc. of the United States for about $201 million. The deal fulfilled a government commitment in April 2001 to fill the gap in the 2000/2001 budget. The company continues to operate as the JPS under a 20-year license issued by the former Minister of Mining and Energy. The license does not provide for a guaranteed rate of return.

At the time, the government believed the sale agreement would allow the JPS to meet the growing demand being placed on it for improved, reliable, cost-effective service, since Mirant intended to invest about $500 million in upgrading the company’s generating capacity.

The key elements of the sale were as follows:
- The short-term debt of $120 million remained with the JPS. The government would, however, maintain the existing guarantees for up to one year of closing.
- The government, as the minority shareholder, would have three of the nine representatives on the board.
- The shareholders may be required to make additional capital contributions.
- Within the first three years of the agreement, neither party will be allowed to transfer any portion of its ownership interest.
- The government or its designee will be allowed to assume operation of the JPS and the power system temporarily if the buyer ceases to operate all or any substantial portion of the system for a specified period.
- All non-related JPS properties will revert to GoJ ownership after six months.

The supply and distribution of electricity in Jamaica is regulated by the Office of Utilities Regulation, and the Government Electrical Inspectorate is responsible for certifying all electrical installations to ensure that they meet the established standards. The GoJ’s Rural Electrification Programme aims to extend electricity to rural Jamaica as part of government’s commitment to provide everyone with access to electricity, to stimulate economic and social activity in rural areas, and to provide better quality life in rural communities.

Responsibility for energy policy development and program implementation in Jamaica is spread over several government agencies. The Cabinet Office and the Prime Minister’s Office are responsible for setting policy. It is implemented through programs developed in the Ministry of Commerce, Science and Technology, which includes the Energy Division of the old Ministry of Mining and Energy. The Petroleum Corporation of Jamaica is a government-owned agency that implements a variety of programs on behalf of MCST, and it houses the newly established Energy Efficiency Unit. In addition, the Ministry of Lands and Environment and, within it, the National Environment Protection Agency (NEPA) implement aspects of the energy policy.

The current 10-year-old National Energy Policy does not have an explicit DSM policy or strategy; however, the Prime Minister’s Office has embarked on development of a new policy. Among the proposals is one for increased government intervention in the renewable and energy efficiency market, given the lack of incentive for JPS. The proposed program would include promotion of CFLs, appliance labeling, outreach and information, energy audits and retrofits, promotion of solar technology, promotion of cogeneration, adoption of an energy efficiency building code, and improvements in the efficient transmission and distribution of electricity.

5.5 Current energy initiatives

At present, activities in the energy efficiency area are mainly discharged by three agencies:
the Energy Services Unit at JPS, which has taken over some of the functions of the DSM Unit and is now conducting energy audits mainly for large JPS customers; the Ministry of Commerce, Science and Technology, which is conducting energy audits for public sector agencies coming under the Ministry’s portfolio; and the newly established Energy Efficiency Unit at the Petroleum Corporation of Jamaica.

As a marketing strategy, JPS is currently focusing its energy audits on customers in the rate 40 and 50 bands. These audits are done at the request of the facility owners and paid for by them. The owners also have the responsibility to implement the recommended energy efficiency measures. One problem with this arrangement is that, since JPS is not directly responsible for implementation, there is no coordinated effort to document what measures have actually been implemented and to track the resulting energy savings.

The Ministry of Commerce, Science and Technology, through a small team of in-house engineers, is currently carrying out energy audits for public sector buildings falling under its portfolio. The recommended energy efficiency measures have yet to be implemented, mainly due to lack of funding. While this initiative provides the Ministry staff with useful hands-on experience, its services are very limited because staff members have a wide range of other duties, including technical regulation within the upstream area of the petroleum industry. Expansion is not recommended, as this would seem to be in conflict with government’s wider public sector policy, which has been unbundling service delivery and regulatory duties from the central ministry portfolio in order to separate policy and planning functions from service delivery and regulatory functions.

The Energy Efficiency Unit at PCJ was established in September 2003 to direct and coordinate the energy efficiency and conservation program at the national level, covering both the public and the private sector. Prior to its establishment, PCJ carried out some of the activities of the JPS DSM Unit and for about 18 months promoted the wide distribution of compact fluorescent lamps and solar lighting systems.

The PCJ Unit, along with the Energy Division of the MCST, has been helping coordinate a series of studies in the energy area:

- **Least Cost Expansion and Electricity Production Improvement Study**: This project was funded by the Canadian International Development Agency, at a cost of C$85,000, and carried out by Acres Management Consulting of Canada. The final report was due in early April 2005. It was to address new generation capacity; capacity for the national grid, including independent power projects; transmission and distribution losses; and investment and polices for the transparent and competitive
procurement of new capacity and the non-discriminatory dispatch of bulk energy.

- **Renewable Energy Study:** This study seeks to identify renewable opportunities and to narrow the potential to areas that are technically and commercially viable in order to increase the share of renewable energy technologies (wind, mini-hydro, bagasse cogeneration, biomass/waste, and solar technology) in the energy mix.

- **Energy Fund Study:** This project focuses on the institutional and financing arrangements needed for the establishment and operation of the proposed energy fund. The French Trust Fund ($45,000) is financing the project through the IDB. A French consulting firm, Innovation Energie Développement, is providing the services.

- **Study of Jamaica Energy Investment Needs:** This IDB study sought to identify the investment needs in the energy sector in Jamaica over the medium term. The final report was due in April 2005.

- **The Sugar Industry Ethanol Export Power Study:** This study sought to identify the potential for the generation and supply of export power to the JPS national grid and the potential for ethanol production from the sugarcane industry to supply the domestic and export markets. It was funded by PCJ and Petrojam Ethanol Ltd and conducted by an Indian consulting firm, Mukerhji and Associates. The final report was due in April 2005.

- **Regulatory Impact Assessment:** An application has been submitted through the Planning Institute of Jamaica to the Public-Private Infrastructure Advisory Facility for technical assistance to carry out an impact assessment of the nonfinancial regulatory agencies established since the structural adjustment and market reform programs of the 1990s. The agencies to be covered are the Office of Utilities Regulation, NEPA, the Spectrum Authority, the Broadcasting Commission, the Fair Trading Commission, and the Telecommunications Appeals Tribunal. The request for $270,000 is still to be approved.

- **Energy Efficiency Campaign Evaluation:** This evaluation of the energy efficiency public awareness and education programme was funded by PCJ and carried out by Market Research Services Ltd. The final report was submitted in January 2005.

The Energy Efficiency Unit at PCJ is also carrying out the following activities:

- Implementation of an energy efficiency program at four hospitals — Bustamante Hospital for Children and Cornwall Regional, St Anns Bay, and Princess Margaret Hospitals
- Capacity building of ESCos — some 22 professionals participated in a one-week energy manager’s workshop, funded by USAID at a cost of $30,000
- Impact case studies of individual energy efficiency projects, funded by USAID at a cost of about $15,000
• Extension of the Hospital Energy Efficiency Programme — the United Nations Development Programme (UNDP) has approved $300,000 to extend the hospitals program; in addition to expenditures at Bustamante Hospital for Children and Cornwall Regional, nine further energy audits are to be carried out in the hospital sector and selected educational institutions and an investment project is to be developed for all the remaining hospitals (public and private) and selected educational institutions.
This chapter assesses the role of the Jamaica Demand-Side Management Demonstration Project in subsequent replication and consumer preferences, government policy development, and use of capacity developed during the project.

6.1 Replication

Because of the privatization of JPS, replication of programs demonstrated during JDSMDP became the responsibility of PCJ.

In 2000, PCJ launched the Energy Efficiency and Conservation Programme (EECP), which focused on awareness programs similar to those delivered during JDSMDP. The program provided for the sale of CFLs through PCJ outlets at somewhat lower prices than the general market (PCJ was not seeking to make a profit on these sales). The program is ongoing and has resulted in CFL sales of approximately 130,000 units during 2000–4. The program also promoted sales of SWHs in 2000 and 2001, resulting in sales of approximately 550 units.

