Generation and Distribution of Electricity in Jamaica:

A regional comparison of performance indicators

Jamaica Productivity Centre

Copyright @ October 2010 by
Jamaica Productivity Centre

Short extracts from this publication may be copied or reproduced, for individual use without permission, provided the source is fully acknowledged. Reproductions that are more extensive or storage in a retrieval system, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, requires prior permission of the Jamaica Productivity Centre.

Published by The Jamaica Productivity Centre

For further information Contact
Jamaica Productivity Centre
12th Floor, Air Jamaica Building
72 Harbour Street, Kingston
922-1598
jpc@cwjamaica.com

CONTENTS

Figures....iv
Tables....v
Abbreviations and Acronyms....vi
Preface....viii
Summary....x
1. Introduction....1
2. Overview of the Jamaican Electricity Industry: 1998 – 2007....6
3. Objectives of the Study....12
4. Methodology....13
4.1 Productivity on the Generation Side....13
4.2 Productivity on the Distribution Side....13
4.3 Data Sources....16
5. Results and Discussions....17
5.1 Generation Side Results and Analysis....17
5.2 Distribution Side Results....19
6. Conclusions and Recommendations....55
References....79
Annex 1 Tables....81
Annex 2 Office of Utilities Regulation Response to Study....111

Figures

Figure 1: Electricity Consumption (KWh/capita) compared to GDP per capita (US$) 2
Figure 2: Value Added by Electricity Generation and Distribution (J$ 2003 Prices) 7
Figure 3: Total Electricity Output (GWh) by Source: 1998 - 2009 7
Figure 4: Electricity Output, Sales (GWh) and Percent Distribution Losses: 1998 - 2009 8
Figure 5: Total Wind and Hydro Output: 1998 - 2009 9
Figure 6: Energy Productivity – KWh/BOE 17
Figure 7: Realized Heat Rate (KJ/KWh) 18
Figure 8: Growth in Total Number of Connections: 2001- 2005 20
Figure 9: Growth in Number of Residential Connections (%): 2001 – 2005 21
Figure 10: Growth in MWh of Electricity Sold per Year (%): 2001 – 2005 22
Figure 11: Growth in Length (km) of Distribution Network (%): 2001 – 2005 23
Figure 12: Electricity Coverage (%) in LAC Economies – 2007 24
Figure 13: Electricity Sold per Connection (MWh/year) 27
Figure 14: Average Operating Expenditure per Connection (US$) 28
Figure 15: Average Operating Expenditure per MWh Sold (US$) 29
Figure 16: Capital Expenditure (CAPEX) per Connection (US$) 30
Figure 17: Capital Expenditure (CAPEX) per MWh of Electricity Sold (US$) 31
Figure 18: Total Expenditure (TOTEX) per Connection (US$) 32
Figure 19: Total Expenditure (TOTEX) per MWh of Electricity Sold (US$) 33
Figure 20: Total Distributional Losses (%) 37
Figure 21: Technical Distribution Losses (%) 38
Figure 22: Technical Distribution Losses (%) 38
Figure 23: Average Duration of Interruptions per Subscriber (SAIDI) - Hours 41
Figure 24: Average Frequency of Interruptions per Subscriber (SAIFI) – Number 42
Figure 25: Residential Electricity Prices (US cents/KWh) 45
Figure 26: Commercial Electricity Prices (US cents/KWh) 46
Figure 27: Industrial Electricity Prices (US cents/KWh) 47
Figure 28: Residential Tariff versus Diesel Price 49
Figure 29: Residential Connections per Employee 52
Figure 30: Electricity Sold per Employee versus Number of Customers per Employee 53
Figure 31: Past and Expected Contribution of Fuels Mix to Electricity Generation 63

Tables

Table 1: Residential and Non-residential Electricity Consumption (KWh/capita) and Growth Rates (%) in LAC (1998-2007) 4
Table 2: Electricity Generation and Purchase (MWh) 11
Table 3: Benchmark Summary of Scale and Coverage Indicators 24
Table 4: Non-labour Efficiency Indicators (2005) 33
Table 5: Breakdown of JPSCo Total Losses (%) 40
Table 6: Summary of Technical Efficiency and Quality Indicators – 2005 43
Table 7: Summary of Electricity Tariffs (US cents/KWh) by End-user Categories 48
Table 8: Summary of Electricity System Productivity (2005) 52
Table 9: Avoided Cost in 2008 and 2009 65
Table 10: Proposed Targets for SAIDI and SAIFI: 2004 – 2008 73
Table 11: Actual SAIDI, SAIFI and CAIDI for JPSCo: 2006 - 2008 74
Table 12: Matrix of Implementing Agencies According to Energy Policy Goals 76
Table 13: Electricity Consumption (KWh/capita) compared to GDP per capita (US$) ... 81
Table 14: Value Added Contribution of the Electricity Sector 81
Table 15: JPSCo and Non-JPSCo Sources of Electricity Generation 82
Table 16: Electricity Output, Sales, and Percent Distribution Losses: 1998 – 2009 82
Table 17: Total Wind and Hydro Output (GWh): 1998 – 2009 83
Table 18: Installed Capacity by Energy Sources and Percent Distribution (2007) 84
Table 19: Energy Productivity (KWh/BOE): 1998 – 2009 85
Table 20: Realized Heat Rate (KJ/KWh): 2003 – 2008 85
Table 21: Total Number of Connections (Residential and Industrial) 2001-2005 86
Table 22: Total Number of Residential Connections 2001-2005 87
Table 23: Electricity Sold Per Year (MWh) 88
Table 24: Length of Distribution Network 89
Table 25: Electricity Coverage (%) 90
Table 26: Electricity sold per connection (MWh/yr) 92
Table 27: Operating Expenditure (OPEX) per Connection (US$/MWh) 93
Table 28: Operating Expenses (OPEX) per MWh sold (US$) 95
Table 29: Capital Expenditure (CAPEX) per connection (in US$) 96
Table 30: Capital Expenditure (CAPEX) per MWh of Electricity Sold (US$) 97
Table 31: Total Expenditure (TOTEX) per Connection (US$) 98
Table 32: Total Expenditure (TOTEX) per MWh of Electricity Sold (US$) 99
Table 33: Total and Average Distribution Losses 2001-2005 and 2004-2005 (%) 100
Table 34: Technical Distribution Losses (%) 2001-2005 101
Table 35: Non-technical Distribution Losses (%) 102
Table 36: Duration of Interruptions per Subscriber – SAIDI (Hrs) 103
Table 37: Frequency of interruptions per subscriber – SAIFI (#) 104
Table 38: Residential Electricity Tariffs (US cents/Kwh) 105
Table 39: Commercial Electricity Tariffs (US cents/KWh) 106
Table 40: Industrial Electricity Tariffs (US cents/KWh) 107
Table 41: Residential tariff versus Diesel Prices 108
Table 42: Electricity Sold per Employee (MWh) 109
Table 43: Residential Connections per Employee 110
Table 44: Energy Intensity of Gross Domestic Product 111

Abbreviations and Acronyms

ABNF	Non-fuel Base Rate
BOE	Barrel of Oil Equivalent
CAIDI	Customer Average Interruption Duration Index
CAPEX	Capital Expenditure
CERE	Centre of Excellence for Renewable Energy
CCGT	Combined Cycle Gas Turbine
CNG	Compressed Natural Gas
EE	Energy Efficiency
EIA	Energy Information Administration
GCT	General Consumption Tax
GDP	Gross Domestic Product
GOJ	Government of Jamaica
GT	Gas Turbine
GWh	Giga Watt Hour
HDI	Human Development Index
IPP	Independent Power Producer
IT	Information Technology
JEP	Jamaica Energy Producers
JPPC	Jamaica Private Power Company
JPSCo	Jamaica Public Service Company
JTI	Jamaica Trade and Invest
JBI	Jamaica Bauxite Institute
KJ	Kilo Joules
KM	Kilo Metre
KWh	Kilowatt Hours
LAC	Latin America & the Caribbean
LCEP	Least Cost Expansion Plan
LNG	Liquefied Natural Gas
MEM	Ministry of Energy and Mining
MFPS	Ministry of Finance and the Public Service
MIIC	Ministry of Industry Investment and Commerce
MSD	Medium Speed Diesel
MW	Mega Watt
MWh	Mega Watt Hour
NOIC	Net Oil Importing Countries
OC	Office of Cabinet
OLADE	Latin American Energy Organization
OPEX	Operating Expenditure
OPM	Office of the Prime Minister
OUR	Office of Utilities Regulation
PBRM	Performance Based Rate Adjustment Mechanism
PCJ	Petroleum Corporation of Jamaica
PEG	Pacific Economics Group

PPA	Power Purchase Agreement
PIOJ	Planning Institute of Jamaica
PPP	Public Private Partnership
PPP	Purchase Power Parity
RE	Renewable Energy
SAIDI	Systems Average Interruption Duration Index
SAIFI	Systems Average Interruption Frequency Index
SSD	Slow Speed Diesel
STATIN	Statistical Institute of Jamaica
TFP	Total Factor Productivity
TOTEX	Total Expenditure
US	United States
US$	United States Dollar
WWF	Wigton Wind Farm

Preface

The mission of the Jamaica Productivity Centre (JPC) is to "Enhance the productivity and competitiveness of the Jamaican economy and lead the process of transformation to a productivity-conscious culture by providing productivity policy advice, expertise and information to private and public sector organizations, through strategic partnerships, and a well resourced, motivated and competent team".

One of its mandates is to provide evidence-based policy advice. To this end, under the directorship of its Advisory Board, JPC has concentrated its research efforts on key infrastructural services such as electricity, water, and transportation. This focus emphasises the fact that the JPC can contribute meaningfully to the process of accelerating economic growth by directly and indirectly raising the productivity of industries which provide critical inputs in the production of goods and services.

This study, "**Generation and Distribution of Electricity in Jamaica: A Regional Comparison of Performance Indicators"** is the first in a series of reports on critically important infrastructural services. It also forms part of a broader exercise to develop a framework for benchmarking the Jamaican electricity sector.

The performance of Jamaica's electricity industry is crucial for several reasons. Firstly, there is a high degree of correlation between electricity consumption and gross domestic product (GDP). Indeed, electricity consumption is believed to be the single best physical indicator of overall economic activity, whether official or unofficial. Secondly, productivity growth is a necessary requirement for sustaining a country's economic growth and international competitiveness. Thirdly, in most industries or sectors a huge part of their productivity growth is due to technical advances that are facilitated by electricity consumption. In addition, for these industries and sectors, productivity growth is generally greater the lower the real price of electricity and the converse is also true.

This study has provided a range of performance comparisons that point to opportunities for improving productivity in electricity generation and distribution, reducing electricity prices and promoting the objectives of the national energy policy. It highlights several

key policy findings and recommends changes that can potentially overcome some of the inherent disadvantages of scale to provide better quality and lower cost electricity services to the Jamaican consumer.

The Centre would like to express its gratitude to the many industry stakeholders, who assisted directly, provided information to its researchers, or provided valuable feedback on the draft document. In particular, the Centre acknowledges the written response to the document by the Office of Utilities Regulation (OUR). In general, the Centre did not consider the comments by the OUR as necessary and sufficient to materially change its conclusions. For the benefit of readers and in the interest of transparency, the comments of the OUR are included in Annex 2. Lastly, the Centre would like to acknowledge the efforts of members of the Research and Measurement Unit and all staff members who contributed to the preparation of this document.

Summary

The primary objective of this study is to evaluate the performance of Jamaica's electricity industry against countries in Latin America and the Caribbean (LAC). In particular, it seeks to:

1. Compare the performance of the Jamaica Public Service Company (JPSCo), on the generation side with other players in the domestic industry (intra-country comparison).
2. Compare the performance of the JPSCo, on the distribution side, with other LAC countries (inter-country comparison) in terms of five major groups of performance indicators, namely: coverage and scale; non-labour efficiencies; technical efficiency and quality; end-user prices and labour productivity.
3. Identify areas of relative strengths and weaknesses of Jamaica's electricity infrastructure vis-à-vis LAC countries (Gap-analysis).
4. Interpret the comparisons in terms that are useful for policy interventions.

The generation side results indicate that IPPs perform much better than the JPSCo As such, JPSCo needs to realize significant improvements to eliminate the productivity gap between itself and the IPPs.

Generation Side Analysis

The **generation side** of Jamaica's electricity industry was analysed using four indicators of energy productivity namely:

(i) KWh/BOE for the entire oil-based thermal generating system (JPSCo plus Independent Power Producers - IPPs);

(ii) KWh/BOE for the JPSCo oil-based thermal generating system (entire generation system less hydro, wind and IPPs);

(iii) KWh/BOE for IPPs using only non-renewable energy; and

(iv) Heat rate – measured as KJ/KWh, which is a key variable monitored by the Office of Utilities Regulation (OUR).

The generation side results indicate that in terms of energy productivity in the Jamaican industry, measured by the above four indicators, the IPPs performed much better than the

JPSCo. As such, the JPSCo needs to realize significant improvements to eliminate the productivity gap between itself and the IPPs.

Distribution Side Analysis

On the **distribution side**, the JPSCo was compared with twenty-five (25) other LAC countries using twenty-two (22) indicators in the World Bank LAC database. The salient findings are summarized below in terms of the twenty-two performance indicators categorized as follows:

(1) Scale and Coverage Indicators (5): number of connections; number of residential connections; electricity sold; length of the distribution network; and electricity coverage.

(2) Non-labour Efficiencies Indicators (7): electricity sold per connection; operating expenditure (OPEX); OPEX per MWh sold; capital expenditure (CAPEX); CAPEX per MWh sold; total expenditure (TOTEX); and TOTEX per MWh sold.

(3) Technical Efficiency and Quality Indicators (5): total distribution losses; technical distribution losses; non-technical distribution losses; systems average interruption duration index per subscriber (SAIDI); systems average interruption frequency index per subscriber (SAIFI).

(4) End-user Price Indicators (3): average residential prices; average commercial prices; and average industrial prices.

(5) Labour Productivity Indicators (2): residential connections per employee and energy sold per employee.

A) Scale and Coverage – The findings reveal that the indicators: number of connections, number of residential connections and electricity sold are clearly influenced by country size, with the largest LAC economies occupying the fourth quartile and the smallest economies the first quartile. However, length of the distribution network and coverage (%) are less clearly defined by country size.

B) Non-labour Efficiencies – The results indicate that electricity sold per connection (MWh) was not influenced by country size. However, countries with higher levels of commercial and industrial activities recorded higher sales per connection. For the six cost indicators (OPEX/connection, OPEX/MWh sold, CAPEX/connection, CAPEX/MWh sold, TOTEX/connection, and TOTEX/MWh sold) Jamaica was consistently located in

the second quartile. This suggests that distribution costs in Jamaica were consistently above those of countries such as Paraguay, Mexico, Honduras and Costa Rica. For the six cost indicators, Jamaica was consistently in the same quartile with Brazil; and in two instances shared the same quartile with Chile (CAPEX/connection and CAPEX/MWh), Ecuador (OPEX/MWh and (CAPEX/connection) and Costa Rica (OPEX/connection and TOTEX/connection). This confirms that the cost indicators are independent of country size. In other words, economies of scale would suggest that larger countries would experience lower costs, but this was not borne out by the data. Indeed, Mexico was the only net oil exporting country to consistently record the lowest cost variables.

C) Technical Efficiency and Quality – As it relates to this group of indicators, the findings revealed that Jamaica was located in the fourth quartile (worst performing group) for total distribution losses, non-technical losses, SAIDI and SAIFI; and in the third quartile (second worst) for total technical distribution losses. Countries reporting the lowest total distribution losses were Chile, Costa Rica, El Salvador, Bolivia, St. Lucia, Antigua and Panama. Costa Rica and Chile also enjoy the lowest technical and non-technical distribution losses. Panama and Mexico recorded the lowest SAIDI and SAIFI.

D) End-user Prices – Based on the findings in 2006, across all tariff categories, the gap between Jamaica and LAC comparators was extremely wide. In the case of **residential tariff**, Jamaica lead the fourth quartile with the highest prices of 24.5 US cents/KWh compared to the average for LAC of 12.05 US cents/KWh and 14.33 for the NOICs. **Commercial tariff** in Jamaica at 23.04 US cents/KWh was the second highest behind the Dominican Republic at 24.17 US cents/KWh and average price of 15.04 US Cents per KWh for NOICs. Finally, at 18.69 US cents/KWh, Jamaica had the third highest **industrial tariff** after the Dominican Republic (19.65 US cents/KWh). Furthermore, the data shows that petroleum prices were not the only factor determining electricity prices. Fuel diversification and the contribution of renewables are important determinants of electricity prices in LAC.

E) Labour Productivity – The analysis indicates that Jamaica was located in the second quartile (second best grouping) with respect to labour productivity indicators (residential connections per employee and energy sold per employee). The Dominican Republic and

Venezuela recorded the highest residential connections per employee, while St Lucia and Ecuador recorded the highest electricity sold per employee.