Most observers view the EECP as a direct continuation of the JDSMDP, and in fact the program was initially implemented by the same staff, who had merely transferred from JPS to PCJ. The general view is that without the JDSMSP precedent, the EECP would not have happened. Although the Assessment Team accepts this view, we believe there was enough internal interest and pressure in Jamaica to suggest that some sort of CFL program would likely have been implemented at some point during the period 2000 to 2004.

Although there have been delays due in part to inconsistencies in energy policy application, there has been some recent activity in terms of GoJ energy initiatives that represent a direct follow-up to the JDSMDP, including the following (as described in Chapter 5):
• The government has prepared drafting instructions for the building code, and is preparing the energy building code to come into law and to be mandatory.

• The government is financing energy retrofit projects in the hospital and education sectors with financial help from UNDP ($1.5 million has been allocated).

• The government has now removed duties and consumption taxes from SWHs and photovoltaic devices and equipment.

However, the impact assessment team found that there has been no substantial activity in the PV market since the JDSMDP pilot program due to several reasons. While the technology is sound and there is capacity to supply and install these systems, problems resulting from the initial pilot project with respect to maintenance, serviceability, replacement parts, and expansion capability have highlighted significant barriers. Although these are an impediment to energy efficiency, it is important to understand the barriers in terms of developing appropriate strategies for targeting energy efficiency efforts. For this reason, the assessment team believes there is significant value that emerged from JDSMDP through demonstration of the fact that some opportunities are not yet viable.

6.2 Government Policy

To date, the JDSMDP appears to have had a limited effect on government energy policy. The privatization of JPS in 2001 significantly affected the enabling environment for EE technologies, programs, and ESCos, and it left a significant vacuum in terms of incentives for system improvements. However, there is currently a plan in place to set up an Energy Fund to provide development financing for investments in energy efficiency measures, especially for the industrial and commercial sectors.

A new energy policy is being prepared with a section on EE that may yet reflect some influence of the project. Some current government programming has also been influenced. Following the project, the government set up the National Energy Efficiency Unit at the Petroleum Corporation of Jamaica. The GoJ’s current drive to be more energy-efficient and to reduce government spending on energy can also be traced back to JDSMDP. The project facilitated the setting up of the intra-government EE committee that still continues meeting and developing programs today. Such projects as the Ministry of Lands and Environment’s Green Procurement Guide stem from this committee and JDSMDP. The Environmental Management System at NEPA, in particular the EE processes, took their base of information from JDSMDP. In addition, the government organizes a Green Expo every two years where EE technologies and services are presented to the public and where public awareness is promoted.

JDSMDP supported the development of an EE code for buildings, but the code was not implemented because of a lack of government
support and, according to some observers, because it was too complicated to be useful. The building code is currently being revised, driven and funded by the private sector. The construction industry is aware of the EE code section (attributed directly to JDSMDP) of the larger building code, and it is possible that the code will eventually be adopted.

One of the failures of the JDSMDP was an inability to influence the Ministry of Finance. During the project, the Ministry offered tariff relief for solar water heaters but took that away after the project was completed. Tariff relief has since been reinstated on SWHs and other EE technologies, as noted earlier.

6.3 Consumer Preference

There appears to be a high level of awareness of energy efficiency in all sectors of Jamaica. One recent study indicated that more than 80 percent of polled residents had heard of CFLs. The main driving force for consumers to purchase EE technologies is to reduce their energy bill. The main reasons for not purchasing EE technologies are price, quality (to a lesser extent), and lack of awareness.

Sales of CFLs in the residential and hotel sectors continue to be robust, as there is confidence in the quality of the lamps in the market and the cost/benefits are seen to be positive. (After the project there was some importation of inferior CFLs, which dampened the public’s enthusiasm, but the Bureau of Standards Jamaica issued a public notice and corrected this situation by identifying the better-quality CFLs.) This situation can be directly attributed to the JDSMDP. While consumers are aware of the energy savings associated with SWHs, the initial cost has been a significant barrier to sales of this technology.

Awareness is present in industry, and industrial audits are available through JPS, MCST, and PCJ (albeit on a limited basis). However, few companies are undertaking energy audits and even fewer are following up with EE measures. Due mainly to financial constraints, only no-cost or very low cost EE measures are being implemented. Where industrial energy efficiency measures are being introduced, they are being driven by recent cost considerations, so the attribution to JDSMDP is limited. In addition, some industrial managers have little interest in EE as they are not price-constrained and can simply pass on higher energy costs to consumers via higher-priced products.

Despite some awareness and a strong government interest in renewables, there has been limited interest from potential end users. As noted previously, the PV installations in remote regions have not been sustainable, and there has not been any significant PV activity since the JDSMDP.

The Energy Efficiency and Conservation Programme launched by the PCJ targeted a number of sectors within the general popula-
tion: household/residential, schools, government/public, manufacturing/sugar industry, hotels and commercial, and professional associations. A public relations firm managed the campaign on behalf of the collaborating agencies. An evaluation of the program determined that, overall, fewer people in the residential segment than in the commercial or public sector were familiar with the term “energy efficiency.” Nevertheless, all were able to correctly interpret the term upon hearing it to mean saving energy or using energy only as needed.

Participants from the various segments had different levels of awareness of specific energy-saving measures. Using CFLs and turning off lights came to mind most readily as measures for saving energy. A number of participants responded positively to the messages and were able to attribute behavioral change in energy usage as a result of these messages (in terms of implementing energy conservation measures and buying energy-efficient equipment or appliances for homes and offices). Respondents felt that rewards and recognition as well as tax or lower import duties for purchasing or buying energy-efficient equipment were necessary. The use of seminars was widely recommended by the commercial and government segments for communicating energy efficiency. The residential segment felt teaching energy efficiency in schools would be an effective means of communicating these messages. PCJ is developing another public education awareness program on energy efficiency.

6.4 Institutional Capacity

Two of the main capacity development outcomes of the JDSMDP were the establishment of a trained group of experts in the DSM Unit and a revolving fund to undertake and operate programs. Unfortunately, with the privatization of JPS and the adoption of a commercial mandate, both the Unit and the revolving fund ceased to operate. Some of staff eventually made their way to PCJ, but by the end of 2001 all of them had left. Some moved to the private sector and improved the capacity of trade allies, but most of the institutional capacity was lost.

Some of the institutional capacity developed during JDSMDP still resides with JPS but is underused due to the utility’s focus on energy sales, not energy conservation. JPS staff and engineers were well trained in all areas of energy engineering, audits, technologies, marketing, and so on. Much of the equipment provided by the project is still with JPS, as is the remnant of the project’s revolving fund-assets acquired when the utility was privatized. Five individuals who received extensive training during JDSMDP remain with the utility. On occasion, JPS will carry out an audit as requested by customers. Energy auditing was not a core capacity at JPS prior to the project. Unfortunately, there is little incentive for JPS to use this capacity to promote or undertake EE measures.
Very little capacity was transferred from JPS to the GoJ at the end of the project, with the result being the loss of expertise and corporate memory. One professional did move from JPS to head the new Energy Efficiency Unit at PCJ following project completion, but that individual left after a short time to join the private sector. JDSMDP provided the Bureau of Standards Jamaica with testing equipment, and the current program of testing CFLs is a direct result of the project. Other than the EE processes found in the Environmental Management System at NEPA, little other institutional capacity in EE technology at the agency can be attributed to JDSMDP.

The project trained a number of villagers in the proper maintenance of PV systems in their rural communities. Many of these people subsequently left their communities, and the systems are no longer functioning. Other EE training programs initiated by the JDSMDP still exist, however. Jamaica Environment Trust, for example, still uses street theatre in their public awareness campaigns for energy efficiency. And the National Consumers League carries out public awareness campaigns using techniques, materials, and equipment provided by JDSMDP.

Capacity in financial institutions remains weak, and financing of retrofit projects in commercial buildings or industry is difficult, as banks are inexperienced with such projects and are reluctant to provide loans.

Current government initiatives in the area of institutional capacity include PCJ’s renewal (with help from USAID) of the program to develop competent energy services consultants; 22 engineers were trained in 2005. And there is a program to train science teachers in high schools on energy management; so far, schools in eight parishes have been covered.

### 6.5 Trade Ally Capacity

Few energy service companies carry out energy audits and subsequent implementation work in Jamaica. JPS does have the capacity but limits itself to performing walk-through audits when asked by a customer and only as a courtesy to maintain customer relations. The government has limited technical capacity either at the Ministry of Commerce, Science and Technology, the Petroleum Corporation of Jamaica, the National Environmental Protection Agency, or the Bureau of Standards Jamaica to help implement energy efficiency measures, so it seeks to contract out such work. In the case of hotels, as noted earlier, the USAID-funded program EAST hired U.S.-based engineers to conduct environmental/energy audits.

Approximately 60 persons received energy audit training from the United States Energy Association during JDSMDP. Some are with JPS, others work in various industries, and some have set up their own businesses. Very few are engaged in EE work. According to PCJ, only two companies in Jamaica
can do energy audits. No ESCos were set up during the project. Since then, however, a few ESCos have been established to sell and install EE lighting and SWHs. They trace their awareness and in one case their training to JDSMDP. In addition, there appears to be little senior management support and understanding of energy efficiency measures in organizations. This is needed in order for management and maintenance systems and EE programs to be implemented effectively.

The supply channel for distributors of EE technologies was established during JDSMDP. There are now a great number of retailers for CFLs throughout Jamaica. The distributors and retailers got started with JDSMDP, which provided the necessary awareness and training. Distributors and retailers have restricted themselves mainly to sales of CFLs and SWHs, as there is demand for these products. Due to the high cost of other EE technologies, however, there is not enough market demand to attract retailers or distributors. Such EE technologies are imported by a few ESCos, which install and maintain the equipment for a select number of consumers or firms (mainly hotels). There are no EE technology manufacturers in Jamaica.
7
Assessment of Ultimate Outcomes

7.1 Transformation of the CFL Lighting Market

Market transformation was not an explicit objective of JDSMDP. Yet through the global impacts sought by the World Bank, the program played a key role in ultimately transforming the residential lighting market from one focused exclusively on incandescent lamps to one relying increasingly on CFLs.

The key indicators of the residential CFL market transformation are availability, price, and sales.

CFL Availability and Marketing

Prior to the JDSMDP, CFLs were available from only a few retailers. Lack of consumer awareness and confidence coupled with substandard products contributed to a small market share within the residential market. In contrast, today consumers can buy a CFL at PCJ-owned petroleum stations anywhere on the island and at all major retailers, including grocery stores. In addition, several specialized energy efficiency product suppliers have set up business over the past few years as the markets matured. Although many factors influenced the increase in availability, the role played by JDSMDP and its successor, the EECP, in launching and nurturing the Jamaican CFL market suggests a relatively high attribution.

CFL Prices

The Study Team heard testimonials confirming that CFL prices had decreased substantially over the years — from highs of $12–15 to the current price of $3–5 (which is comparable to the price change observed in Mexico during the same period). The current cost was verified by the Study Team during a visit to a retailer. In the absence of any concrete information on the historical price of CFLs in Jamaica, the Study Team assumed a steady decrease in prices over the period. Incandescent bulbs cost about 50¢, and the price was assumed to have not changed significantly over the period. Table 7.1 provides
Table 7.1. Summary of CFL Price Data (nominal $)

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>CFL</td>
<td>$14.00</td>
<td>$13.33</td>
<td>$12.67</td>
<td>$12.00</td>
<td>$11.33</td>
<td>$10.67</td>
<td>$10.00</td>
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<td>$8.67</td>
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<td>$6.00</td>
<td>$5.33</td>
<td>$4.67</td>
<td>$4.00</td>
</tr>
<tr>
<td>Incandescent</td>
<td>$0.50</td>
<td>$0.50</td>
<td>$0.50</td>
<td>$0.50</td>
<td>$0.50</td>
<td>$0.50</td>
<td>$0.50</td>
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<td>$0.50</td>
</tr>
</tbody>
</table>

a summary of assumed CFL and incandescent price data for Jamaica.

Although the Study Team was told that the JDSMDP had a large influence on the retail price of CFLs in Jamaica through bulk purchases, lower margins, and increased competition, the Team believes that the worldwide market changes had a more significant impact. Overall, our assessment is that the price reduction had a moderate attribution to the JDSMDP program.

CFL Sales

Sales is the most important market transformation indicator, particularly for estimating the impact on energy savings and GHG emissions. The Study Team was able to find sources of sales data for the JDSMDP and the subsequent EECP. But information related to retail sales of CFLs was not available and was therefore estimated analytically.

In order to estimate a time series of sales, the Study Team used the following sources of information:

- Figures on the total sales of CFLs through the JDSMDP, as reported in the ICR
- Figures on the total sales of CFLs through the PCJ/MCST EECP, as provided by PCJ
- Interpretation of figures and statistics on the penetration of CFLs in the residential market as reported in 2001–2003 PCJ/MCST EECP Evaluation; it was estimated that approximately 40 percent of households currently use CFLs and that the average household uses two CFLs
- Figures on the total number of residential customers, as reported in the JPS annual report

In order to estimate total sales, we started by estimating the current size of the installed base of CFLs in Jamaica using the above sources. Assuming 40 percent penetration in 2004 and considering 462,000 residential households in Jamaica, this would imply an installed base of CFLs of 462,000 x two CFLs per household x 40 percent, or 370,000 CFLs. With this current base, we then used the following assumptions to develop a historical and projected time series of CFL sales:

- Three sources of CFLs sales to the residential sector: JDSMDP, EECP, and private sector retail sales
- JDSMDP total sales figures of 100,000 units during 1995–9
- EECP total sales figures of 130,000 units during 2000–4
• EECP continuing until 2010, using a modest sales rate increase of 1,000 units per year
• An average CFL service life of five years, so the installed base at the end of 2004 is represented by sales from 2000–4 and should add up to approximately 370,000 CFLs, as calculated above
• A small dip in the sales of CFLs during the transition at the end of the JDSMDP to the start of the PCJ/MCST EECP
• For 1995–2010, assuming a steady growth rate of retail sales of approximately 5,000 units per year to reach 50 percent market saturation in 2010, based on an average of 2.5 CFLs per household for an estimated 500,000 households

We adjusted the time series of program and retail sales to match these assumptions and produced Table 7.2. Note that the slowdown in sales in 2000 is explained as a reduction in CFL sales during the transition period from the JDSMDP to the EECP.

JDSMDP had an important part in generating these sales through its effect on prices, consumer awareness, and marketing. Of course, JDSMDP was not the only driver for these changes, and there were also other significant factors, including increases in electricity tariffs. Our overall assessment of the attribution of the sales to JDSMDP is presented in Table 7.3.

These four key factors are considered to have the most influence on CFL sales. Electricity prices, which increased steadily, were seen as highly influential on the CFL market. Lower CFL prices, both from program inducement and from market influences, had a moderate influence, since high CFL prices were a major barrier to consumer purchase. Product availability was seen as an important influencing factor because it was a barrier to widespread use of CFLs during the early period of the JDSMDP since retailers were not selling CFLs. Similarly, consumer awareness is an important influencing factor, since consumer awareness and understanding was low at the time of the JDSMDP.