Increasing labour productivity (measured as number of residential connections per employee or electricity sold per employee) should lower distribution cost as well as electricity prices. However, electricity sold per employee will rise faster if the number of large commercial and industrial consumers increases faster than the number of residential customers. This in turn will foster economic growth.

Overall, the worst performance by Jamaica's electricity distribution sector (JPSCo) was in the areas of technical efficiency and quality as well as end-user price indicators. These indicators were shown to be largely unaffected by economies of scale. In the cost areas, Jamaica's performance was quite consistent (second quartile) suggesting scope for improvement. Perhaps, the greatest challenge for the Jamaican electricity sector is how to bring end-user prices more in line with its LAC counterparts.

Overall, the worst performance by Jamaica's electricity distribution sector (JPSCo) was in the areas of technical efficiency and quality as well as end-user price indicators.

Opportunities for Improvement

The study has uncovered interesting opportunities which can position the electricity sector as a key enabler for productivity improvement, local and foreign investments, and economic growth. These opportunities include:

1. Capacity Addition – establishing urgent yet realistic timelines for the replacement of inefficient generation capacity in the public electricity grid.
2. Tackling the problem of distribution losses and inefficiency in fuel conversion to bring costs and prices down to regionally comparative levels.
3. Reducing dependence on a single energy source through fuel diversification.
4. Improving sector governance, especially as it relates to measurement issues such as the X-Factor and Q-Factor.
5. Improving policy coordination and implementation.
6. Energy Efficiency – using energy services company (ESCO) model.
7. Research to explain and model the role of electricity in economic development (a policy imperative).

1. Generating Capacity: Replacement and Expansion

Several reports (Loy and Coviello, 2005; World Bank, 2005; OUR, 2007; MEM, 2009) have indicated that a significant number of the generating plants owned by the JPSCo have exceeded their useful economic lives and require replacement. In other words, the average age and technical characteristics of plants in the generating fleet are such that they cannot be expected to deliver even modest heat rate improvement.

The main factors driving high electricity prices in Jamaica are high distribution losses, fuel choices, fuel prices and fuel conversion inefficiencies. Tackling these problems are necessary conditions for bringing electricity prices to Jamaican consumers in line with those of the average LAC countries.

The OUR (2004) in a document titled "Generation Expansion Plan 2004–2012 Decision and Recommendations" indicated that if a real decrease in the retail price of electricity is to be achieved, base load plants must be added to the system. The document cautioned that the practice of adding intermediate plants to meet incremental increase in demand must be reversed and to this end capacity additions must be structured to provide the opportunity for the maximum possible capacity using "base load technology" that can be added economically.

Within the constraints of the current Electricity Licence (2001) opportunities exist for the OUR to reduce electricity cost to consumers by operating an "almost competitive market for electricity generation" (OUR, 2006). Condition 24 of the Licence provides for the addition of generation capacity on a competitive basis, it also sets out the framework principles that must govern the competitive bidding process.

Condition 18 of the Licence, Competition for New Generation, requires the Licensee to utilize a competitive tendering procedure for procurement of new capacity above 15 MW. This includes, among other conditions, setting out the arrangements for pre-qualification, and advertising. At the same time, the Licence holder is also eligible to participate in the tender process. This provides them with an insider advantage and gives rise to a conflict of interest. In September 2010, a bid invitation was issued to a selected group of local and international power suppliers for 480MW of new capacity. There is no evidence that pre-

qualification, advertising or other open tender procedures were used to shortlist potential suppliers.

Using a competitive bidding process to add capacity to the grid has several advantages. First, a competitive bidding process will deliver the best combination of price and technology. Second, it minimizes the concentration of generating capacity in a single ownership structure thereby minimizing the exercise of monopoly power. Third, a competitive generation market facilitates economic dispatch. That is, the most expensive plants will be low on the economic order of merit, as they will not minimize the system's variable costs, which is primarily fuel. Fourth, strict adherence to competitive bidding, over time, facilitates the decoupling of generation from transmission and distribution.

Given the threat of continued loss of international competitiveness for Jamaican businesses and the burden imposed on residential customers by high electricity prices, it is critical that the MEM take the lead to develop a medium-term plan and fast-track its implementation to ensure base load capacity replacement and expansion. Valuable time has been lost since privatization in 2001. Essentially, what has occurred during this period is a plethora of project proposals but no implementation. Immediate action is required, while still maintaining the merits of a competitive tendering process. The entire process is a time consuming one, which includes requesting, evaluating and approving proposals, followed by construction and commissioning of plants and equipment.

2. Reducing Distribution Losses and Increasing Fuel Conversion Efficiency

The main factors driving high electricity prices in Jamaica are high distribution losses, fuel choices, fuel prices, and fuel conversion inefficiencies. Tackling these problems are necessary conditions for bringing electricity prices to Jamaican consumers in line with those of the average LAC countries.

At present, fuel and IPP charges are recovered directly from customers subject to adjustments for performance against **heat rate and system loss targets**. In this regard, the OUR's protocols and procedures used to validate actual performance against targets must be of uttermost interest to electricity consumers. In the case of the heat rate, it is unclear if or how frequently the OUR analyzes the JPSCo's economic dispatch logs to validate actual versus planned heat rate and how variances are handled in the fuel pass

through equation. It should be noted that the actual heat rate performance reported by the JPSCo was 18,832, 10985, 10174, 10627 and 10215 KJ/KWh for 2004, 2005, 2006, 2007 and 2008, respectively. In other words, average heat rate for the period 2004-2008 of 10,566 was well below the target of 11,200 KJ/KWh or a difference of 634 KJ/KWh. This means that JPSCo could reap monetary benefits from fuel price pass-through, even if some benefits were offset by higher than targeted distribution losses. In the case of distribution losses, the frequency with which load measurement programmes are reviewed to validate non-technical and technical losses is also unknown to the public.

The OUR (2009) in its Rate Case Determination observed that the "JPSCo has stated that for every 100 KJ/KWh reduction in the heat rate, the benefit to the JPSCo using 2008 fuel prices would be US$4.5M per annum. Based on this, the net benefit to the JPSCo in 2008 was in excess of US$44M or J$4 Billion. The fact that the JPSCo was making a significant profit on fuel used would mean that, all other things being equal:

- Consumers were paying more than they should have;
- JPSCo had an incentive to purchase fuel at the highest price possible rather than at the lowest price possible".

This observation by the OUR is indeed significant as the licence does not provide for JPSCo to make profits on fuel, as fuel costs are passed through to consumers. It should be placed in context that the current OUR heat rate target of 10,400 KJ/KWh is 27 percent higher than the average heat rates of 8,172 KJ/KWh achieved by the IPPs for the period 2004-2008. This implies that the magnitude of the savings on fuel, holding distribution loss constant, that would accrue from more efficient generating plants is quite substantial. Hence, the urgency of replacing inefficient plants is better appreciated.

If the heat rate target was set to reflect expected heat rate under efficient performance, and distribution loss target reflected improvements that should have been achieved to date, the impact on reducing the fuel component of consumer prices would be huge. For example, holding distribution loss constant (15.8%) and reducing heat rate from 10,400KJ/KWh to 8,100 KJ/KWh would reduce fuel pass through cost by 26.3 percent or an estimated savings of J$7.86 billion, yielding savings of 1.2 million BOE.

On the other hand, moving from the 2004-2008 heat rate target of 11,200 KJ/KWh and distribution loss of 15.8 per cent to the 2009-2014 heat rate target of 10,400 KJ/KWh and distribution loss target of 17.5 per cent would yield only 5.23 percent reduction in fuel pass through cost, or savings to consumer of J$1.68 billion. However, it must be emphasized that the impressive savings from the radical approach to heat rate reduction will entail substantial investments in fuel diversification and modern generating plants.

Note also that the heat rate projections by the JPSCo and the OUR for 2009-2014 averaged 10,189 and 9,203 KJ/KWH, respectively. However, JPSCo was proposing an average heat rate of 10,730 KJ/KWh for the period and with conditions. In the view of the OUR, JPSCo projections should form the cap for heat rate target, nonetheless the OUR set the new target at 10,400 KJ/KWh.

If the JPSCo were to reduce total distribution losses from 23.97 percent to 16 percent (the average for Net Oil Importing Countries in the sample) this would lead to a 17.39 percent decline in average electricity price or yield savings of J$7.43 billion annually (using 2009 prices). The simple fact is that the OUR by increasing the distribution loss target from 15.8 to 17.5 per cent is sending the wrong signal to the JPSCo. If a Central Bank wants to lower interest rates, it cannot signal higher repurchase rates as this would confuse investors.

Non-technical losses in Jamaica, at 13 percent (mainly due to electricity theft) are very high by regional standards. There is no evidence that this reported value has been validated by the OUR. However, if the JPSCo were to reduce non-technical losses from the current 13 to 5 percent (the average for NOIC in the sample), this would yield an 8 percent savings or J$7.43 billion annually.

It is not clear whether the fuel rate paid by consumers to the JPSCo is based on adjustments for validated actual performance relative to **heat rate and system loss targets**. In the interest of transparency, validated actual performance versus targets should be published periodically. Condition 7 of the Licence, Restriction on Use of Certain Information, provides the OUR with adequate powers to require the submission of such performance related information from the JPSCo. Furthermore, consumers must

be assured that protocols are in place for auditing the actual heat rate of the system as well as the distribution losses.

3. Fuel Diversification

Jamaica's residential, commercial, and industrial electricity prices are among the highest in the LAC region. This is partly because 95 percent of the electricity generated uses expensive imported petroleum coupled with the inefficiency with which the fuel is converted to electricity. Jamaica's dependence on petroleum results in erratic swings in the price of electricity, as seen over the last tariff period (2004-2009), when prices reached a record high of 38 US cents/KWh in July 2008 (JPSCo, 2009). Effective fuel diversification is expected to improve energy security, reduce generation costs, mitigate the volatility of oil prices, and reduce vulnerability to external shocks.

Jamaica's, residential, commercial, and industrial electricity prices are among the highest in the LAC region.

According to the MEM (2009), in 2008 Jamaica's electricity generating mix consisted of 95 percent petroleum and 5 percent renewables. This mix is expected to change markedly by 2015 when petroleum is expected to represent 67 percent, natural gas 15 percent, petcoke/coal 5 percent, renewables 12.5 percent and others 0.5 percent. By 2030, the share of petroleum in the supply mix is expected to decline to 30 percent, with natural gas accounting for as much as 42 percent, renewables 20 percent, petcoke/coal 5 percent and others 3 percent. In this regard, the implied policy is that no single fuel source will constitute more than 42 percent of the electricity generating mix in the year 2030.

Renewable Energy

Byer, Crousillat and Dussan (2009) recommend several conditions to encourage the supply of renewable energy. First, rates should be based on prospected avoided costs. That is, on the basis of displaced power plants and their respective production costs. Second, rates should incorporate a premium for environmental and social benefits. Third, rates will only be attractive for operators and financing institutions if they are fixed for a period of at least 10 years and adjusted for annual inflation and currency devaluation.

According to the MEM (2009), the Government of Jamaica is facilitating expansion of the renewable energy industry by providing the following concessions:

- Reductions of import duty from 30 percent to 5 percent on all renewable energy equipment;
- Zero rating for GCT purposes on renewable energy equipment;
- Payment of a premium of 15 percent above the current "Avoided Generation Cost" for the procurement of electrical energy from renewable sources.

The latest available avoided costs for power generation published by the OUR (2008) is 10.48 US cents/KWh for conventional technology (`capacity and energy), while that for energy only (including renewable energy) is 8.88 US cents/KWh. It is of interest to note that Jamaica's renewable energy policy is consistent with the three conditions stated above. This raises concern regarding the perceived unwillingness of companies to take up the Wigton Windfarm (WWF) divestment offer. One questions whether this is connected to the viability of the business at 5.6 US cents/KWh that the JPSCo pays it for the electricity produced. Furthermore, the OUR's avoided cost (2008) of 8.8 US cents/KWh brings to the fore the concern that the Petroleum Corporation Jamaica (PCJ) is undertaking this expansion instead of private investors.

It seems reasonable to recommend that both the structure of the incentives and the avoided costs be re-examined if the medium to long-term targets of Jamaica's renewable policy are to be realized, and contribute to driving down electricity prices to consumers. In addition, once avoided costs are published by the OUR, this should be the price plus the premium offered by the JPSCo in power purchase agreements (PPA) with approved suppliers.

One can reasonably assume that the fundamental objective of energy diversification is to reduce end-user electricity prices. In this connection, a national strategic electricity target price could be seen as a useful starting point. The choice of fuel mix is then made based on their relative contribution to meeting that strategic electricity target price.

This means that all fuel types including nuclear should be subjected to rigorous technical, financial, and economic analysis. In terms of price risk analysis, it seems logical that the

price of fuels that are highly co-integrated with oil prices would present the greatest risk to the achievement of the national strategic electricity target price.

4. Improving Governance Through Measurement

The JPSCo is regulated by the OUR under an incentive-based framework, known as a price cap regime, introduced through the 2001 Electricity Licence. Under this price cap framework non-fuel base rates are set once every five (5) years. The tariff charged for electricity consists of two components, the **fuel rate,** and the **non-fuel base rate**. The fuel rate represents the fuel cost to the JPSCo and IPPs to generate electricity. It is recovered directly from customers through a Fuel and IPP charge subject to adjustments for performance against heat rate and system loss targets. The non-fuel base rate is used to recover costs associated with the operation and maintenance of the Company's regulated assets (the rate base) and its weighted average cost of capital.

The OUR can improve the governance structure of the sector by addressing issues related to the accurate measurement of the X-factor and the Q-factor, using a systematic framework.

The price cap regime also includes a performance based rate adjustment mechanism (PBRM) in which non-fuel rates are adjusted annually based on a productivity offset to inflation (X-factor) and performance against quality of service targets (Q-factor). The OUR can improve the governance structure of the sector by addressing issues related to the accurate measurement of the X-factor and the Q-factor, using a systematic framework. Both the OUR and the JPSCo should abide by this agreed methodology.

X-Factor

A central element of the price cap regime is the use of an X-factor which decreases the allowed tariff by a pre-defined percentage based on expected productivity gains. The way the X-factor is currently determined can result in major disagreement between the OUR and the JPSCo and may result in credibility concerns being raised by customers. Several issues of methodology must be agreed on between the OUR and the JPSCo, these include the index method to be used, the variables comprising the output and input indices and their respective weights and the choice of periods. In addition, once an X-factor is agreed on, other issues such as stretch factor, US Total Factor Productivity (TFP) growth rate,

Jamaican TFP growth rate and the weights to be attached to the US and Jamaican components of costs must be decided.

The TFP growth rates for the US and Jamaica used to determine the X-factor shows very important conceptual methodological differences that needs to be re-examined including the measurement of output, labour input and capital services. In the US, the TFP growth rates are based on the multifactor productivity (MFP) index of the US nonfarm, private business sector, computed by the Bureau of Labour Statistics (BLS). This differs from the methodology used to calculate TFP in Jamaica where PEG utilizes a growth accounting framework that is based on the overall Jamaican economy.

Analysis by the JPC suggests that if the TFP measure from the Groningen Total economy Database which uses standard growth accounting framework for the period 2001-2007 was used for both Jamaica and the US, the X-factor would be 1.58 instead of 0.78. The major issue here is the need to standardize the X-factor measurement for both the USA and Jamaica.

The discretionary approach to X-factor determination process must be discontinued. For example, in the 2009 rate application the JPSCo recommended an X-factor of 0.8 percent for the period 2009-2014. In contrast, the OUR determined that the X-factor should be zero percent at June 2010 and 2.72 percent for the period June 2011-2014. A zero percent change in the X-factor is not in the interest of consumers.

It should be noted that the non-fuel base rate (ABNF) is extremely sensitive to adjustments in the weights applied to the US and Jamaican components of costs as well as adjustments for productivity (X-Factor). Exhibit 1 of the Electricity Licence sets the weights at 60:40 for US and Jamaica, respectively. However, for the 2004-2009 and 2009-2014 tariff adjustment periods this ratio was changed to 76:24. The justification being that depreciation of the Jamaican dollar has led to an increase in the proportion of US$ non-fuel costs relative to local components.

According to the OUR, along with the change in weights “the inflation adjustment formula (dI) to be used during the 2004 -2009 and 2009-2014 tariff periods, has been changed to more accurately reflect the inflation costs incurred on JPSCo”. There are three

issues of concern associated with the assumed debt factor adjustment of 0.922 in the dI formula. First, the way in which the debt factor is defined suggests that its value should be 0.078 and not 0.922. Accurate definition is important to allow other analyst to replicate the OUR's calculation. The second issue has to do with the economic rationale for the debt factor as it has been observed that increasing the debt factor actually reduces the annual adjustment for inflation and devaluation (dI). The third issue questions the rationale for adjusting the non-debt costs (1-d) for US inflation and exchange rate depreciation, a point that can be highly debatable. The main concern here is the need to appropriately define terms that will allow analysts to replicate calculations, thereby avoiding confusion.