We also used information from the interviews to assign the relative influence that JDSMDP had on each of these factors. The JDSMDP program had no influence on tariff increases,

### Table 7.2. Estimated Annual Residential CFL Sales (Thousands of Units)

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<th></th>
</tr>
</thead>
<tbody>
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<td>14</td>
<td>20</td>
<td>25</td>
<td>30</td>
<td>24</td>
<td>25</td>
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<td>29</td>
<td>30</td>
<td>31</td>
<td>32</td>
<td>33</td>
</tr>
<tr>
<td>PCJ/MCST EECP</td>
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<tr>
<td>Retail Market</td>
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<tr>
<td>Sales</td>
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<tr>
<td>TOTAL</td>
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<td>37</td>
<td>48</td>
<td>59</td>
<td>66</td>
<td>73</td>
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<td>94</td>
<td>101</td>
<td>108</td>
<td>115</td>
<td>122</td>
<td>129</td>
</tr>
</tbody>
</table>
which were brought on by economic and international pressures. JDSMDP and the subsequent EECP had a small impact of CFL prices. By offering CFLs to consumers at fair market prices, retailers were required to reduce their prices in order to compete, although a variety of other factors worked in parallel to reduce prices. The JDSMDP had a strong influence on product availability, due primarily to the convenience of the distribution channels set up through it and the PCJ/MCST EECP program. JDSMDP also contributed greatly to consumer awareness through the success of its public awareness and education campaigns.

The composite attribution resulting from each factor’s influence on sales and the JDSMDP influence on each factor resulted in assigning no attribution to electricity prices, low attribution to CFL prices, and moderate attribution to the other two factors.

### 7.2 Transformation of the SWH Market

The key indicators of the SWH market transformation are the same as for CFLs: availability, price, and sales.

#### SWH Availability

Prior to the JDSMDP, the market for SWHs was small (an estimated 250–400 units per year) and limited to a few suppliers. Lack of consumer awareness, coupled with a high cost, contributed to the small share within the residential market. In contrast, today there are many SWH suppliers and installation contractors operating in the market, including Solar Dynamics, which set up business in Jamaica in 1994, the year the JDSMDP began. The market is currently estimated at approximately 800–1,000 units installed per year. Although many factors influenced the increase in availability, JDSMDP and the EECP played an important role in nurturing the Jamaican SWH market. Overall, this suggests a moderate attribution of availability outcomes to the JDSMDP.

#### SWH Prices

Despite increases in input costs, the price of SHWs in Jamaica has remained relatively constant over the past few years due to increased competition from new players entering the market and the introduction of new import sources. Without any concrete information on the historical price of SWHs

<table>
<thead>
<tr>
<th>Key Factors</th>
<th>Factor’s Influence on Sales</th>
<th>JDSMDP Influence on Factor</th>
<th>Composite Attribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity Prices</td>
<td>High</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>Lower CFL Prices</td>
<td>Moderate</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Availability and Marketing</td>
<td>Moderate</td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td>Higher Consumer Awareness</td>
<td>Moderate</td>
<td>High</td>
<td>Moderate</td>
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</table>
in Jamaica, we have assumed a constant price of $1,200 for a typical 50-gallon residential unit. The price is primarily a result of global and regional market forces that were not significantly influenced by the JDSMDP. Our overall assessment is that price has a low attribution to the JDSMDP program.

**SWH Sales**

The Study Team was able to find sources of SWH sales data for the JDSMDP and the subsequent EECP. The time series of retail sales of SWHs had to be estimated analytically, however, based on trend information.

In order to estimate the time series of sales, the Study Team used the following sources of information:

- Figures on the total sales of SWHs through the JDSMDP as reported in the ICR
- Figures on the total sales of SWHs through the EECP as provided by PCJ
- An estimate of the installed base of SWHs currently in Jamaica as provided by Solar Dynamics
- An estimate of the current annual market sales rate

We then used the following assumptions to develop the historical and projected time series of SWH sales shown in Table 7.4:

- A current installed base of 10,000 units in Jamaica
- A current sales rate of 800–1,000 units per year
- 300 units installed under the JDSMDP between 1997 and 1999
- 550 units installed under the EECP between 2000 and 2001
- For 1995–2010, start with 400 units per year and assume a steady growth rate of retail sales of approximately 8 percent a year to reach 12,900 units a year by 2010 (or 2.5 percent of an estimated 500,000 households)

Note that the reduction in sales in 2002 is explained by the departure of the principal expert from the DSM Unit and the end of the solar water heater program at PCJ.

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</tr>
</thead>
<tbody>
<tr>
<td>JDSMDP</td>
<td>50</td>
<td>125</td>
<td>125</td>
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<tr>
<td>PCJ/MCST</td>
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<td>250</td>
<td>300</td>
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<tr>
<td>EE &amp;CV Retail</td>
<td>400</td>
<td>432</td>
<td>467</td>
<td>504</td>
<td>544</td>
<td>588</td>
<td>635</td>
<td>686</td>
<td>740</td>
<td>800</td>
<td>864</td>
<td>933</td>
<td>1,007</td>
<td>1,088</td>
<td>1,175</td>
<td>1,269</td>
</tr>
<tr>
<td>Market Sales</td>
<td>400</td>
<td>432</td>
<td>517</td>
<td>629</td>
<td>669</td>
<td>838</td>
<td>935</td>
<td>686</td>
<td>740</td>
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<td>933</td>
<td>1,007</td>
<td>1,088</td>
<td>1,175</td>
<td>1,269</td>
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<tr>
<td>TOTAL</td>
<td>400</td>
<td>432</td>
<td>517</td>
<td>629</td>
<td>669</td>
<td>838</td>
<td>935</td>
<td>686</td>
<td>740</td>
<td>800</td>
<td>864</td>
<td>933</td>
<td>1,007</td>
<td>1,088</td>
<td>1,175</td>
<td>1,269</td>
</tr>
</tbody>
</table>
JDSMDP played an important part in generating these sales through its effect on consumer awareness and marketing. Of course, as with CFLs, JDSMDP was not the only driver for these changes; other significant factors include increases in electricity tariffs. Our overall assessment of the attribution of the sales to JDSMDP is presented in Table 7.5.

These key factors are considered to be the most likely influential factors on SWH sales. Electricity prices, which increased steadily, were seen as highly influential on the SWH market. Stable SWH prices had high influence, since SWH prices were a major barrier to consumer purchase. Product availability and consumer awareness were seen as important influencing factors because they were considered as a barrier to acceptance and penetration of SWHs during the early years of the JDSMDP.

We also used information from the interviews to assign the relative influence that JDSMDP had on each of these factors. As with CFLs, the JDSMDP program had no influence on tariff increases, which were induced by the economic and international pressures. JDSMDP and the subsequent EECP had some influence on stabilizing SWH prices, since these were primarily influenced by increased uptake in the market. The JDSMDP had some influence on product availability by expanding and luring new players into the market. JDSMDP also influenced consumer awareness through the success of its public awareness and education campaigns.

The composite attribution resulting from each factor’s influence on sales and the JDSMDP influence on each factor resulted in the Team assigning no attribution to electricity prices and moderate attribution to the other three factors.

### 7.3 Transformation of the Commercial Energy Services Market

There has been very little activity in the commercial energy services market in terms of investment in energy efficiency products and services since the JDSMDP. While the Study Team did uncover some indication of market transformation, such as the emergence of new EE equipment suppliers, none of the transformation could be directly attributed to the JDSMDP.

<table>
<thead>
<tr>
<th>Key Factors</th>
<th>Factor’s Influence on Sales</th>
<th>JDSMDP Influence on Factor</th>
<th>Composite Attribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity Prices</td>
<td>High</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>SWH Prices</td>
<td>High</td>
<td>Low</td>
<td>Moderate</td>
</tr>
<tr>
<td>Availability</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Higher Consumer Awareness</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
Our assessment of impacts is based on the identification of the principal ultimate outcomes: increased sales of CFLs and SWHs. In order to assess the impacts of JDSMDP, we needed the time series of sales as they actually happened and are expected to happen in the near future (Tables 7.2 and 7.4). We also needed one or more counter-factual scenarios that represent hypothetical case(s) of how sales would have evolved in the absence of JDSMDP. Because of the significant amount of uncertainty involved in this speculation, we developed two counter-factual scenarios representing a range of potential impacts, as described in Chapter 3:

- A No JDSMDP — High Baseline scenario that sets a higher boundary of the range of estimates of CFL and SWH sales that would have happened in the absence of JDSMDP and hence represents the lower boundary of the range of estimates of the incremental impact of JDSMDP.

8.1 CFL Impacts

The CFL scenarios were defined on the basis of the interviews and our assessments of JDSMDP’s impact on EECP (see section 6.1) and on overall sales (Table 7.3). The key features of these counter-factual scenarios are outlined in Table 8.1. Detailed calculation spreadsheets for the impacts are provided in Appendix C.

As with the JDSMDP scenario, we start with a base of retail sales of 5,000 units. For the two scenarios, we assume that GoJ would have initiated a CFL energy efficiency program equivalent to the JDSMDP and EECP in 2000 and 2004 respectively, until 2010,
Table 8.1. Counter-Factual CFL Scenarios (No JDSMDP Program)

<table>
<thead>
<tr>
<th></th>
<th>High Baseline Sales – Low Impact</th>
<th>Low Baseline Sales – High Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>JDSMDP</td>
<td>No sales</td>
<td>No sales</td>
</tr>
<tr>
<td>EECP Sales</td>
<td>No sales</td>
<td>No sales</td>
</tr>
<tr>
<td>Equivalent Program to EECP</td>
<td>Energy efficiency program initiated in 2000 (6-year delay) with similar sales performance as JDSMDP and EECP and extended to 2010</td>
<td>Energy efficiency program initiated in 2004 (10-year delay) with similar sales performance as JDSMDP and EECP and extended to 2010</td>
</tr>
<tr>
<td>Retail Sales</td>
<td>Retail sales profile increases at a rate of 15% annually prior to program and 20% after program initiation</td>
<td>Retail sales profile increases at a rate of 15% annually prior to program and 20% after program initiation</td>
</tr>
</tbody>
</table>

and that retail sales rates would increase at a rate of 15% prior to the program and at 20% following initiation of the program. These assumptions yield the sales scenarios illustrated in Figure 8.1. This figure shows the JDSMDP scenario and the two counter-factual scenarios, as well as the incremental sales under both counter-factual scenarios.

Energy Savings

In order to calculate the energy savings, we first calculate the stock of CFLs installed for each scenario in each year and multiply this by the hours of use and the amount of energy saved per hour per CFL. We also apply an adjustment factor for snap-back, stockpiling, early removal, and burnout (see explanation.

Figure 8.1
Total CFL Sales

![Figure 8.1](image-url)
The stock is determined by the average lifetime of each CFL and the sales in the preceding years of CFLs that would still be in service.

Key assumptions were as follows:

- **CFL Lifetime**: We assumed the average CFL lifetime in this analysis to be 6,000 hours. CFLs in the Jamaican market are characterized by a range of lifetimes, from 10,000 hours for highest-quality products to less than 3,000 hours for low-quality bulbs. Persistence studies suggest that CFLs last more than five years in households, but the introduction of 3,000-hour CFLs provides a contrary influence on average lifetime. We chose 6,000 hours as an average.

- **Utilization**: We estimated CFLs would operate three hours per day (the same value as used in the Mexico study).

- **Adjustment Factor for Snap-back, Stockpiling, Early Removal, and Burnout**: Snapback is the tendency of consumers to use fixtures containing CFLs more than they would incandescent bulbs, since the wattage is lower. Stockpiling is the tendency of consumers to hold on to a CFL and not install it. Early removal and burnout affect the replacement rate of CFLs in households. The Study Team found no data on the replacement rate of CFLs sold under JDSMDP and its successor program. In the absence of data, we have chosen to use a constant factor of 15 percent to account for all of these effects.

- **Power Savings per CFL**: CFL wattage is typically between one-quarter and one-third of the wattage of the incandescent bulb it replaces. For our analysis we used an average wattage difference of 50 watts (similar to the approach used in the Mexico study). We assumed that these values are similar for all CFL replacements, whose choice should be based on nearly equivalent light output for each.

- **Transmission and Distribution Losses**: This factor identifies the amount of energy lost between generation and the lighting fixture, providing a basis for calculating the amount of energy savings at the generating station. For the purposes of this study, we use 18 percent, as reported in the JPS 2003 Annual Report.

Based on these assumptions, the various scenarios and range of incremental impacts are shown in Table 8.2 and Figure 8.2.

Based on these estimates, the use of CFLs resulted in energy savings of approximately 111 gigawatt-hours (GWh) in 1995–2004 and will save an additional 204 GWh to 2010. Of this total, 76–90 GWh are attributable to JDSMDP in 1995–2004 and an additional 92–125 GWh through 2010.

**GHG Emission Reductions**

Without running a dispatch model to see which plants would be curtailed, it is not
Table 8.2. Estimated Energy Savings

<table>
<thead>
<tr>
<th>Year</th>
<th>Stock of CFLs (w/ JDSMDP)</th>
<th>Stock w/o JDSMDP</th>
<th>Incremental Stock due to JDSMDP</th>
<th>Estimated Energy Saving (GWh)</th>
<th>Stock w/o JDSMDP</th>
<th>Incremental Stock due to JDSMDP</th>
<th>Estimated Energy Saving (GWh)</th>
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<td>5,000</td>
<td>11,000</td>
<td>0.6</td>
<td>5,000</td>
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<td>5.7</td>
<td>24,967</td>
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<td>5.7</td>
</tr>
<tr>
<td>1999</td>
<td>185,000</td>
<td>33,712</td>
<td>151,288</td>
<td>8.6</td>
<td>33,712</td>
<td>151,288</td>
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<td>10.1</td>
<td>38,769</td>
<td>189,231</td>
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<td>44,584</td>
<td>224,416</td>
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<td>207,044</td>
<td>11.8</td>
<td>51,272</td>
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<td>58,962</td>
<td>278,038</td>
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<td>174,839</td>
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<td>215,306</td>
<td>200,694</td>
<td>11.4</td>
<td>108,857</td>
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<td>2006</td>
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<td>2007</td>
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<td>375,140</td>
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<td>393,992</td>
<td>331,008</td>
<td>18.8</td>
<td>311,284</td>
<td>413,716</td>
<td>23.5</td>
</tr>
<tr>
<td>2010</td>
<td>803,000</td>
<td>455,996</td>
<td>347,004</td>
<td>19.7</td>
<td>366,830</td>
<td>436,170</td>
<td>24.8</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>168.1</td>
<td></td>
<td></td>
<td>215.3</td>
</tr>
</tbody>
</table>

Figure 8.2
Energy Savings
Assessment of Impacts

It was reported to the Study Team that the base load is generated with heavy-fuel-oil-powered steam turbines and that the variable loads are handled with diesel generators. Therefore a GHG emission reduction factor of 1.2 t/MWh was used, based on the use of diesel as the marginal fuel. The results are shown in Table 8.3 and Figure 8.3.

Based on these estimates, the use of CFLs resulted in GHG emission reductions of approximately 132 kilotons (Kt) in 1995–2004, with additional reductions of 245 Kt expected through 2010. Of this total, 91–108 Kt are attributable to JDSMDP in 1995–2004 and an additional 111–150 Kt in the period to 2010.

Local Environmental Benefits

In addition to the global benefits of reduced GHGs, the electricity savings have also lowered emissions of air pollutants that have significance at the local level. Emission factors for NOx and SO₂ were obtained from Marbek’s in-house database of GHG emission reduction factors as SO₂ at 4.5 kg/MWh and NOx at 7.5 kg/MWh.