Q-Factor

The JPSCo (2004) in its Rate Application proposed that for the period (2004-2009) the value of the Q-Factor should be based upon actual values of SAIDI and SAIFI for each year compared to a benchmark year. In other words, in each year from 2004 to 2008 the values of SAIDI and SAIFI should be improving consistently by 2 percent relative to the actual 2003 level. As such, for each year of the five-year period following 2003, one of the following conditions would apply:

- If SAIDI and SAIFI values are equal to or greater than 2 percent of the target, Q will be a fixed positive addition to the inflation adjustment factor.
- If SAIDI and SAIFI values are less than 2 percent of the target (little or no improvement), Q will be zero (a dead band).
- If SAIDI and SAIFI values show deterioration relative to the target, Q will be a fixed negative reducer of the inflation adjustment factor.

In response, the OUR (2004) determined that:

a) The Q-factor should remain at zero until June 2005 when the data on forced outages at both the feeder and sub-feeder levels would have been collected, audited, and analysed. Baseline data on SAIDI, SAIFI, and the Customer Average Interruption Duration Index (CAIDI) would then be available at that time to facilitate the application of the Q-factor.

b) Should the JPSCo fail to provide the supporting data, the OUR would apply international benchmarks to inform the derivation of the Q-factor with effect from June 2005.

c) The targets required the JPSCo to reduce the frequency and duration of customer outages by 8 percent between 2006 and 2009, or otherwise face a penalty that would be applied to reduce the tariff.

The OUR (2009) in its determination noted that:

- The available baseline data provided by the JPSCo on SAIDI, SAIFI and CAIDI was risky, as there was need for auditing of the data collection procedure and processes along with further analysis on the variability of the performance of the indices overtime.
- Accordingly, the OUR determined that the Q-factor be set at zero until the integrity of the data and its collection procedures were fully implemented and audited.

Setting the Q-factor to zero sends the wrong signal to the JPSCo. Indeed, it raises the question of regulator credibility as the OUR had promised that the utility would be penalized for its failure.

Data from the study shows that there are huge gaps between the SAIDI and SAIFI values for JPSCo and the average values for the NOIC in the sample. In the case of SAIDI the values were 57 and 16 hours per customer per year in 2005, for Jamaica and the average NOIC, respectively. The corresponding number of interruptions (SAIFI) is 36.7 and 12, respectively. Applying the proposed OUR methodology (2004) and the NOIC average for SAIDI and SAIFI of 16 hours per customer per year and 12 times per year (in 2005 as the base) savings to customers in 2009 would amount to J$0.13 billion and for the five year (2005-2009) amount to J$0.44 billion.

It is reasonable to conclude that since 2004 the JPSCo has not provided the OUR with reliable data to calculate and incorporate an appropriate Q-factor in the rate making mechanism. More importantly, there is no evidence that the OUR has made good on its promise to apply international benchmarks to inform the derivation of the Q-factor with effect from June 2005. In addition, there is no evidence that the JPSCo has been penalized

by a factor that reduced the tariffs, as promised by the OUR. As such, it clear that the consumer is the loser.

The OUR must establish transparent and consistent monitoring protocols and procedures for administering the rate cap regime and the related Performance Based Rate Adjustment Mechanism (PBRM). The transparency of these processes is critical to the enhancement of the credibility of the regulator. In particular, consumers must be assured by the regulator that:

- The heat rate used to calculate the fuel pass through is not simply that submitted by the Licensee, but rather determined and verified by the economic dispatch log;
- Consumers are retroactively compensated for any deviations from economic dispatch;
- The distribution loss data employed in the fuel pass through calculations are adequately validated and published;
- The procurement of goods is regularly audited as provided for by Condition 20 of the Licence;
- The weights applied to the US and Jamaican components of costs as well as in determining the X-Factor are not arbitrarily adjusted;
- International benchmarks for SAIDI and SAIFI indicators will be applied if JPSCo fails to supply the requisite verifiable data; and
- Protocols, policies, and procedures are subject to periodic auditing by an independent body.

5. Improving Policy Coordination and Implementation

According to the MEM (2009), nineteen (19) state entities will play key roles in implementing the seven goals of the National Energy Policy. However, all the agencies will be coordinated by the MEM.

One of the main concerns of this study is that Jamaica has a better record of planning than that of implementation. For example, the JPSCo invested in constructing the 120 MW plant at Bogue in 2002. However, since that time, Jamaica has not undertaken any generation investment even close to that magnitude. Furthermore, despite the capacity required for replacement and expansion, no progress is obvious on the ground.

An overriding objective of the MEM should be the achievement of a specified strategic national target price for electricity. Subsequently all the policies, projects and programmes should be aligned to achieve that strategic target price. For instance, if Jamaica could reduce its 2006 residential tariff from J$16.14 per KWh toJ$9.40 (the average for NOIC in the sample) the savings to consumers would be an estimated J$7.4 billion.

6. Energy Efficiency

There are huge opportunities for increasing the efficiency of electricity use in Jamaica, particularly using an Energy Services Company (ESCO) framework. ESCOs are Energy Services Companies who bundle a number of energy services to form an energy saving project. Their services include training, auditing, design, maintenance, installation of technology improvements, measurement, and verification of savings. ESCOs guarantee the energy savings and/or the provision of the same level of energy service at a lower cost. Remuneration is directly tied to the energy savings achieved. ESCOs provide a savings guarantee to either finance, or assist in arranging financing for energy projects. ESCOs often use performance contracting as a financing mechanism for customers who want to avoid upfront capital expenditure.

There are huge opportunities for increasing the efficiency of electricity use in Jamaica.

A stakeholder consultation workshop hosted by the JPC in 2010 identified the main problems or barriers to developing an ESCO industry in Jamaica as lack of customer awareness, lack of confidence and trust in energy efficiency savings, low priority placed on energy efficiency, limited technical and management capabilities and inadequate legal and regulatory frameworks to protect stakeholders. There is also the perception that commercially viable financing is not available to potential investors in the ESCO industry.

Accordingly, if Jamaica could reduce its energy intensity measured as BOE required to produce each U$1,000 of GDP (2000 prices), from 2.87 to 1.85 (the average for NOIC in the sample) at 2009 GDP level the potential savings would be approximately 1.0 million BOE (see Table 44).

The successful experience of Mexico indicates that savings of about 15 percent of peak electricity demand are possible with well designed Energy Efficiency (EE) programmes. These savings will be based on, among other things, the enactment of efficiency legislation, application of norms, financing of projects, labelling of appliances and equipment, dissemination of information and the promotion and establishment of required policies and frameworks for the creation of a viable ESCO industry in Jamaica. The solution lies in a holistic approach to the development of an ESCO industry involving the participation of all key stakeholders.

7. Research Needs

Research is needed to identify and quantify the relationships between electricity and economic growth in view of their critical importance and complexity. The strong and persistent relationship between electricity use and GDP requires that close attention be paid to the adequacy of electricity supply to sustain a high future rate of economic growth.

Although favourable electricity supply conditions of themselves will not assure economic growth, inadequate supply will almost certainly constitute a serious impediment to such growth. Accordingly, additional research is needed in areas such as:

1. Firm and industry-level benchmarking of key performance indicators and best practices to identify opportunities for productivity improvement.
2. Econometric estimates of appropriate elasticities (price and income), technical change, and productivity growth to advance the understanding of the impact of electricity prices on economic growth.
3. Benchmarking of the governance and tariff structures against global best practices
4. Detailed technical review of the existing licence.

In light of the above findings, the conservative estimate of the JPC is that potential savings of J$15.42 billion in the cost of electricity could be realized if:

- The JPSCo were to achieve the fuel efficiencies realized by the IPPs (8100KJ/KWh)
- Jamaica achieved the average values of NOIC for (16 percent) distribution losses

- The JPSCo achieves the NOIC averages for SAIDI (16hr/customer/year) and SAIFI (12 times/year)
- The OUR enforced the provisions of the Electricity Licence.

1. Introduction

Electricity is a critical input in the production of goods and services and therefore in economic and social development. Industries use electrical power to drive machinery to produce goods and services. Households use electricity to provide light and run appliances that improve the quality of life through recreation, literacy, and health. Consequently, how the electricity industry performs strongly influences economic growth and a wide range of human development indicators (World Bank, 2005).

The utilization of electricity has increased significantly in the 20th and 21st century and is now a permanent feature in daily life. In addition to its continuing facilitation of communication, most industrial processes utilize electricity. The rising numbers of electronic devices such as computers have further placed electricity as a mainstay in homes and businesses. The United States Energy Information Administration (EIA) forecasted that electricity consumption for electronic devices (including TVs and computers) would grow by 3.5 percent annually between 2003 and 2005. At this rate, the level of electricity usage in 2025 for electronic devices is expected to double that of 2003.

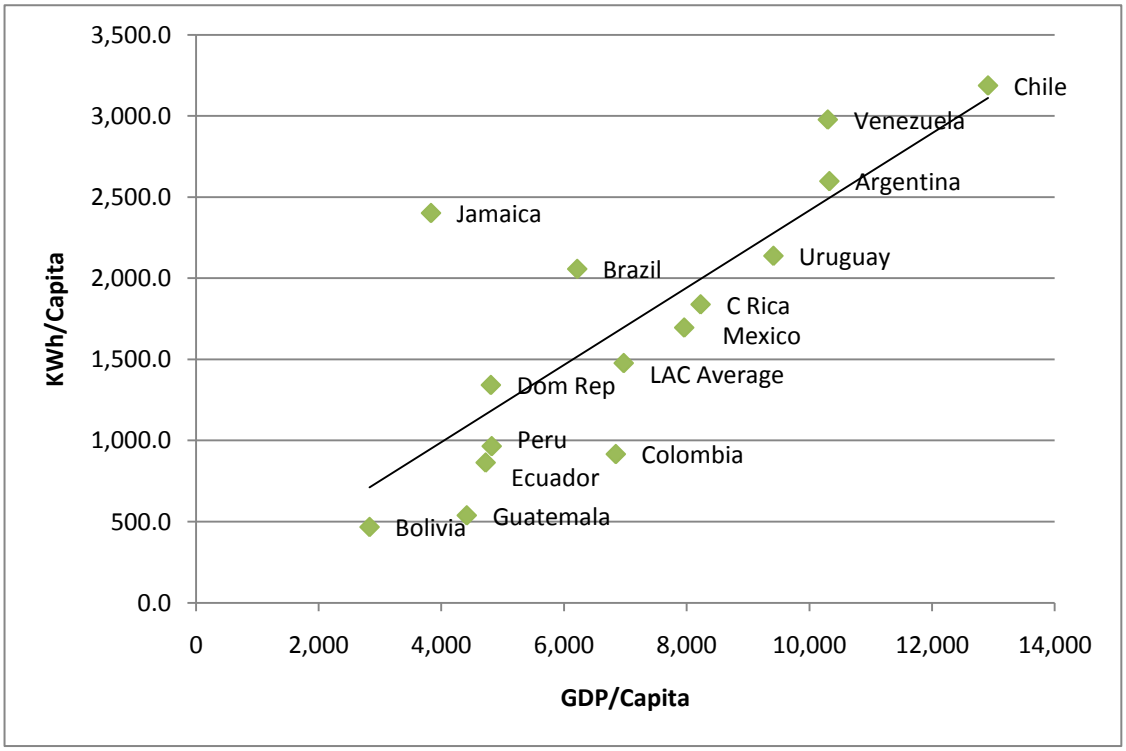
Electricity has facilitated the adoption of new technology and contributed to overall efficiency in businesses and households. Research has shown that productivity growth is highly correlated with technical change and new technology. A report by the National Research Council in the United States entitled Electricity in Economic Growth[1] found that technical change in some industries will increase the use of electricity and that in these industries productivity growth was greater, the lower the real price of electricity.

To illustrate the importance of electricity services to LAC economies, Figure 1 and Table 13 (Annex 1) compares electricity consumption per capita (KWh/capita) with GDP per capita (1990 PPP$). As expected, countries with low GDP per capita (less than US$6,000) such as Bolivia, Guatemala, Ecuador, and Peru consume relatively low electricity services (under 1,000 KWh/capita). In contrast, countries with relatively high

[1] "Electricity in Economic Growth", Commission on Engineering and Technical Systems, National Research Council. National Academic Press, Washington DC 1986.

GDP/capita (above US$10,000) such as Chile, Venezuela and Argentina consume more electricity (above 2,500 KWh/capita). Interestingly, Jamaica with a GDP per capita of below US$4,000 consumed more electricity per capita than some countries with much higher incomes, such as Brazil ($6,215), Uruguay ($9,400) and Costa Rica ($8,227). In essence, Jamaica's energy consumption has been increasing at a much faster pace than the expansion of the economy. This could mean that Jamaica's increasing electricity consumption is supporting low value added activities. If the same electricity resource was targeted toward higher value added activities, Jamaica could increase GDP per capita. At the same time, the efficiency with which electricity is used appears to be low compared to other countries; therefore, Jamaica can produce the same GDP per capita with less consumption of electrical energy. In other words, per capita electricity consumption is uneven among countries of the region, reflecting differences in income per capita, EE, and participation of electricity intensive industries.

Figure 1: Electricity Consumption (KWh/capita) compared to GDP per capita (US$)



Source: Compiled using data from United States Energy Information Administration (EIA) and World Bank

In terms of energy intensity, in 1970 the Jamaican economy utilized 2.35 BOE to produce each US$1,000 of GDP. However, by 2008 it was using 2.87 BOE to produce the same level of output. This is in contrast to Costa Rica which in 1970 used 1.61 BOE to produce each US$1,000 of GDP. However, in 2008 its energy intensity was reduced to 1.19 BOE. Indeed, countries such as Brazil, Ecuador, Honduras and Paraguay which in 1970 had higher energy intensity than Jamaica managed to reduce their levels to below that of Jamaica in 2008.

Many factors, including climate, the structure of the economy in terms of sectoral energy consumption and the technology used by dominant industries, influence an economy's overall energy intensity. For example, the bauxite industry is more energy intensive compared to agriculture.

Over the 10-year period 1998-2007, the consumption of electricity in Jamaica, measured by growth in residential and non-residential consumption (KWh/capita), grew by 11.0 and 7.0 percent for residential and non-residential, respectively. In contrast, the LAC average growth rate was much higher at 15.0 percent for residential and 35.0 percent for non-residential consumption. Close examination of Table 1 shows that of the 21 countries in the sample, 12 recorded growth rates in non-residential consumption that exceeded those of residential consumption (e.g., Bolivia, Brazil, Chile, Costa Rica, Honduras, the Dominican Republic and LAC average). For the remaining 9 countries, growth in residential consumption exceeded those for non-residential (e.g., Jamaica, Argentina, Colombia, Grenada, Mexico, Nicaragua, Panama and Venezuela). This means that in the latter group electricity consumption is supporting low value added activities.

A reliable supply of competitively priced electricity is necessary if a nation's households and firms are to compete effectively in an increasingly global economy. As globalization drives the demand for technology and innovation, the derived demand for electricity is expected to intensify.

Erratic supply of electricity is probably the most significant constraint to economic growth in LAC countries (World Bank, 2005). Businesses that depend on a constant supply of electricity (including resorts, hospitals, data-processing and IT facilities, supermarkets, and other industries that depend on refrigeration) must either invest in expensive standby generation or face periodic significant disruption to their operations. Voltage fluctuations damage electrical equipment so customers must either invest in their own power-conditioning and standby assets or face significant repair or replacement costs.

Table 1: Residential and Non-residential Electricity Consumption (KWh/capita) and Growth Rates (%) in LAC (1998-2007)

Countries	Residential Consumption		Non-residential Consumption		Growth Rate (%) 1998-2007	
	1998	2007	1998	2007	Non-residential	Residential
Argentina	531	749	1,354	1,849	37	41
Bolivia	160	178	236	289	22	11
Colombia	297	382	536	534	-	29
Ecuador	280	302	396	562	42	8
Mexico	331	431	1,102	1,265	15	30
Venezuela	625	741	1,941	2,236	15	19
NOEC[2]	371	464	928	1,123	22	23
Brazil	479	473	1,316	1,584	20	- 1
Chile	648	536	1,435	2,651	85	- 17
Costa Rica	607	734	758	1,105	46	21
Dom Rep	458	448	179	894	399	- 2
El Salvador	206	223	342	380	11	8
Grenada	404	557	597	807	35	38
Guatemala	104	175	218	363	67	68
Honduras	231	288	213	396	86	25
Jamaica	366	404	1,869	1,997	7	11
Nicaragua	94	123	218	256	18	31
Panama	363	478	899	1,134	26	32
Paraguay	491	548	279	364	30	12
Peru	235	229	406	735	81	- 2
Uruguay	789	875	1,000	1,262	26	11
NOIC[3] Average	391	435	695	995	67	17
LAC Average	385	444	765	1,033	35	15

Source: OLADE Statistical Report (2007)

[2] The six Net oil exporting countries (NOEC) in the sample are Argentina, Bolivia, Colombia, Ecuador, Mexico and Venezuela.
[3] The Net oil importing countries in the sample are Brazil, Chile, Costa Rica, Dominican Republic, El Salvador, Grenada, Guatemala, Honduras, Jamaica, Nicaragua, Panama, Paraguay, Peru and Uruguay, St. Lucia, St. Kitts, Antigua and Belize.

High electricity price is probably the most important barrier to economic growth in LAC countries. Lack of incentives to increase fuel efficiency and reduce system losses are key drivers behind high electricity prices. High fuel prices can also be partly explained by reliance on expensive imported petroleum for generation, when cheaper alternatives could significantly reduce generation costs.

The importance of electricity to businesses and consumers means that improvements in the performance of this industry will contribute to growth in national productivity and competitiveness. In particular, increased productivity in the generation and distribution of electricity is expected to pass-through to businesses in the form of lower prices and a more reliable service. Consumers will then spend less for quality electricity service and therefore be in a position to purchase more of other goods and services. This will improve overall well-being which should positively impact national productivity. The government should also benefit from lower electricity price and therefore spend more on other public infrastructure services provided to the public.

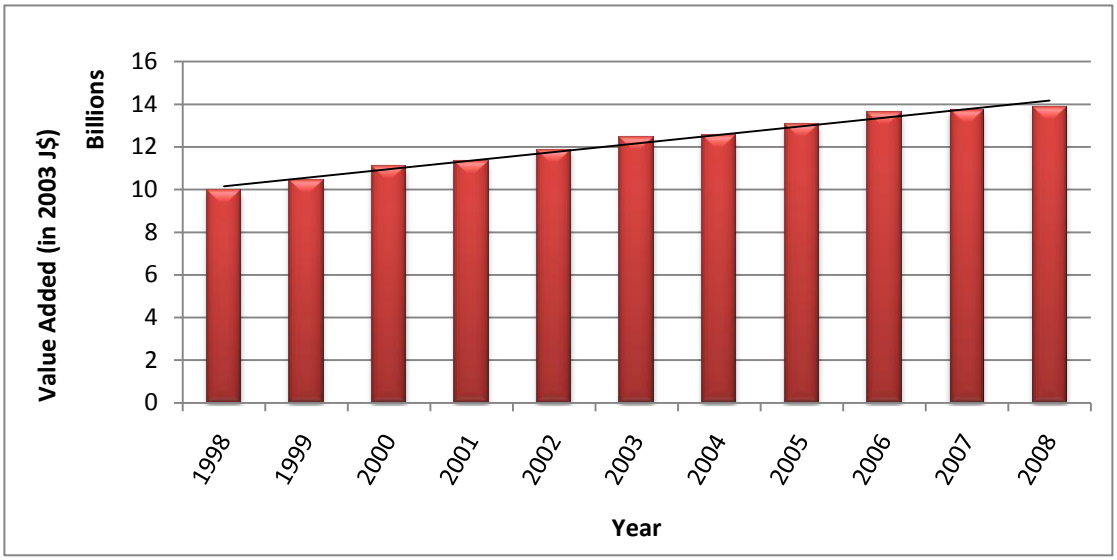
2. Overview of the Jamaican Electricity Industry: 1998 – 2007

The electricity industry contributes appreciably to GDP and productivity at the firm and aggregate levels. In 2008, the generation and distribution of electricity in Jamaica contributed 2.8 percent to real GDP and recorded one of the highest levels of labour productivity amongst local industries.

Over the period 1998-2008 average value added by the industry grew by 3.4 percent annually, compared to 1.3 percent for the general economy. Value added by the industry in 1998 was estimated at J$9.95 billion, reaching J$13.9 billion in 2008 (Figure 2 and Table 14 – Annex 1). Between 1998 and 2008, average annual growth in value added was less than 4 percent in only four years: 2001 (1.95%), 2004 (0.75%), 2007 (0.88%) and 2008 (1.1%). The performance in these respective years can be partly attributed to Hurricane Ivan (2004), Hurricane Dean (2007) and the onset of the global recession (2008). The largest growth in value added of 6.01 percent was recorded in 2000.

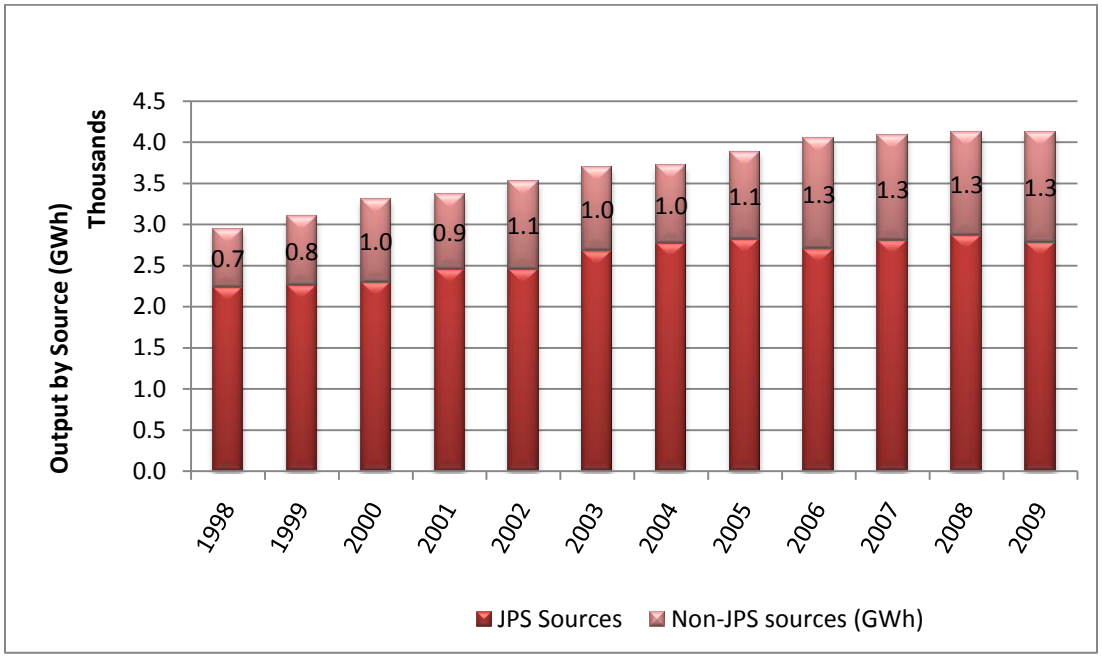
As shown in Figure 3 Table 15 - Annex 1, electricity generated (GWh) increased, on average, by 3.3 percent per annum over the period (1998-2009), moving from 2,950 GWh in 1998 to 4,214 GWh in 2009. As expected, trends in GWh of electricity produced mirrored the trends in value added. The lowest growth years were 2004 (0.6%), 2007 (0.7%) and 2008 (1.2%); and the highest growth year was 2000 (6.53%). Of the total electricity generated, IPPs accounted for 32 percent in 2009, up from 25 percent in 1998.

Figure 2: Value Added by Electricity Generation and Distribution (J$ 2003 Prices)



Source: Compiled using data from STATIN

Figure 3: Total Electricity Output (GWh) by Source: 1998 - 2009

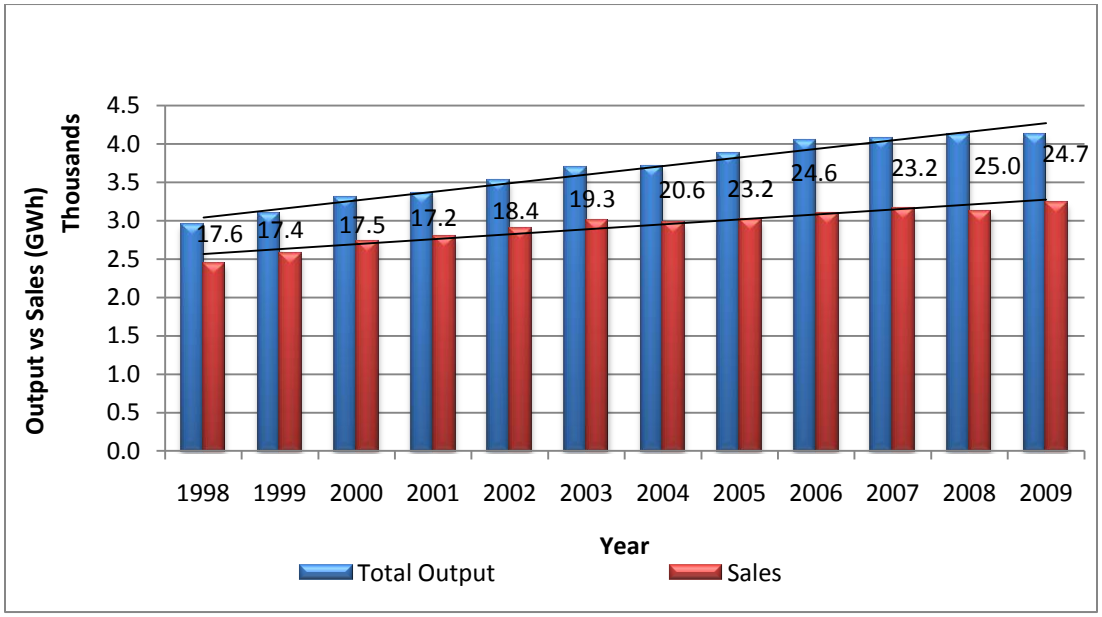


Source: Compiled using data from the Planning Institute of Jamaica

As the population increases and the economy expand, the demand for electricity services is expected to rise. Even with slow economic growth, Jamaica experienced rising demand for electricity. Between 1998 and 2009, electricity sold increased, on average, by 2.6 percent annually compared with an average increase of 3.3 percent increase in output.

The gap between growth in electricity sales and growth in output was greater in the last five years (2005 – 2009) with sales increasing by 2.6 percent annually, on average, while output accelerated at 1.7 percent annually. The difference between output and sales stood at 982.5 GWh in 2009 relative to 503.4 in 1998. The gap between electricity output and sales represents distributional losses which moved from 17.6 percent in 1998 to 24.7 percent in 2009 (Figure 4 and Table 16 – Annex 1).

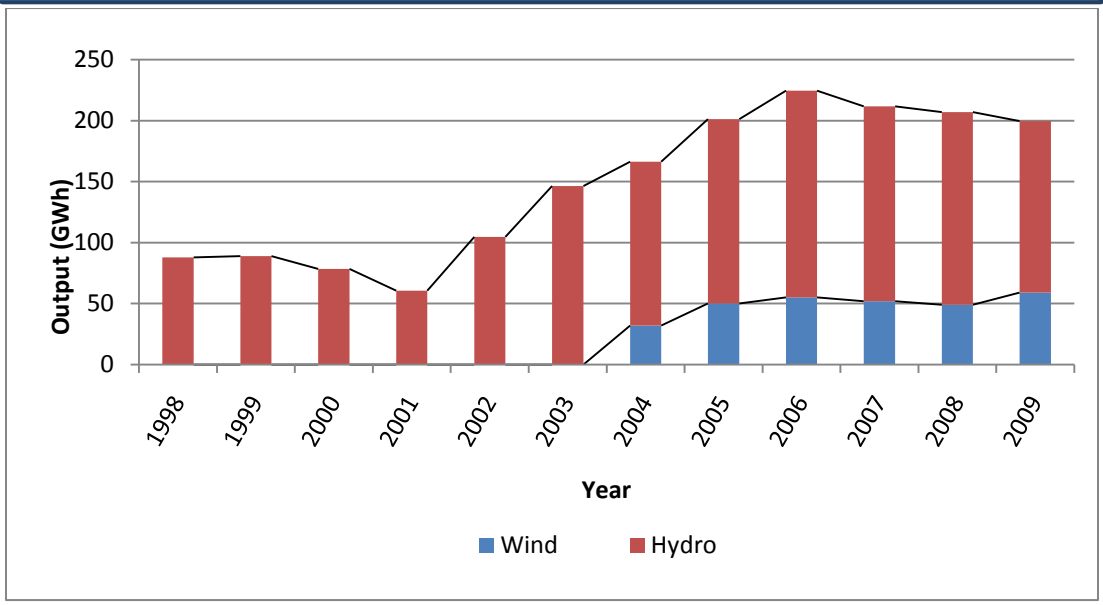
Figure 4: Electricity Output, Sales (GWh) and Percent Distribution Losses: 1998 - 2009



Source: Compiled using data from the Planning Institute of Jamaica

Figure 5 and Table 17 (Annex 1) shows that electricity generation from renewable sources was 199 GWh or 4.8 percent of total electricity generated in 2009. Hydroelectric power accounted for the largest portion with 140.7 GWh and has increased steadily since 2001; the remainder was generated from wind farms. Even though the contribution of renewable energy to total output was very small in 2009, there has been a marked improvement over what prevailed in 1998 of 80 GWh or 3 percent of output and a low of 60.5 GWh or 1.8 percent contribution in 2001. Output from the wind farms started in 2004 and has improved steadily since. Overall electricity from renewable sources grew by 10 percent on average per annum over the ten-year period.

Figure 5: Total Wind and Hydro Output: 1998 - 2009



Source: Compiled using data from the Planning Institute of Jamaica and Ministry of Energy

In 2009, electricity generation consumed 6.7 million barrels of oil or 33.6 percent of total petroleum consumption. Over the five-year period (2005–2009) the proportion of petroleum consumed by the electricity industry ranged from a low of 22 percent (2006) to a high of 33.6 percent (2009). Prior to 2009, electricity generation was the second highest user of petroleum (bauxite industry being the first), but due to the fall off in demand for alumina on the world market in late 2008 and 2009, two bauxite plants were closed and for the first time in Jamaica's history, the electricity industry became the largest consumer of oil.

The cost of petroleum products utilized for electricity generation was valued at J$2.26 billion in 1998. However, by 2009 it was J$32.1 billion, an average increase of 30 percent per annum. This was because of trends on the world market for crude oil where average price moved from US$14.38 per barrel in 1998 to US$79.36 per barrel in 2009. The rate of increase in fuel cost was greater than the growth of revenue in the industry. Revenue grew on average by 20.3 percent per annum, from J$10 billion in 1998 to J$71.5 billion in 2009. Given the aforementioned, as a percentage of gross revenue, fuel cost moved from 22.5 percent in 1998 to 44.8 percent in 2009.

The average rate charged by the JPSCo for electricity increased from J$4.06 per KWh in 1998 to J$21.44 per KWh in 2009. This represents an increase of 16.8 percent per year, far exceeding the average annual inflation rate of 10.5 percent over the corresponding period.

In 2009, the tariff for street lighting was J$25.28 per KWh, general service J$24.89, residential customers J$24.37, power service J$19.47 and large power J$17.75. The dramatic increases in the price of electricity have not only suppressed demand for the service but seriously affected the competitiveness of local businesses. The escalating electricity prices also reduced the purchasing power of households and contributed to non-technical distribution losses.

In 2004 the total installed capacity of the generation system was 821MW (Table 18 – Annex 1), but a number of plants were out of operation. The available capacity accounted for about 780 MW (95%), including the 20 MW from the Wigton Wind Farm. Of the available capacity, 621 MW was provided by the JPSCo and the remainder by four IPPs under long-term (20 years) power purchase agreements (PPAs).

Between 2002 and 2003, a total of 120 MW combined cycle capacity was put into operation. As such, in 2003 the JPSCo power plants contributed 72.3 percent to the total electricity output, with the remainder (27.7%) delivered by IPPs (see Table 2). In 2003, more than 70.5 percent of the electricity produced by the JPSCo was generated in the relatively old and inefficient thermal (steam) and low speed diesel plants. However, by 2009 this was reduced to 60.2 percent. The JPSCo steam plants were commissioned between 1968 and 1976 and need to be gradually replaced by modern generating assets.

Electricity produced by the JPSCo using gas turbines has declined from 17.5 percent in 2003 to 8.5 percent in 2008. On the other hand, production from combined cycle has increased from 6.5 percent in 2003 to 26.9 percent in 2008.