The use of CFLs resulted in SO₂ emission reductions of approximately 498 tons in 1995–

<table>
<thead>
<tr>
<th>Year</th>
<th>High Baseline – Low Baseline Scenario</th>
<th>Low Baseline – High Impact Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimated Energy Savings (GWh)</td>
<td>GHG Emission Reduction (kT)</td>
</tr>
<tr>
<td>1995</td>
<td>0.6</td>
<td>0.7</td>
</tr>
<tr>
<td>1996</td>
<td>1.7</td>
<td>2.1</td>
</tr>
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<td>1997</td>
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<td>1998</td>
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<td>6.9</td>
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<td>2000</td>
<td>10.1</td>
<td>12.1</td>
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<tr>
<td>2001</td>
<td>11.3</td>
<td>13.5</td>
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<tr>
<td>2002</td>
<td>11.8</td>
<td>14.1</td>
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<td>2003</td>
<td>11.6</td>
<td>13.9</td>
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<td>2005</td>
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<td>2006</td>
<td>12.4</td>
<td>14.8</td>
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<tr>
<td>2007</td>
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<td>16.8</td>
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<tr>
<td>2008</td>
<td>16.2</td>
<td>19.4</td>
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<td>2009</td>
<td>18.8</td>
<td>22.5</td>
</tr>
<tr>
<td>2010</td>
<td>19.7</td>
<td>23.6</td>
</tr>
<tr>
<td>Total</td>
<td>168.1</td>
<td>201.5</td>
</tr>
</tbody>
</table>
2004 and a projected additional 919 tons to 2010. Of this total, 158–405 tons are attributable to the JDSMDP in 1995–2004 and an additional 503–565 tons through 2010. NOx emission reductions of approximately 830 tons were estimated for 1995–2004, with an additional 1,532 tons expected to 2010. Of this total, 263–675 tons are attributable to the JDSMDP in 1995–2004 and an additional 839–941 tons through 2010.

**Capacity Savings**
The generating capacity savings displaced by the use of CFLs were derived using a peak coincidence factor of 0.5. Furthermore, based on the interviews, we estimate that Jamaica was capacity-constrained during the period of the JDSMDP and until 2003 but that the island currently has excess capacity (and is likely to continue to have this to 2010), since a new 120-MW combined cycle plant was brought online in 2003.

Based on our estimates, the use of CFLs resulted in capacity savings of approximately 9 megawatts in 2003. Of this total, 1.5–3.5 MW are attributable to the JDSMDP.

**Financial Impacts**
To determine the financial impacts, we applied the following tests: total resource costs and benefits, costs and benefits for the consumer participants (the beneficiaries), and costs and benefits for the utility, as follows:

- Total Resource Benefit-Cost = Cost of Incandescent Lights Saved + Cost of Energy Saved + Cost of Capacity Saved (until
2003 only) + Value of GHG Emission Reductions – Cost of CFLs

- Consumer Participant Benefit-Cost = Cost of Incandescent Lights Saved + Cost of Energy Saved – Cost of CFLs

To complete these calculations, we used the energy savings calculated earlier and the following cost information:

- **Cost of Lamps**: The sources of unsubsidized prices of both CFLs and incandescent bulbs are discussed in Chapter 6. The lifespan of incandescent bulbs was assumed to be one year, so the entire stock rolls over each year.

- **Electricity Prices**: Consumer electricity prices, shown in Table 8.4, were derived from actual utility prices (1999–2003) taken from the JPS 2003 annual report. The historical and projected price profiles were based on the rate of increase observed during the period 1999 to 2003.

- **Long-Range Marginal Cost (LRMC) of Energy and Capacity**: We were unable to obtain actual values and therefore used a value from the year 1992 of $0.07 per kWh (and expect the value to be low) and a LRMC of capacity value (at the distribution level) of $126/kW/year used in the Mexico study.

- **Value of GHG Reductions**: We assume a value of $10/tonne of CO₂-equivalent (GHG) reductions, a typical value used for estimating the value of GHG reductions.

Using these estimates, we calculated the following regarding CFL use over the period 1995 to 2010: total benefits at $9.6 million, total costs at $3.7 million, and net benefit at $5.9 million.

The breakdown of the benefits and costs is shown in Figures 8.4 and 8.5.

Total costs and benefits for CFL use over the entire period 1995–2010 are shown in Figure 8.6. Figure 8.7 provides the low end

---

### Table 8.4. Electricity Prices Used in the Analysis (nominal US cents/kilowatt-hour (kWh))

<table>
<thead>
<tr>
<th>Year</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>0.110</td>
</tr>
<tr>
<td>1996</td>
<td>0.115</td>
</tr>
<tr>
<td>1997</td>
<td>0.121</td>
</tr>
<tr>
<td>1998</td>
<td>0.127</td>
</tr>
<tr>
<td>1999</td>
<td>0.133</td>
</tr>
<tr>
<td>2000</td>
<td>0.140</td>
</tr>
<tr>
<td>2001</td>
<td>0.160</td>
</tr>
<tr>
<td>2002</td>
<td>0.160</td>
</tr>
<tr>
<td>2003</td>
<td>0.180</td>
</tr>
<tr>
<td>2004</td>
<td>0.190</td>
</tr>
<tr>
<td>2005</td>
<td>0.196</td>
</tr>
<tr>
<td>2006</td>
<td>0.202</td>
</tr>
<tr>
<td>2007</td>
<td>0.208</td>
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<tr>
<td>2008</td>
<td>0.214</td>
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<tr>
<td>2009</td>
<td>0.220</td>
</tr>
<tr>
<td>2010</td>
<td>0.227</td>
</tr>
</tbody>
</table>
of the range of incremental impacts attributable to JDSMDP, and Figure 8.8 provides the upper end.

- **Total Resource Benefit-Cost**: The total net benefits of CFL use in the period 1995–2010 have a net present value (NPV) of $5.9 million, representing a rate of return of approximately 104 percent. Of this, $4–4.6 million is attributable to JDSMDP.
- **Consumer Participant Benefit-Cost**: The total benefits net to consumer participants in the period 1995–2010 have an NPV of
approximately $10.9 million, representing a rate of return of 94 percent. Of this, $6–7.6 million is attributable to JDSMDP.

- **Utility Benefit-Cost**: For the utility, there is a net cost over the period 1995–2010 that amounts to an NPV of approximately
$5.4 million. Of this, $2.1–3.4 million is attributable to JDSMDP.

### 8.2 Solar Water Heater Impacts

The SWH scenarios were defined on the basis of the interviews, our assessments of JDSMDP’s impact on subsequent programs (Section 6.1), and JDSMDP’s impact on overall sales (Table 7.5). The key features of these counter-factual scenarios are found in Table 8.5. (As noted earlier, detailed calculation spreadsheets are available in Appendix C.)

As with the CFL scenarios, we assumed that the government would have initiated an energy efficiency program similar to the JDSMDP in 2000 and to the EECP solar water programs in 2004 and that this would continue through. We also assumed that retail sales rates would increase at a rate of 3 percent prior to the program and at 8 percent after the program began. These assumptions yield the sales scenarios illustrated in Figure 8.9, which includes the JDSMDP scenario and the two counter-factual scenarios, along with the incremental sales under the latter.

#### Energy Savings

In order to gauge the energy savings, we simply calculated the number of SWHs installed for each scenario in each year and then multiplied this number by the average annual savings per unit. Key assumptions were as follows:

- **SWH Lifetime**: We assumed a lifetime of 20 years.
- **Energy Savings**: We assumed an average unit savings of 907 kWh per year, derived from the results presented in the ICR.
- **Demand Savings**: We assumed an average unit power draw of 4 kW and a coincidence factor of 0.5, resulting in a unit demand savings of 2 kW (4 x 0.5).
- **Transmission and Distribution Losses**: This factor identifies the amount of energy lost between generation and an existing electric DHW tank heater, providing a basis for calculating the amount of energy.