Table 2: Electricity Generation and Purchase (MWh)

Type	2003	2004	2005	2006	2007	2008	2009
Steam	1,685,000	1,491,700	1,567,900	1,311,900	1,532,700	1,452,700	1,470,300
Slow Speed Diesel	200,300	239,800	220,400	232,000	138,500	240,700	255,500
Hydro	146,318	134,327	151,310	169,633	159,820	158,181	140,700
Gas Turbines	468,334	286,939	358,080	231,889	267,503	244,485	N/A
Combined Cycle	173,596	611,376	513,126	756,602	701,384	769,596	N/A
Subtotal JPSCo	2,673,575	2,763,677	2,810,881	2,702,001	2,799,924	2,865,635	2,867,100
Purchases from IPPs	1,022,435	953,345	1,067,109	1,344,427	1,278,847	1,257,655	1,346,900
Total (JPSCo &IPPs)	3,696,010	3,717,022	3,877,990	4,046,428	4,078,771	4,123,290	4,214,000
Steam (%)	63.0	54.0	55.8	48.6	54.7	50.7	51.3
Slow Speed Diesel (%)	7.5	8.7	7.8	8.6	4.9	8.4	8.9
Hydro (%)	5.5	4.9	5.4	6.3	5.7	5.5	4.9
Gas Turbines (%)	17.5	10.4	12.7	8.6	9.6	8.5	N/A
Combined Cycle (%)	6.5	22.1	18.3	28.0	25.1	26.9	N/A
Subtotal JPSCo	100	100	100	100	100	100.0	100.0
Purchases from IPPs (%)	27.7	25.6	27.5	33.2	31.4	43.9	47.0

Source: Calculated from JPSCo Annual Reports (various years)

3. Objectives of the Study

The primary objective of this study is to compare the performance of Jamaica's electricity sector against a group of comparator countries in LAC. Specifically, the research seeks to:

1. Compare the performance of the JPSCo, on the generation side, to other players in the domestic industry (inter-country comparison).
2. Compare Jamaica's electricity sector performance, on the distribution side, to other LAC countries (intra-country comparison) in terms of five major groups of performance indicators: coverage and scale; non-labour efficiencies; technical efficiency and quality; end-user prices and labour productivity.
3. Identify areas of relative strengths and weaknesses of Jamaica's electricity infrastructure vis-à-vis LAC countries (Gap-analysis).
4. Interpret, where feasible, the comparisons that are useful for policy intervention.

A secondary objective is to add value to the existing World Bank Electricity Database by updating it with data that are more current and utilize it to compare the sector on a continuous basis. This comparison is important given the need for continuous productivity improvement in the sector to off-set increases in the price of imported fuel and its concomitant impact on electricity prices as well as its implications for the country's competitiveness.

4. Methodology

4.1 Productivity on the Generation Side

Performance on the generation side of the electricity industry is measured in terms of energy productivity defined in Equation 1.

Equation 1

$$Energy\ Productivity = \frac{total\ net\ generation - generation\ from\ renewable\ sources}{barrels\ of\ oil\ consumed}$$

In the case of Jamaica, total net generation by the industry is made up of net generation[4] by the JPSCo and by IPPs. The energy sources from which electricity is generated include thermal, hydro and wind. Therefore, net generation of the system has to be adjusted by subtracting electricity produced by hydro and wind energy[5].

From the generation side, at least four energy productivity calculations can be performed. These include energy productivity of:

1. The entire oil-based thermal generation system (JPSCo plus IPPs).
2. The JPSCo oil-based thermal generation system (entire generation system less hydro and wind, less IPPs).
3. The IPPs using only non-renewable energy.
4. The Heat rate – which is a measure of the efficiency with which a utility converts fuel into electricity (KJ/KWh). This is a key performance indicator used by the OUR to determine the pass-through of fuel prices to electricity consumers.

4.2 Productivity on the Distribution Side

The performance of the electricity sector on the **distribution side** is conducted using the *World Bank's Benchmarking Database of the Electricity Distribution Sector in Latin*

[4] Net electricity generation or net electricity production is equal to gross electricity generation minus the consumption of power stations' auxiliary services. Gross electricity generation or gross electricity production refers to the process of producing electrical energy. It is the total amount of electrical energy produced by transforming other forms of energy, for example nuclear or wind power. It is commonly expressed in gigawatt-hours (GWh) i.e. 1 billion (10^9) watt-hours.
[5] Wind energy is only produced by the Wigton Windfarm.

America and the Caribbean Region (1995-2005). In the case of Jamaica, the JPSCo is the sole distributor of electricity, therefore this database refers only to them.

The analysis, on the distribution side, compares the Jamaican electricity distribution industry with twenty four (24) other LAC economies over the period 2001 to 2005. This five-year period will highlight performance before and after the tariff cap regime was introduced in Jamaica in 2004. Accordingly, it provides insights into whether the industry's performance under a regulatory regime is deteriorating, static or improving. The analysis is conducted using twenty two (22) indicators in the World Bank Database. For analytical convenience, these were divided into the following five groups:

A. *Coverage and Scale Indicators*

1. Total number of connections – residential and non-residential.
2. Total number of residential connections (subscribers)**.**
3. Total electricity sold per year - the total electricity supplied in MWh or the amount of electricity that was put on the distribution network.
4. Length of the distribution network in kilometres (km).
5. Electricity coverage or percent of the population with access to electricity.

B. *Non-labour Efficiency Indicators*

6. Energy sold per connection or energy density - ratio of total energy sold per year (MWh) relative to the total number of connections or customers.
7. Operating expenditures (OPEX) of the distribution service per connection (US$). It consists of operating and maintenance, customer service and accounts, sales, administrative and general expenses. Usually, the biggest items of OPEX are labour, materials, and third party service contract expenses. OPEX reflects the operations of the distribution segment and therefore do not include depreciation.
8. OPEX of the distribution services per MWh sold (US$). Same OPEX definition above but divided by the total energy sold.
9. Capital expenditure (CAPEX) of the distribution service per connection (US$). CAPEX consists of the expenditures to acquire, expand, repair, or renovate fixed assets, implying the purchase of goods and services whose benefits extend beyond

the year and add to the company's assets. CAPEX represents the annual gross capital outlays of a company.

10. CAPEX of the distribution service per MWh sold (US$). Same CAPEX definition as above but divided by the total energy sold.

11. Total expenditure (TOTEX) of the distribution service per connection (US$). TOTEX is the sum of OPEX and CAPEX.

12. TOTEX of the distribution service per MWh sold (in dollars). Same TOTEX definition above but divided by the total energy sold.

C. Technical Efficiency and Quality Indicators

13. Total energy losses in distribution (%) per year (due to technical losses and illegal connections). Total losses in distribution are defined as the sum of technical and non-technical (commercial) losses.

14. Energy losses in distribution (%) per year due to technical losses only. Energy losses due to technical reasons including dissipation of power in electrical system components.

15. Energy losses in distribution (%) per year due to non-technical losses. Includes non-technical or commercial losses (illegal connections and losses due to failure in the billing system).

16. Average duration of interruptions per subscriber - the number of hours-subscriber of the system were without power in a year, divided by the total number of subscribers. The equivalent is SAIDI, System Average Interruption Duration Index calculated by dividing the sum of all customer interruption durations by the total number of customers served.

17. Average frequency of interruptions per subscriber (#) - average number of interruptions experienced by a consumer unit per year. The equivalent is System Average Interruption Frequency Index (SAIFI) calculated by dividing total number of sustained customer interruptions by total number of customers served.

D. End-User Price Indicators

18. Average residential tariff - average price per MWh of electricity sold to residential consumers, including both fixed and variable components (local nominal currency converted to US$).

19. Average industrial tariff - average price per MWh of electricity sold to industrial consumers, including both fixed and variable components (local nominal currency converted to US$).

20. Average commercial tariff - average price per KWh of electricity sold to commercial consumers, including both fixed and variable components (local nominal currency converted to US Cents).

E. Labour Productivity Indicators

21. Residential connections per employee - number of residential connections divided by the number of employees.

22. Energy sold per employee - energy sold in MWh divided by the number of employees.

4.3 Data Sources

Value added GDP for the industry was obtained from the Statistical Institute of Jamaica (STATIN) while data on output and sales (GWh), energy use, tariff by customer group, revenue and fuel cost was obtained partly from the Economic and Social Survey of Jamaica (Planning Institute of Jamaica), JPSCo, OUR and Ministry of Energy. Comparative tariff data for LAC was also obtained from the Latin American Energy Organization (OLADE). This is because it was uncertain whether the World Bank Database included taxes, accordingly, the OLADE time-series which included taxes was used, this is likely to exhibit greater uniformity across countries.

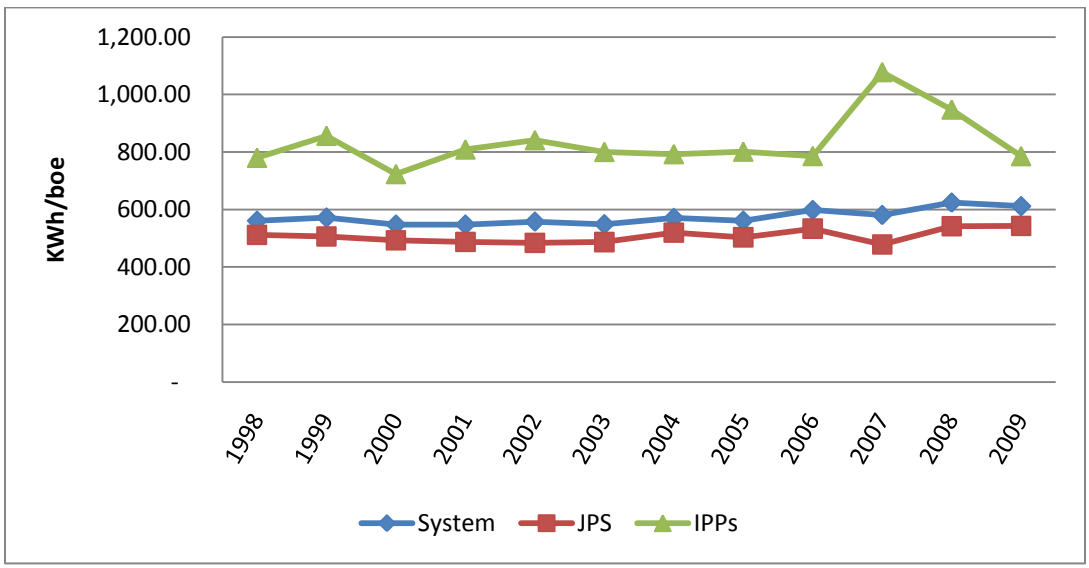
5. Results and Discussions

5.1 Generation Side Results and Analysis

Energy productivity of the oil-based generation system (JPSCo plus IPPs) was estimated at 560 KWh/BOE in 1998. Ten years later (2007), energy productivity improved to 580 KWh/BOE (Figure 6 and Table 19). This corresponds to an average energy productivity increase of 0.45 percent annually. In contrast, energy productivity in the generation of electricity by the JPSCo oil-base system (excluding IPPs) declined from 512 KWh/BOE in 1998 to 478 KWh/BOE in 2007. This represents an average decline of 0.6 percent per annum.

The energy productivity of the oil-based IPPs was superior to that of the entire system and that of the JPSCo, yielding 780 KWh/BOE in 1998 and rose to 1,078KWh/BOE in 2007. This is equivalent to an average increase of 4.5 percent annually. This is a significant finding and raises the question of what is responsible for the observed productivity gap. One plausible explanation is the older generating assets of the JPSCo such as steam plants that are relatively fuel inefficient and need to be replaced by modern generating assets.

Figure 6: Energy Productivity – KWh/BOE



Source: Compiled using data from the Planning Institute of Jamaica and Ministry of Energy

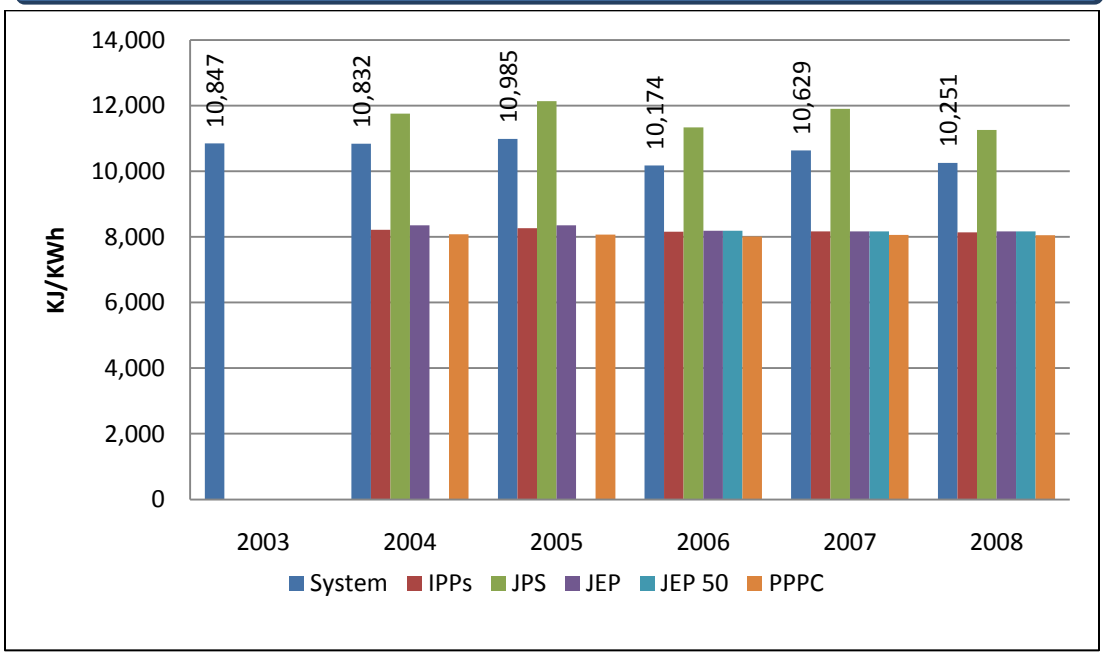
Heat Rate Indicator

The heat rate is a key performance indicator that is targeted by the OUR and used in calculating the monthly fuel price pass-through to customers. It is calculated as shown in Equation 2. Figure 7 and Table 20 (Annex 1) shows that the realized heat rate for the entire generating system ranged from a high of 10,985 KJ/KWh in 2005 to a low of 10,174 KJ/KWh in 2006.

Equation 2

$$Pass\ thru\ Fuel\ Cost = Fuel\ Cost\ Actual * \frac{Heat\ \ Rate\ Target}{Heat\ \ Rate\ Actual} * \frac{(1 - Losses\ Actual)}{(1 - Losses\ Target)}$$

Figure 7: Realized Heat Rate (KJ/KWh)



Source: Compiled using data from the JPSCo Tariff Application

It is of interest to note that the heat rate for the JPSCo generating assets were consistently higher than those for the system as well as the individual IPPs. This means that the system is dependent on the relatively low heat rate performance of the IPPs to counterbalance the relatively high heat rate performance of the JPSCo.

5.2 Distribution Side Results

5.2.1 Country-level Comparison

In this section, the Jamaican electricity distribution sub-sector (JPSCo) is benchmarked with twenty four (24) other LAC economies using twenty one (21) indicators divided into five (5) major categories: Coverage and scale (five indicators), non-labour efficiency measures (seven indicators), technical efficiency and quality (five indicators), end-user prices (two indicators) and labour productivity measures (two indicators).

It should be noted that only the indicators for which robust data existed have been included in the benchmarking analysis. Furthermore, where data is available, the analyses have been extended to 2008. This will provide the opportunity to determine whether the Jamaican electricity distribution sector has improved, remained static or declined.

Coverage and Scale Indicators

Total number of connections

Total number of connections is presented in Table 21 (Annex 1). In Jamaica the number of connections stood at 493,497 in 2001, increasing to 548,446 in 2005 or a growth of 11.1 percent in five years (2001-2005). Post 2005, the JPSCo has reported consistent increases in the number of connections to 584,218 in 2009. For the period 2004-2005, the increase slowed to 2.0 percent. This compares with a faster growth rate of 14 percent (2001-2005) and 3 percent (2004-2005) for the LAC average. Figure 8 shows that the highest increases were observed in countries with relatively low coverage such as Panama (29.5%), Honduras (28.4%), Nicaragua (26.6%) and the Dominican Republic (24.8%).

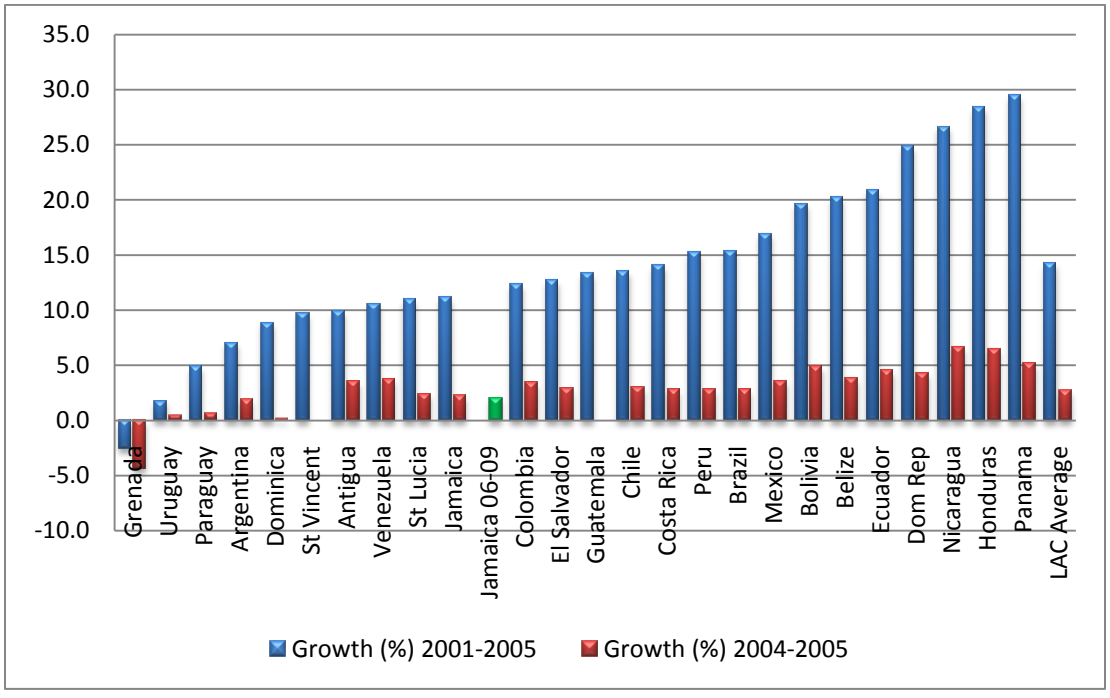
The total number of residential connections

The total number of residential connections is displayed in Table 22 (Annex 1), while growth (%) over the periods 2001-2005 and 2004-2005 is depicted in Figure 9. Residential connections in Jamaica grew from 427,903 in 2001 to 491,452 in 2005 or a period increase of 8 percent. This is about the same growth rate experienced by Peru, Mexico and Guatemala. This period of growth is slightly higher than the 7 percent LAC

average. The countries experiencing the strongest growth in this indicator were Panama (16%), Dominican Republic (14%), Honduras (14%) and Nicaragua (11%). In general, the number of residential connections in the smaller Caribbean states grew at rates well below the LAC average (7%). These range from 2 percent in Grenada to 6 percent in St. Lucia. Post 2005, JPSCo estimates show that residential connections in Jamaica have increased by approximately 6 percent to around 520,591 in 2009.

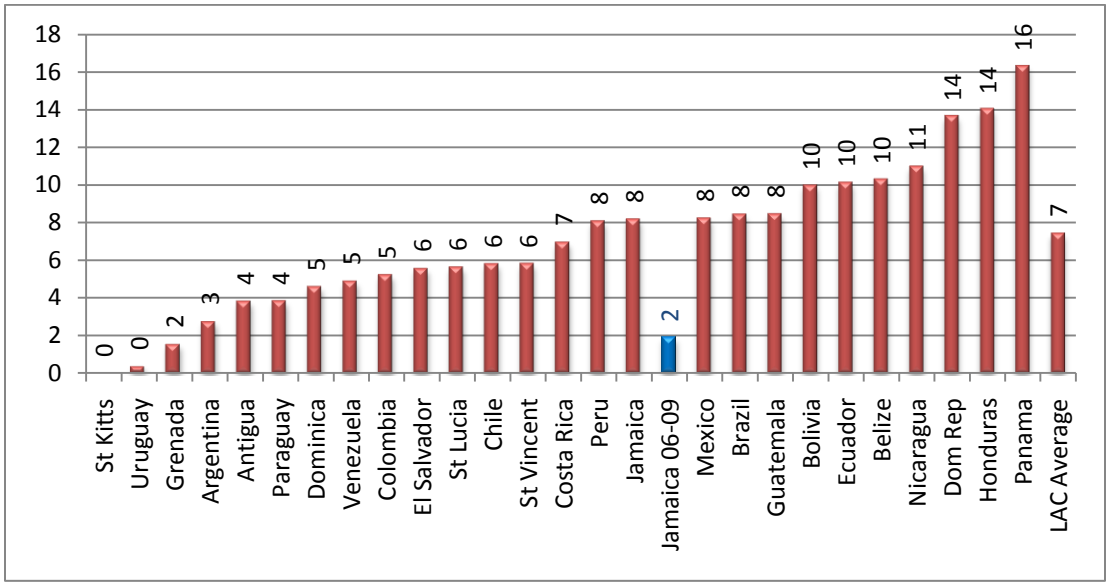
Table 23 shows that in terms of number of connections, the countries closest to Jamaica (548,446) in 2005 were Nicaragua (574,808), Panama (681,600) and Honduras (888,797). Most Caribbean islands reported below 100,000 connections. These include Antigua (28,724), Belize (68,635), Dominica (29,025), Grenada (33,406), St. Lucia (53,002) and St. Vincent (43,208). The three largest countries in the sample, in terms of land mass, recorded connections exceeding 10 million. These were Argentina (10.6 m), Brazil (57.9 m) and Mexico (29 m).

Figure 8: Growth in Total Number of Connections: 2001- 2005



Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Figure 9: Growth in Number of Residential Connections (%): 2001 – 2005

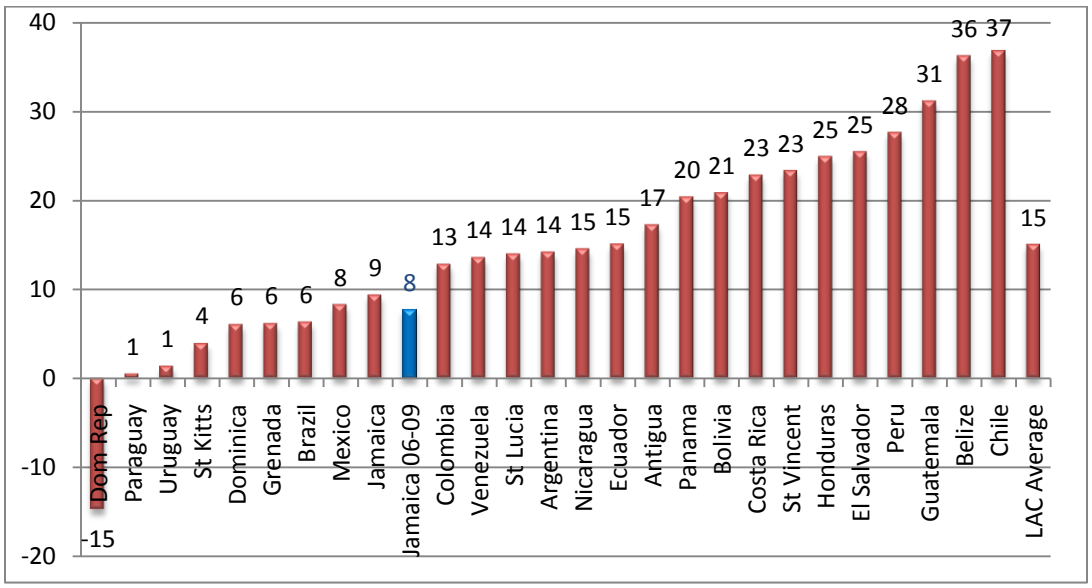


Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Electricity Sold (MWh)

Data on total electricity sold per year is provided in Table 23 (Annex 1) while growth is depicted in Figure 10. Electricity sales per year in Jamaica moved from 2,793,575 MWh in 2001 to 2,943,786 MWh in 2005. This is equivalent to a period growth (2001-2005) of 9 percent. This is significantly below the 15 percent LAC average over the corresponding period. In the region, electricity sales for the period grew the fastest in Chile (37%), Belize (36%), Guatemala (31%) and Peru (28%). Caribbean islands exceeding the LAC average included Antigua (17%), Costa Rica (23%) and St. Vincent (23%). Interestingly, electricity sales in the Dominican Republic declined by 15 percent over the same period. Electricity sales in Jamaica continued to improve following 2005, growing at an average annual rate of 1.4 percent before settling at 3,231,500 MWh in 2009.

Figure 10: Growth in MWh of Electricity Sold per Year (%): 2001 – 2005

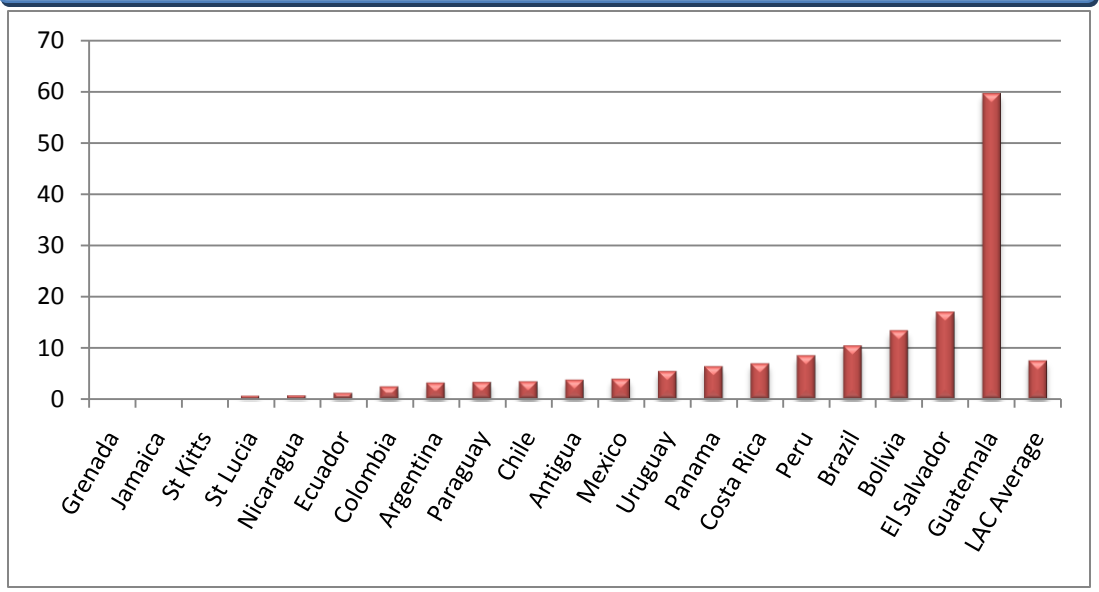


Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Length of distribution network

Jamaica recorded little change over the five-year period (2001-2005). Indeed, the data suggests that the length of the network has been constant at 14,000 km and was still estimated at that length in 2008. The closest country to Jamaica with respect to this indicator is Panama (11,274 km). In contrast, the average network length for LAC is 83,505 km. For instance, in Brazil the average length of the distribution network is 214,697 km. Figure 11 shows that in two-thirds of the LAC economies, the length of the distribution network did not grow by more than 4 percent over the five-year period. However, remarkable growth occurred in Guatemala where the network grew by 59 percent between 2001 and 2005.

Figure 11: Growth in Length (km) of Distribution Network (%): 2001 – 2005



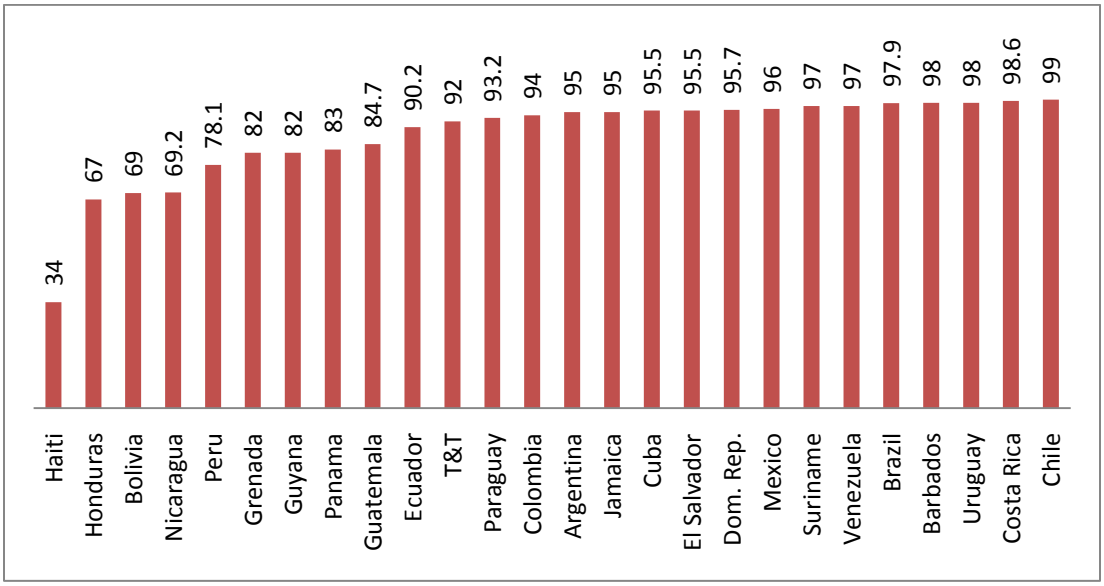
Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Electricity Coverage

In the 1970s, only about 50 percent of Jamaican households had access to electricity. However, Figure 12 and Table 25 (Annex 1) show that by 2007 Jamaica had attained coverage of 95 percent, which places it in the high coverage group. The low coverage LAC economies include Haiti (34%), Honduras (67%), Nicaragua (69%) and Bolivia (69%). Households use electricity to provide light and run electrical appliances; accordingly, households in low coverage states are expected to experience a relatively lower quality of life, literacy and health.

The results of the **scale and coverage indicators** are summarized in Table 3. With respect to total connections, Jamaica fell in the first quartile with its CARICOM partners, although it had close to eight times more connections than its closest partner, Belize with 68,635 connections. In the case of the number of residential connections, Jamaica remained in the first quartile with St. Kitts being the only additional country to fall into that category. In this grouping, total residential connections ranged from 4,782 in St. Kitts to 491,452 in Jamaica.

Figure 12: Electricity Coverage (%) in LAC Economies – 2007



Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Table 3: Benchmark Summary of Scale and Coverage Indicators

First Quartile		Second Quartile		Third Quartile		Fourth Quartile	
Total Connection (2005)							
Antigua	28,724	**Nicaragua**	574,808	**Costa Rica**	1,236,847	**Venezuela**	5,392,500
Dominica	29,025	**Panama**	681,600	**El Salvador**	1,293,664	**LAC Average**	5,406,435
Grenada	33,406	**Honduras**	888,797	**Guatemala**	1,849,629	**Colombia**	8,848,554
St Vincent	34,208	**Dom Rep**	914,279	**Ecuador**	3,025,614	**NOEC**	9,657,081
St Lucia	53,002	**Paraguay**	1,006,807	**Peru**	3,997,575	**Argentina**	10,600,000
Belize	68,635	**Bolivia**	1,075,816	**NOIC**	4,064,126	**Mexico**	29,000,000
Jamaica	548,446	**Uruguay**	1,217,021	**Chile**	4,861,913	**Brazil**	57,900,000
Residential Connection (2005)							
St Kitts	4,782	**Nicaragua**	534,885	**Uruguay**	1,091,523	**LAC Average**	4,536,648
Dominica	24,851	**Panama**	606,127	**El Salvador**	1,191,459	**Venezuela**	4,802,261
Antigua	26,188	**Honduras**	809,843	**Guatemala**	1,583,268	**Colombia**	7,788,933
Grenada	29,123	**Dom Rep**	844,613	**Ecuador**	2,647,131	**NOEC**	8,488,882
St Vincent	30,304	**Paraguay**	871,716	**NOIC**	3,350,978	**Argentina**	9,252,165
St Lucia	47,417	**Bolivia**	942,804	**Peru**	3,597,326	**Mexico**	25,500,000
Belize	68,041	**Costa Rica**	1,080,591	**Chile**	4,486,053	**Brazil**	49,600,000
Jamaica	491,452						

First Quartile		Second Quartile		Third Quartile		Fourth Quartile	
Electricity Sold – MWh (2005)							
St Kitts	34,300	**Jamaica**	3,055,154	**Paraguay**	5,164,954	**LAC Average**	29,701,331
Dominica	67,789	**Bolivia**	3,485,516	**Uruguay**	6,515,000	**Colombia**	31,700,000
St Vincent	106,800	**Dom Rep**	3,719,640	**Ecuador**	9,152,424	**Argentina**	62,800,000
Grenada	131,571	**Honduras**	4,176,357	**Costa Rica**	11,800,000	**NOEC**	65,689,657
Antigua	175,897	**El Salvador**	4,199,616	**Peru**	13,400,000	**Venezuela**	117,000,000
St Lucia	277,398	**Guatemala**	4,476,000	**NOIC**	18,904,833	**Mexico**	170,000,000
Belize	349,726	**Panama**	4,666,343	**Chile**	29,000,000	**Brazil**	285,000,000
Nicaragua	1,780,119						
Length of Distribution Network – Km (2005)							
Chile	31	**Nicaragua**	3,998	**NOIC**	32,045	**LAC Average**	87,267
St Kitts	53	**Panama**	11,492	**El Salvador**	37,614	**Ecuador**	120,196
Grenada	354	**Jamaica**	14,000	**Paraguay**	56,912	**Brazil**	235,343
Antigua	666	**Costa Rica**	23,986	**Uruguay**	66,595	**NOEC**	252,932
St Lucia	1,425	**Peru**	24,611	**Colombia**	74,000	**Argentina**	333,011
Guatemala	3,594	**Bolivia**	27,079			**Mexico**	710,376
Coverage - 2007 (%)							
Haiti	34	**Guatemala**	85	**Colombia**	94	**Suriname**	97
Honduras	67	**NOIC**	86	**Argentina**	95	**Venezuela**	97
Bolivia	69	**LAC Average**	88	**Jamaica**	95	**Brazil**	98
Nicaragua	69	**Ecuador**	90	**Cuba**	96	**Barbados**	98
Peru	78	**NOEC**	91	**El Salvador**	96	**Uruguay**	98
Grenada	82	**T&T**	92	**Dom. Rep.**	96	**Costa Rica**	99
Guyana	82	**Paraguay**	93	**Mexico**	96	**Chile**	99
Panama	83						

Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution sector in Latin America & the Caribbean Region 1995-2005

In terms of electricity sold each year (MWh), Jamaica moved into the second quartile position. Other countries in the grouping were Bolivia, Honduras, Dominican Republic, El Salvador, Guatemala and Panama. Electricity sales in the grouping ranged from 3,055,154 MWh in Jamaica to 4,666,343 MWh in Panama.