<table>
<thead>
<tr>
<th>Table 8.5. Counter-Factual SWH Scenarios (No JDSMDP Program)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High Baseline Sales – Low Impact</strong></td>
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<tr>
<td>JDSMDP</td>
</tr>
<tr>
<td>EECP Sales</td>
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<tr>
<td>Equivalent Program to EECP</td>
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<tr>
<td>Retail Sales</td>
</tr>
</tbody>
</table>
savings at the generating station. For the purposes of this study, we use 18 percent, as reported in the JPS 2003 Annual Report.

Based on these assumptions, the various scenarios and range of incremental impacts are shown in Table 8.6 and Figure 8.10.

The installed SWHs resulted in energy savings of approximately 36 GWh in 1995–2004 and will save an additional 67 GWh through 2010. Of this total, 8–9 GWh can be attributed to JDSMDP in the first period and an additional 13–20 GWh up to 2010.

**GHG Emission Reductions**

Figure 8.11 shows the assumed and potential GHG emission reductions, based on a GHG emission reduction factor of 1.2 t/MWh, as described earlier.

Based on these estimates, the installation of SWHs resulted in GHG emission reductions of approximately 43 kilotons in the period 1995–2004 and additional reductions of 80 Kt up to 2010. Of this total, 10–11 Kt are attributable to JDSMDP in the period 1995–2004 and an additional 16–24 Kt up through 2010.

**Local Environmental Benefits**

As noted in the discussion on CFLs, electricity savings have also reduced emissions of air pollutants that have significance at the local level. The same emission factors mentioned
Table 8.6. Estimated Energy Savings

<table>
<thead>
<tr>
<th>Year</th>
<th># of SWHs (w/ JDSMDP)</th>
<th>Stock w/o JDSMDP</th>
<th>Incremental Stock due to JDSMDP</th>
<th>Estimated Energy Saving</th>
<th>Total</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Units)</td>
<td>(Units)</td>
<td>(Units)</td>
<td>(GWh)</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>400</td>
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<td>0</td>
<td>0.00</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
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<td>832</td>
<td>812</td>
<td>20</td>
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<td>0.1</td>
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<td>0.94</td>
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<td>1.0</td>
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<td>1.7</td>
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<td>2.0</td>
</tr>
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<td>2.2</td>
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<td>2.8</td>
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<td>11,711</td>
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<td>3.8</td>
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<td>4.2</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>20.9</td>
<td>29.3</td>
</tr>
</tbody>
</table>

Figure 8.10
Energy Savings
earlier were used here: $\text{SO}_2$ at 4.5 kg/MWh and $\text{NOx}$ at 7.5 kg/MWh.

The use of SWHs resulted in $\text{SO}_2$ reductions of approximately 163 tons in 1995–2004 and an additional 302 tons to 2010. Of this total, 36–43 tons can be attributed to the JDSMDP over the last 10 years and an additional 58–89 tons up through 2010. Using SWHs resulted in $\text{NOx}$ emission reductions of about 271 tons for 1995–2004 and an additional 503 tons to 2010. Of this total, 60–71 tons are attributable to the JDSMDP in the first period and an additional 97–149 tons up to 2010.

**Capacity Savings**

As indicated, the generating capacity savings displaced by the use of SWHs was derived using a peak coincidence factor of 0.5. Based on our estimates, the use of SWHs resulted in capacity savings of approximately 14 megawatts in 2003, with 3–4 MW attributable to the JDSMDP.

**Financial Impacts**

The financial impact of SWH sales is small in comparison with CFL sales and was therefore not included in the analysis.

**8.3 Total Impacts**

The combined impacts of the CFL and SWH sales are summarized in Table 8.7.

![Figure 8.11: GHG Emissions Avoided](image_url)
Table 8.7. Impacts of CFL and SWH Sales

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Units</th>
<th>Impact of Total Sales</th>
<th>Incremental Impact due to JDSMDP (Low Impact Estimate)</th>
<th>Incremental Impact due to JDSMDP (High Impact Estimate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Savings (1995 to 2010)</td>
<td>GWh</td>
<td>271</td>
<td>105</td>
<td>145</td>
</tr>
<tr>
<td>GHG Emission Reductions (1995 to 2004)</td>
<td>kt</td>
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<td>119.3</td>
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<tr>
<td>GHG Emission Reductions (1995 to 2010)</td>
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<td>325</td>
<td>126.3</td>
<td>173.8</td>
</tr>
<tr>
<td>SO2 Emission Reductions (1995 to 2004)</td>
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<td>0.376</td>
<td>0.448</td>
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<tr>
<td>SO2 Emission Reductions (1995 to 2010)</td>
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<td>0.661</td>
<td>0.474</td>
<td>0.654</td>
</tr>
<tr>
<td>NOx Emission Reductions (1995 to 2004)</td>
<td>kt</td>
<td>1.221</td>
<td>0.627</td>
<td>0.746</td>
</tr>
<tr>
<td>NOx Emission Reductions (1995 to 2010)</td>
<td>kt</td>
<td>1.101</td>
<td>0.79</td>
<td>1.09</td>
</tr>
<tr>
<td>Capacity Savings (2003)</td>
<td>MW</td>
<td>2.035</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Total Resource Net Benefit</td>
<td>$M</td>
<td>5.9</td>
<td>4.0</td>
<td>4.6</td>
</tr>
<tr>
<td>Consumer Net Benefit</td>
<td>$M</td>
<td>10.9</td>
<td>6.0</td>
<td>7.6</td>
</tr>
<tr>
<td>Utility Net Benefit</td>
<td>$M</td>
<td>–5.4</td>
<td>–2.1</td>
<td>–3.4</td>
</tr>
</tbody>
</table>
9
CONCLUSIONS

The Jamaica Demand-Side Management Demonstration Project served as a model that was replicated in PCJ’s Energy Efficiency and Conservation Programme. Both JDSMDP and EECP played significant roles in raising consumer awareness and increasing consumer acceptance of some EE technologies, especially CFLs and, to a lesser degree, SWHs. The projects also played significant roles in improving availability of those technologies and smaller roles in lowering prices, all of which contributed to significant increases in sales.

The contribution of the JDSMDP to institutional capacity and energy policy was limited by the coincidental privatization of the host organization, JPS. As a result, most of the trained experts have moved to other organizations, although a new EE Unit has recently been established and proposals have been prepared to integrate EE into a new energy policy.

9.1 Replication

The main conclusions are:

- The most successful feature of JDSMDP was the sales of CFLs. Replication of this sales program has taken place in Jamaica and has resulted in large-scale public acceptance of the product and its benefits. The program begun by the project was replicated first by PCJ and then grew to the point where today CFLs are available to consumers in most retail outlets throughout the island.
- Sales of SWHs were also relatively successful and were replicated by PCJ.
- PCJ, in collaboration with MCST, launched the Energy Efficiency and Conservation Programme, which focused on awareness programs similar to those delivered during the project.
- Since privatization, JPS has focused on a commercial mandate, which is incompatible with EE programs.
None of the other JDSMDP programs have been replicated. This is partly due to the lessons learned during JDSMDP and partly due to the lack of incentives, which results from the policy vacuum created by the privatization of JPS.

There has been no known replication of JDSMDP programs outside Jamaica.

The lessons learned are:

- Privatized utilities cannot be expected to implement DSM programs unless there are regulatory incentives.
- Other government agencies can implement DSM programs, but they need appropriate resources and policy support.
- Subsidies can be effective in jump-starting markets for EE technologies.
- Not all EE opportunities will be viable. By pursuing modest pilot programs, it is possible to identify which are most likely to be successful in wider applications.
- The sale of EE technologies through established service outlets can be very effective.
- The lack of funds for financing energy efficiency projects is a significant barrier. This lesson reinforced one learned through the USAID Energy Assistance Programme of the 1980s. Before launching other initiatives, it is clear that barriers and lessons learned need to be understood and that policy or program measures (for example, some form of program financing subsidy or other incentives) need to be taken to overcome these barriers.