Jamaica maintained its second quartile position with respect to length of the distribution network (km), associating with Nicaragua, Panama, Costa Rica, Peru and Bolivia. Network length varied from roughly 4,000 Km in Nicaragua to 27,079 km in Bolivia.

Finally, Jamaica migrated to the third quartile with respect to electricity coverage in the range of 94-96%, with countries such as Colombia, Argentina, Cuba, El Salvador, Dominican Republic and Mexico.

The indicators, total connections, residential connections and electricity sold are clearly influenced by country size, with the larger economies occupying the fourth quartile and the smaller economies of the Caribbean populating the first quartile. However, length of the distribution network and coverage are less clearly defined by country size.

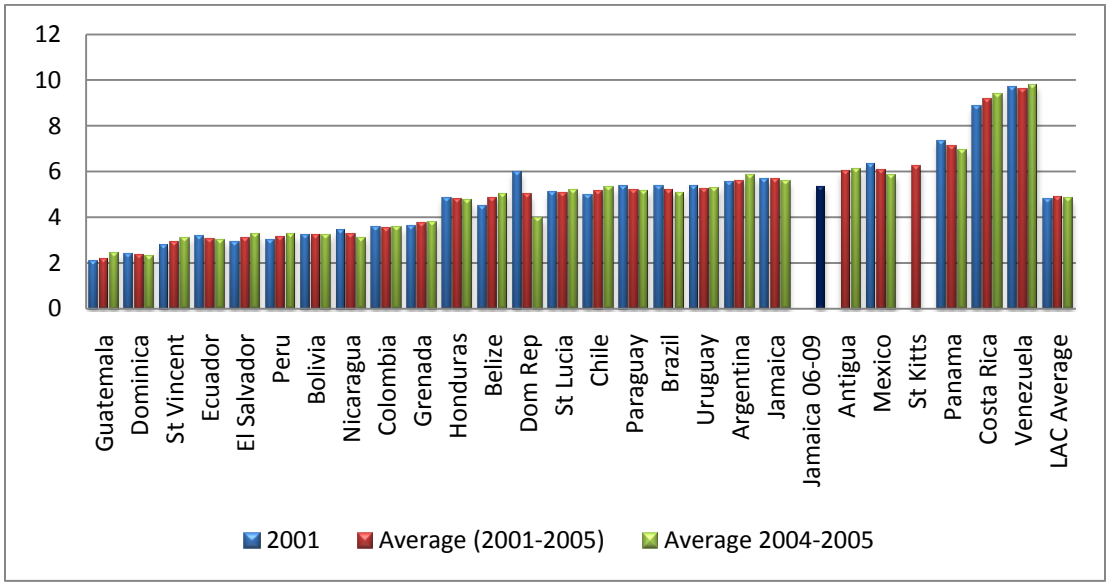
Non-labour Efficiency Indicators

Electricity sold per connection

Data on electricity sold per connection for the period 2002-2005 is summarized in Table 26 (Annex 1) and Figure 13. Electricity sold per connection is a ratio of total MWh of electricity sold per year and the total number of connections. Figure 13 shows that for the period (2001-2005) average electricity sold per connection for the LAC average was 5 MWh per year. Countries clustering around this LAC average include Belize, Brazil, Honduras, Paraguay and the Dominican Republic.

Jamaica was above the LAC average at 6 MWh per connection per year, in a group with Uruguay, Chile and St. Lucia. For Jamaica, this ratio has continued to linger around the 6 MWh mark up until 2009. Countries significantly exceeding the LAC average are Venezuela (10), Costa Rica (9) and Panama (7).

Figure 13: Electricity Sold per Connection (MWh/year)



Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

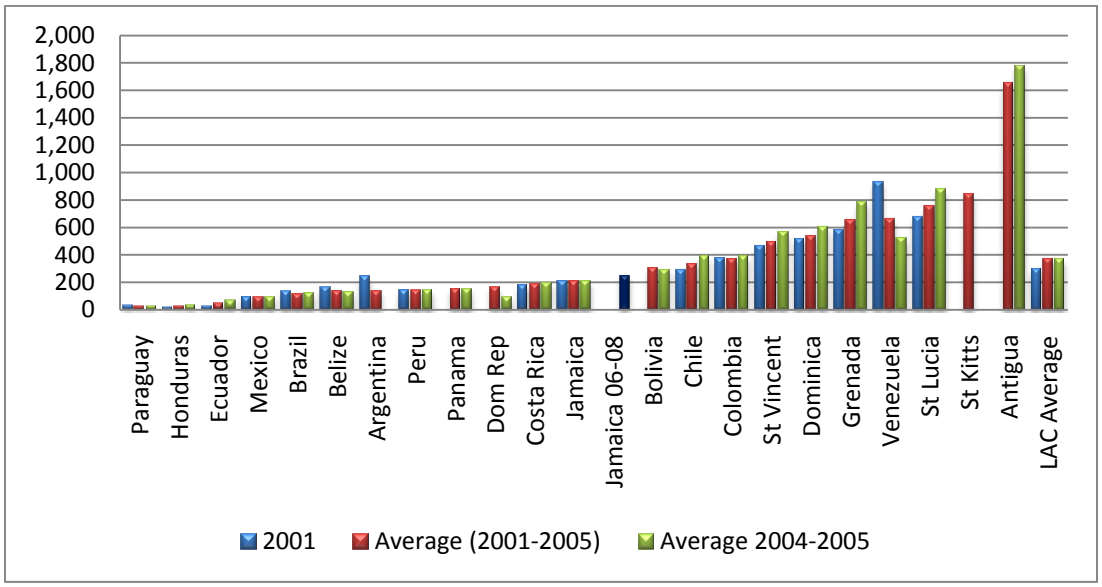
Operating expenditure (OPEX) per connection (US$)

This consists of operating and maintenance, customer service, sales, administrative and general expenses. Usually, the biggest items of OPEX include labour, materials and third party service contract expenses.

Data on OPEX per connection is summarized in Table 27 (Annex 1) and Figure 14. Average OPEX per connection for LAC economies for the periods 2001-2005 and 2004-2005 were calculated, respectively as (US$ 364 and US$372). Jamaica falls in a band below the LAC average (US$204 and US$207). According to the latest data available (2006-2008), Jamaica continues to perform below the LAC average at US$250 even though this represents an increase in OPEX relative to the average of US$207 in the 2004-2005 period. Closest to Jamaica is Costa Rica (US$184 and US$194). The most efficient countries in terms of OPEX include Paraguay (US$24 and US$25), Ecuador (US$47 and US$63), Mexico (US$93 and US$93) and Belize (US$137 and US$128).

The smaller Caribbean islands are essentially the least efficient in terms of OPEX per connection, which far exceeds the LAC averages. At one extreme is Antigua (US$1,651 and US$1,775) and at the other is Dominica (US$536 and US$605).

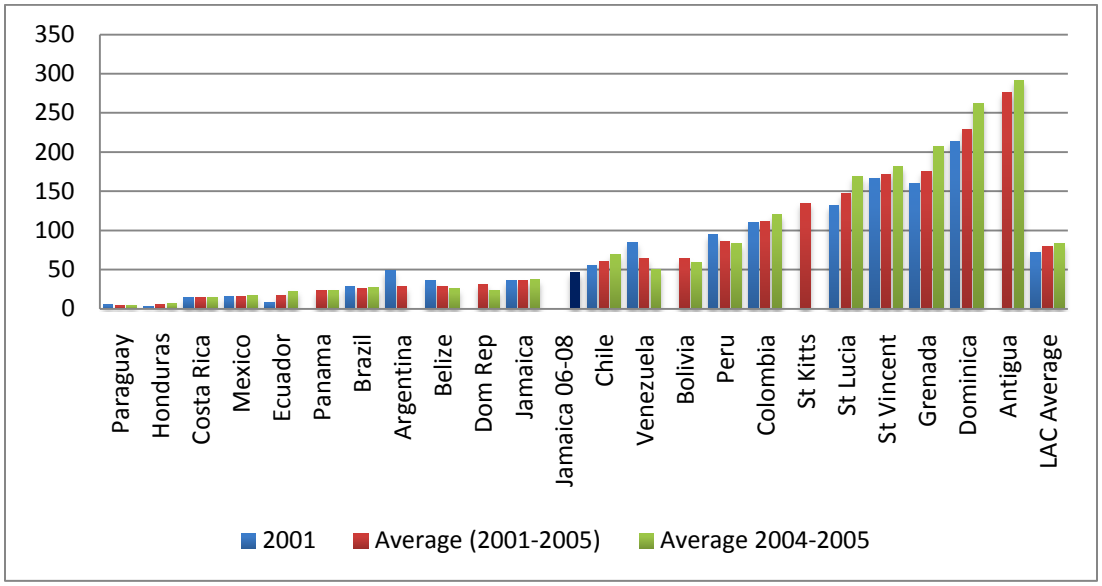
Figure 14: Average Operating Expenditure per Connection (US$)



Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Data on OPEX per MWh of electricity sold (US$) is provided in Table 28 (Annex 1) and Figure 15. The LAC average OPEX per MWh of electricity sold for the periods 2001-2005 and 2004-2005 were (US$80 and US$85). For the corresponding periods, the indicators for Jamaica were (US$36 and U$37), less than half that of the LAC average. Countries with the closest outturn to Jamaica include the Dominican Republic (US$31 and US$24), Argentina (US$ and US$28), Belize (US$29 and US$16) and Brazil (US$25 and US$29). Countries with the lowest averages for the corresponding periods were Paraguay (US$5 and US$5), Honduras (US$5 and US$7), Costa Rica (US$15 and US$15), Mexico (US$16 and US$16) and Ecuador (US$17 and US$23). Similar also to OPEX per connection, it turns out that the Caribbean islands have the highest OPEX per MWh of electricity sold. This ranged from the least efficient being Antigua (US$276, and US$291) and the most efficient being St Kitts (US$135).

Figure 15: Average Operating Expenditure per MWh Sold (US$)



Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Capital Expenditure (CAPEX) per Connection (US$)

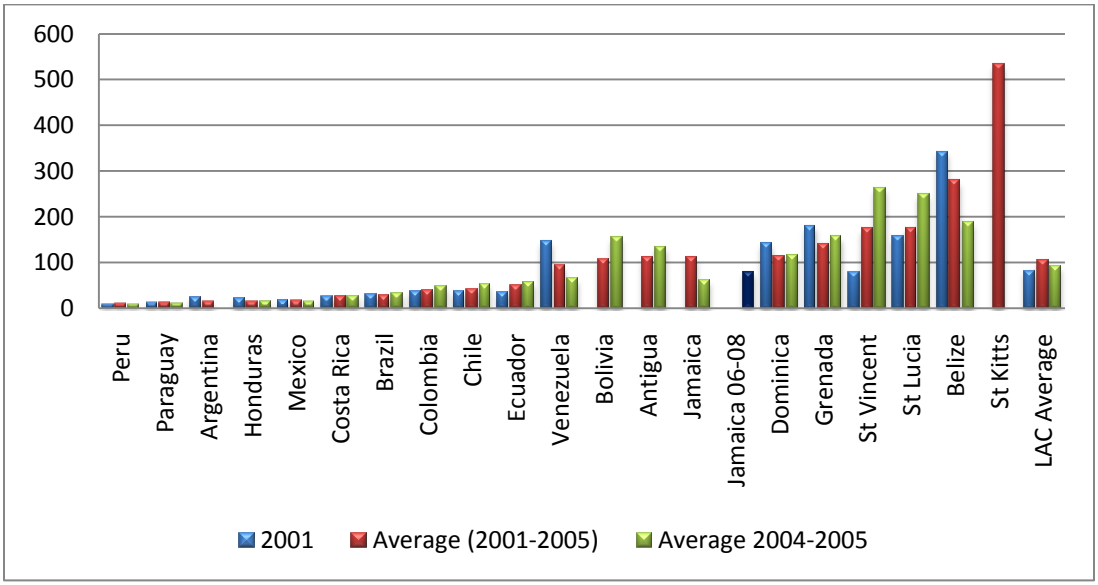
Capital expenditure (CAPEX) consists of the costs to acquire, expand, retrofit or renovate fixed assets, implying expenditure on goods and services whose benefits extend beyond a single year and add to the company's fixed assets. **CAPEX per connection (US$)**, therefore measures the annual gross capital outlays of the distribution system per connected subscriber. Data for this variable is presented in Table 29 (Annex 1) and summarized in Figure 16.

Table 29 shows that CAPEX per connection in Jamaica stood at US$200 in 2002 and declined to US$61 by 2005. The average was US$110 (2001-2005) and US$60 (2004-2005). This compares favourably with the averages for LAC economies in both periods (US$104 and US$91). In other words, CAPEX per connection in Jamaica was 6 percent higher (2001-2005) and 35 percent lower (2004-2005) relative to the LAC region. The countries with CAPEX/connection close to Jamaica for the 2001-2005 periods were Antigua (US$110) and Dominica (US$112). For the 2004-2005 period, the similar countries were Venezuela (US$64), Ecuador (US$57) and Chile (US$52). While much

lower than in 2002, there was a steady increase in CAPEX per connection for Jamaica, moving from US$61 in 2005 to US$95.21 in 2008.

Countries with the lowest CAPEX/connection that Jamaica may wish to emulate for both periods were Peru (US$9 and US$8), Paraguay (US$12 and US$10), Mexico (US$15 and US$13) Honduras (US$14 and US$16), Brazil (US$29 and US$33), and Costa Rica (US$27 and US$27).

Figure 16: Capital Expenditure (CAPEX) per Connection (US$)



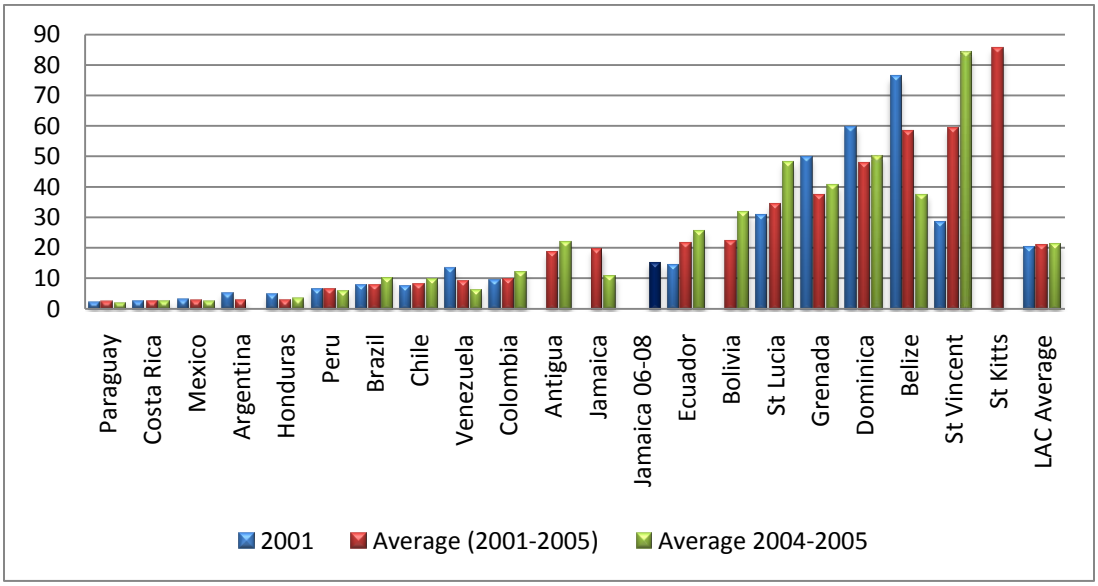
Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

CAPEX per MWh sold (US$) is another way of measuring the efficiency with which a distribution system utilizes its annual capital outlay. Data for this indicator is outlined in Table 30 (Annex 1) and summarized in Figure 17.

The average CAPEX per MWh sold for the LAC region over the periods 2001-2005 and 2004-2005 were US$21 and US$21. Jamaica at (US$19 and US$11) was slightly better than the LAC average. However, the best performing countries by this indicator were Paraguay (US$2 and US$2), Mexico (US$3 and US$2), Costa Rica (US$3 and US$3), Honduras (US$3 and US$3) and Peru (US$7 and US$6). The least efficient countries by

this indicator were St. Vincent (US$59 and US$84), Dominica (US$48 and US$50) and Grenada (US$37 and US$41).