9.2 Consumer Awareness and Preference

The main conclusions are:

- Public awareness of energy efficiency grew greatly as a result of the project.
- The main driving force for consumers to purchase EE technologies is reducing their energy bills.
- The main reason for not purchasing EE technologies is price, with concerns about quality and lack of awareness being secondary.
- Thanks to the JDSMDP and the subsequent EECP, consumers are generally aware of the energy savings potential of CFLs and SWHs and have confidence in the technology.
- Even with the energy savings potential, initial cost is a significant barrier for most investments other than CFLs.
- While there is a high level of awareness within industry of the medium and longer-term benefits of EE technologies, short-term financial considerations are preventing their adoption.

The lessons learned are:

- Public education is an important aspect of successful DSM programs.
- Although most consumers are able to invest in low-cost, short payback measures (such as CFLs), most of them (whether
residential, commercial, or industrial) need additional assistance (such as low-cost financing) for larger investments.

9.3 Capacity Development

The main conclusions are:

- Most of the institutional capacity developed during JDSMDP still resides within JPS but is underutilized due to the utility’s focus on energy sales, not energy conservation.
- Little capacity was transferred from JPS to the government at the close of the project, with a resultant loss of expertise and corporate memory.
- JDSMDP provided the Bureau of Standards Jamaica with testing equipment, and the current program of testing CFLs is a direct result of the project.
- Both the Jamaica Environment Trust and the National Consumers League are using the capacity they developed through JDSMDP in their public awareness programs.
- Limited capacity was developed within the energy service industry.
- There are now many CFL distributors and retailers and several SWH distributors. Most got their start with the JDSMDP.

The lessons learned are:

- Capacity development efforts need to consider the possibility of institutional changes such as privatization. This requires a broad reach and a risk management strategy to ensure capacity is preserved under all plausible scenarios.
- It is important to align program objectives with organizational objectives. In this case, the objectives of JPS ultimately diverged from those of the program, and the capacity was lost.
- Ultimately, government has the greatest influence on the development of energy efficiency policy. Consequently, government entities (ministries and agencies) should be primary targets for capacity building.

9.4 Ultimate Outcomes

The key outcomes were the transformations of the residential lighting market and the beginning of the transformation of the domestic water heater market.

- Prices for CFLs dropped from over $14 to less than $4. JDSMDP played a moderate role in this change. Prices for SWHs stayed relatively constant at approximately $1,200 for a typical 50-gallon residential unit and have not been significantly influenced by the project.
- Both CFLs and SWHs are readily available, largely due to the project.
- Annual CFL sales in Jamaica rose from approximately 5,000 in 1994 to 85,000 in 2004 and are forecast to reach some 130,000 by 2010. Annual sales of SWH systems doubled from approximately 400 in 1995 to 800 in 2004 and are expected to surpass 1,200 by 2010. The increase
in sales was driven primarily by higher electricity costs but also by the greater availability, consumer awareness and confidence, and lower relative prices for the technology. JDSMDP had a significant impact on most of these factors, except for electricity prices.

JDSMDP has not had a significant impact on the mainstreaming of energy efficiency or global environmental issues in the policies of the government of Jamaica.

9.5 Sustainability

The main conclusions are:

- The greatest level of sustainability can be seen with the CFL component of the project. Sales and use of CFLs have become common in Jamaican residential and commercial environments.
- To a lesser extent, SWH sales seem sustainable, although at much lower levels than CFLs.
- The PV initiatives were not sustained.
- There is limited evidence of institutional sustainability of the project, particularly around energy audits and resulting measures implemented. This can be traced directly to the effects of the privatization of the Jamaica Public Service Company. The project had been focused on the utility, and it was assumed that the utility would carry on with the project activities at its completion. This did not happen, as the newly privatized organization re-engineered to concentrate on marketing electricity and was no longer interested in demand-side management.
- Some limited institutional sustainability can be seen in the work of the Energy Efficiency Unit at PCJ. Unfortunately, the Unit did not benefit from the JDSMDP infrastructure and corporate memory that was left at project completion.
- Since the end of the project, the policy environment has not facilitated market transformation. With the privatization of JPS, there was no entity that could provide incentives to purchase EE technologies or undertake retrofit projects. The market transformation that did take place in the CFL market was mainly due to the relative low cost measures and the public awareness generated by JDSMDP.
- Although PCJ followed up with the EECP, energy efficiency has not been a high priority of the government of Jamaica.
- The supply channel for distribution of EE technologies was established during JDSMDP and continues today (particularly for CFLs and SWHs).

9.6 Impacts

The sales of CFLs and SWHs and the associated increase in stock are estimated to have produced energy savings of approximately 28 GWh in 2004 and associated GHG emission reductions of 34 Kt. In the period 1995–2004, GHG emission reductions of 176 Kt were achieved and a further reduction of 325 Kt is expected to 2010.
The following range of impacts are attributed specifically to the JDSMDP:

- Energy savings of 12.5–18.4 GWh in 2004
- GHG emission reductions of 14.8–22.1 Kt in 2004
- GHG emission reductions of 100–120 Kt between 1995 and 2004 and a further 125–175 Kt by 2010
- NOx emission reductions of 625–750 tons between 1995 and 2004 and a further 790–1,100 tons by 2010
- \(\text{SO}_2\) emission reductions of 375–450 tons between 1995 and 2004 and a further 475–655 tons by 2010
- Capacity savings of 4–8 MW in 2003 (the last year of capacity constraint)
- Total resource net benefits of $4–4.6 million in the period 1995–2010 (approximately half the original investment)
- Total net benefits to consumer participants of $6–7.6 million in the period 1995–2010
- Total net costs to the utility of $2.1–3.4 million in the period 1995–2010
Appendix A: Bibliography


APPENDIX B: INTERVIEWEES

Automatic Control Engineering Limited
• Louise Henrigues — Owner

Bureau of Standards Jamaica
• Hermon Edmundson — Manager, Metrology and Testing Division

ECO-TEC
• Maikel Oerbekke — Owner

Environmental Audits for Sustainable Tourism Project
• Hugh Cresser

Environmental Solutions Ltd.
• Eleanor Jones — Managing Director

Jamaica Environment Trust
• Diana McCaulay — Chief Executive Officer

Jamaica Public Service Company Limited
• Pamela Hill — CFO and Senior Vice-President, Finance/Regulatory

Ministry of Commerce, Science and Technology
• Denise Tulloch — Director, Customer Care

Ministry of Land and Environment
• Joseph Williams

• Michelle Dunn

• Conroy Watson — Senior Director, Energy Division

• Leonie Barnaby — Senior Director, Environment and Emergency Management

• Gillian Guthrie
National Consumers League • Joyce Campbell
National Environment Protection Agency • Paulette Kolbusch • Hopeton Heron
Other • Franklin McDonald — Consultant • Mia Zian — Consultant
Petroleum Corporation of Jamaica • Dr. Raymond Wright — Group Managing Director • Dr. Cezley Sampson — Director, National Energy Efficiency • David Barrett — Manager, Energy and Environment
Solar Dynamics • Hugh Harris — General Manager
United Nations Development Program • David Smith
World Bank • Errol Graham — Kingston Office
APPENDIX C: DATA ANALYSIS

Available online at www.worldbank.org/gef
NOTES

1. This is the approach used by Navigant Consulting Inc. in *Evaluation of the IFC/GEF Poland Efficient Lighting Project CFL Subsidy Program*, Final Report (Edition 2), August 1999. In that case, the baseline scenario was based on CFL sales data for the entire Central and Eastern European region (a reasonable proxy for Poland without the program).


3. ESMAP is a global technical assistance program that helps build consensus and provides policy advice on sustainable energy development to governments of developing countries and economies in transition. ESMAP also contributes to the transfer of technology and knowledge in energy sector management and the delivery of modern energy services to the poor.


5. Source: Solar Dynamics.


7. Sampson, op. cit. note 2.