Figure 17: Capital Expenditure (CAPEX) per MWh of Electricity Sold (US$)



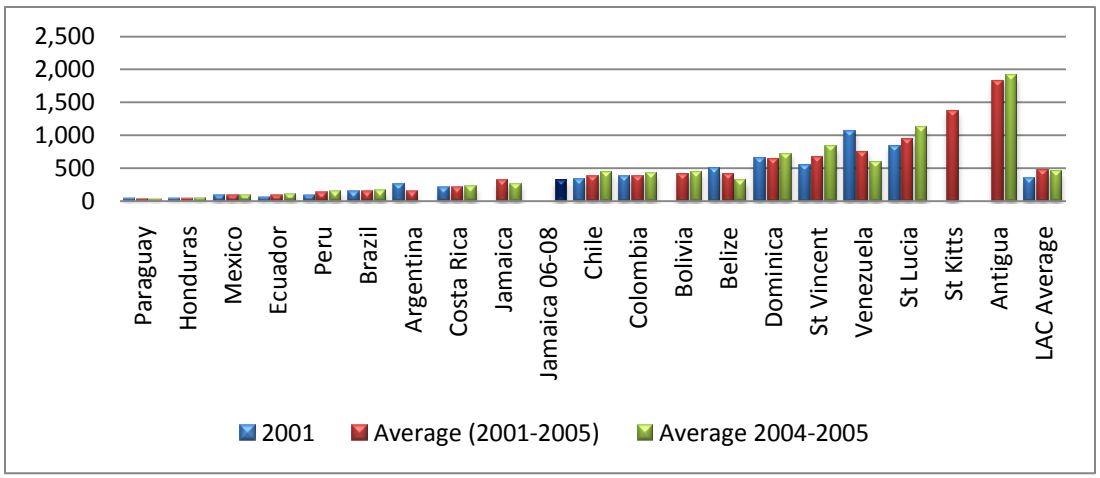
Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Total Expenditure (TOTEX) per Connection (US$)

Total expenditure (TOTEX) of the distribution service is the sum of OPEX and CAPEX. Table 31 (Annex 1) reveals that the average for LAC for the two periods 2001-2005 and 2004-2005 were (US$472 and US$462). For the corresponding periods, Jamaica performed better than the LAC average at (US$315 and US$267). Calculations based on the JPSCo' published Annual Reports indicate that TOTEX per connection in 2006, 2007 and 2008 were US$287, US$322 and US$362 respectively.

Figure 18 shows that for this indicator the most efficient distribution systems were to be found in Paraguay (US$35 and US$35), Honduras (US$37 and US$49), Mexico (US$90 and US$90) and Ecuador (US$90 and US$107).

Figure 18: Total Expenditure (TOTEX) per Connection (US$)

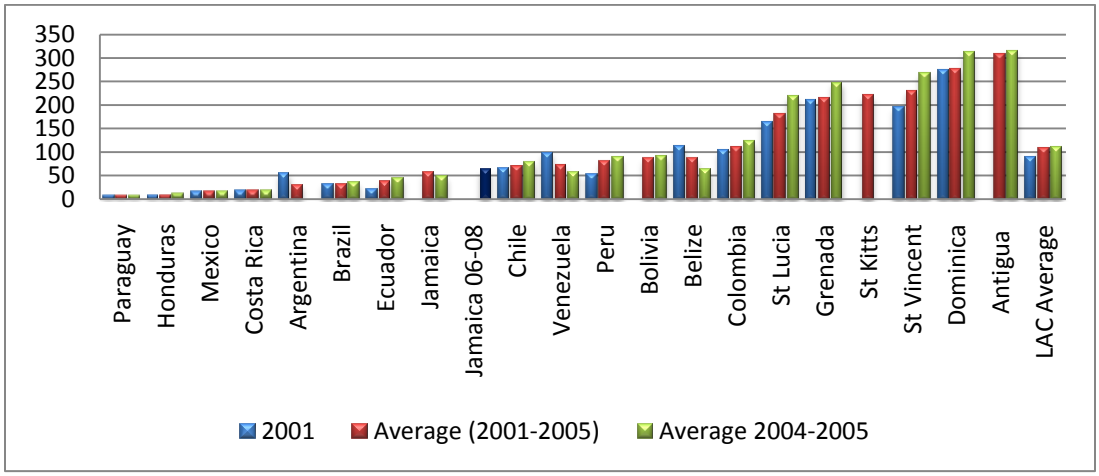


Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Total Expenditure (TOTEX) per MWh of Electricity Sold (US$)

According to Table 32 (Annex 1) and Figure 19 for the period 2001-2005 and 2004-2005 the average TOTEX per MWh of electricity sold for LAC were US$107 and US$113. The corresponding results for Jamaica were US$56 and US$48. The most efficient countries by this indicator for the corresponding periods were Paraguay (US$ 9 and US$7), Honduras (US$8 and US$10), Costa Rica (US$17 and US$17) and Bolivia (US$31 and US$36). Calculations performed using data published in the JPSCo Annual Report revealed that TOTEX per MWh of electricity sold worsened consistently in 2006, 2007 and 2008 to US$55, US$62 and US$67, respectively.

Figure 19: Total Expenditure (TOTEX) per MWh of Electricity Sold (US$)



Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

A summary of these non-labour efficiency indicators for 2005 is provided in Table 4. Jamaica was located in the third quartile for the electricity sold per connection (MWh) indicator. This means that only countries in the fourth quartile performed better than Jamaica, as it topped the group (third quartile). However, Jamaica was consistently positioned in the second quartile for the other indicators such as OPEX/connection, OPEX/MWh sold, CAPEX/connection, CAPEX/MWh sold, TOTEX/connection, and TOTEX/MWh sold. This means that only countries in the first quartile recorded lower costs than Jamaica, while both the third and fourth quartile country groupings experienced higher costs.

Table 4: Non-labour Efficiency Indicators (2005)

First Quartile		Second Quartile		Third Quartile		Fourth Quartile	
Electricity Sold per Connection – MWh (2005)							
Dominica	2	**NOIC**	5	**Argentina**	6	**Panama**	7
Bolivia	3	**Belize**	5	**Mexico**	6	**Venezuela**	10
Ecuador	3	**Brazil**	5	**Antigua**	6	**Costa Rica**	10
El Salvador	3	**Chile**	5	**Jamaica**	6		
Nicaragua	3	**Honduras**	5				
Peru	3	**Paraguay**	5				
Colombia	4	**St Lucia**	5				
Dom Rep	4	**Uruguay**	5				
Grenada	4	**LAC Average**	5				

First Quartile		Second Quartile		Third Quartile		Fourth Quartile	
		NOEC	5				
OPEX per Connection (2005)							
Paraguay	24	**Brazil**	138	**Colombia**	406	**Venezuela**	496
Honduras	49	**Panama**	146	**LAC Average**	423	**Dominica**	647
Ecuador	71	**Costa Rica**	201	**Chile**	435	**Grenada**	926
Mexico	99	**Jamaica**	214	**NOIC**	475	**St Lucia**	984
Belize	129	**NOEC**	268			**Antigua**	1,805
OPEX per MWH Sold (2005)							
Paraguay	5	**Ecuador**	25	**NOEC**	53	**Colombia**	123
Honduras	10	**Belize**	25	**Chile**	76	**St Lucia**	188
Costa Rica	15	**Brazil**	31	**LAC Average**	89	**Grenada**	235
Mexico	17	**Jamaica**	38	**NOIC**	102	**Dominica**	277
Panama	23	**Venezuela**	48			**Antigua**	295
CAPEX per Connection (2005)							
Paraguay	9	**NOEC**	46	**Venezuela**	67	**Dominica**	168
Mexico	12	**Ecuador**	60	**LAC Average**	91	**Belize**	184
Honduras	12	**Jamaica**	61	**NOIC**	103	**St Lucia**	190
Costa Rica	21	**Chile**	64	**Antigua**	147	**Grenada**	233
Brazil	40						
CAPEX per MWH Sold (2005)							
Mexico	2	**Jamaica**	11	**LAC Average**	22	**Belize**	36
Costa Rica	2	**NOEC**	12	**Antigua**	24	**St Lucia**	36
Paraguay	2	**Chile**	12	**NOIC**	25	**Grenada**	59
Honduras	3	**Brazil**	14	**Ecuador**	27	**Dominica**	72
Venezuela	7						
TOTEX per Connection (2005)							
Paraguay	32	**Costa Rica**	215	**Colombia**	457	**Venezuela**	563
Honduras	61	**Jamaica**	275	**LAC Average**	482	**Dominica**	814
Mexico	94	**NOEC**	308	**Chile**	500	**St Lucia**	1,174
Ecuador	117	**Belize**	313	**NOIC**	552	**Antigua**	1,952
Brazil	185						
TOTEX per MWH Sold (2005)							
Paraguay	6	**Ecuador**	49	**NOEC**	64	**Colombia**	135
Honduras	13	**Jamaica**	49	**Chile**	88	**St Lucia**	224
Mexico	17	**Venezuela**	55	**LAC Average**	115	**Grenada**	294
Costa Rica	17	**Belize**	61	**NOIC**	133	**Antigua**	319
Brazil	42					**Dominica**	349

Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Jamaica, with 6 MWh of electricity sold per connection occupied the third quartile with Argentina (6), Mexico (6) and Antigua (6). The countries making up the fourth quartile are those with the highest electricity sales per connection and included Venezuela (10), Costa Rica (10) and Panama (7).

Jamaica was positioned in the second quartile at an OPEX of US$214 per connection. Others in this group were Brazil (US$138), Panama (US$146), Costa Rica (US$201) and the NOECs (US$268). In contrast, countries with the lowest OPEX per connection were positioned in the first quartile and included Paraguay (US$24), Honduras (US$49), Ecuador (US$71), Mexico (US$99) and Belize (US$129).

For Jamaica, OPEX per MWh of electricity sold was US$38. This places the country in the second quartile with Brazil (US$31), Ecuador (US$25), Belize (US$25) and Venezuela (US$48). This is in contrast to the first quartile, which contains countries with the lowest OPEX per MWh of electricity sold and includes Paraguay (US$5), Honduras (US10), Costa Rica (US$15), Mexico (US$17) and Panama (US$23).

In terms of CAPEX per connection, Jamaica falls in the second quartile with Ecuador, Chile and the NOECs. CAPEX per connection in this grouping ranged from US$46 in the NOECs to US$64 in Chile. In contrast, the lowest cost countries are found in the first quartile and range from US$9 in Paraguay to US$40 in Brazil.

The picture for CAPEX per MWh of electricity sold is quite similar with Jamaica falling in the second quartile with values varying from US$11 in Jamaica, US$12 in the NOECs, US$12 in Chile and US$14 in Brazil. This compares with countries in the first quartile where the values are US$2 per connection in Paraguay, Costa Rica and Mexico, US$3 in Honduras and US$7 in Venezuela.

Jamaica maintains its second quartile position with respect to TOTEX per connection valued at US$275. Values for other countries in the group were US$215, US$308 and US$313 in Brazil, NOECs and Belize, respectively. Countries with the lowest values are located in the first quartile and include Paraguay (US$32), Honduras (US$61), Mexico (US$94), Ecuador (US$117) and Brazil (US$185).

In terms of TOTEX per MWh of electricity sold, Jamaica held its second quartile position with Ecuador, Venezuela and Belize; with values ranging from US$49 in Ecuador to

US$61 in Belize. In comparison, the first quartile countries recorded the lowest TOTEX per MWh of electricity sold at US$6, US$13, US$17, US$17 and US$42 for Paraguay, Honduras, Costa Rica, Mexico and Brazil respectively.

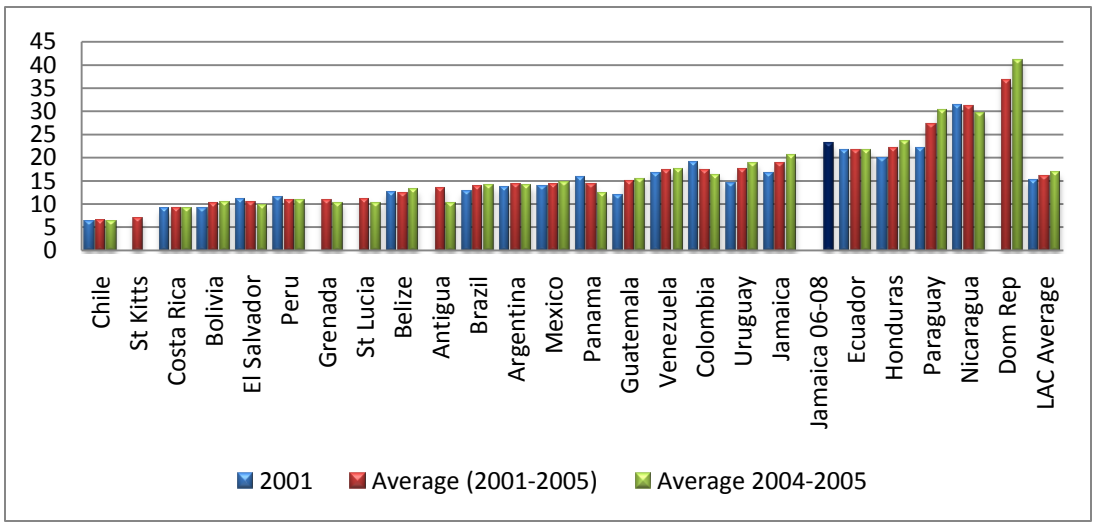
Finally, for the six (6) cost related indicators in this group, the countries that consistently recorded the lowest costs in descending order were Paraguay, Honduras, Mexico and Costa Rica. This means that these are suitable out of class benchmarking countries for Jamaica. This is not an unreasonable proposition as the data clearly shows that these indicators are independent of country size.

Technical Efficiency and Quality

Total Energy Losses in Distribution

Total energy lost in distribution (%) per year due to both technical and illegal connections is presented in Table 33 and summarized in Figure 20 which shows average total distribution losses for the period 2001-2005 and 2004-2005. Jamaica began the period (2001) with total distributional losses of 17 per cent, compared to a 15 percent average for LAC countries. However, Jamaica ended the period (2005) with losses of 21 percent, compared to 17 percent for LAC countries. Interestingly, countries such as Chile, Costa Rica and Bolivia have consistently been below 10 percent based on the three data periods analyzed. Since 2005, distribution losses for Jamaica have increased to 22.9, 23.3 and 23.0 percent, for 2006, 2007 and 2008, respectively. The Dominican Republic, Nicaragua and Paraguay are the worst performers by this indicator. The fact that both large and very small countries recorded the highest and lowest losses suggests that country size is not an important factor.

Figure 20: Total Distributional Losses (%)



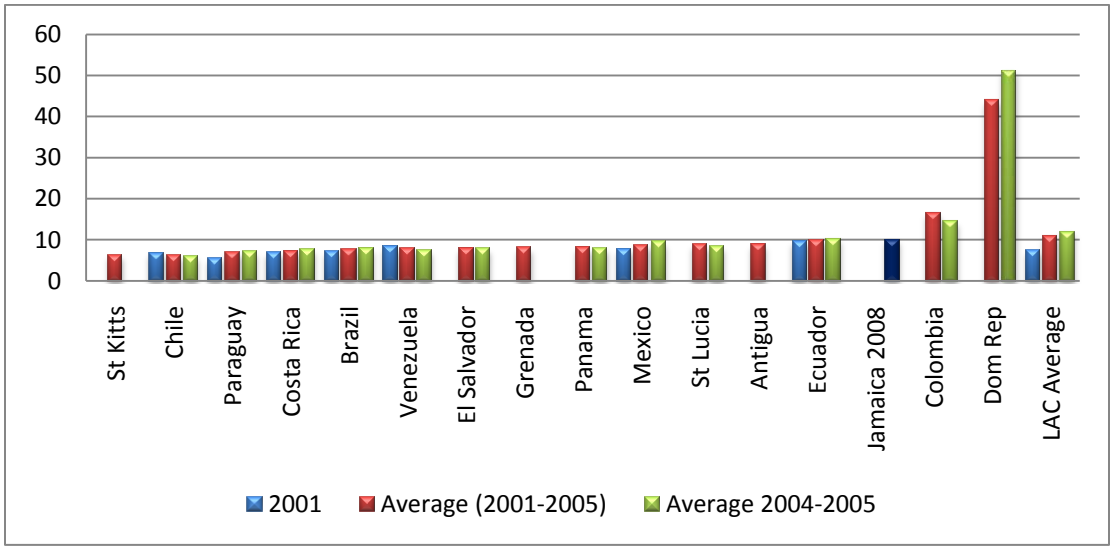
Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Technical Distribution Losses (%)

Technical losses occur naturally and consist mainly of power dissipation in electricity system components such as transmission and distribution lines, transformers, and measurement systems.

Energy losses in distribution per year due to technical reasons are shown in Figure 21 and Table 34 (Annex 1). Data for the period 2001-2005 for Jamaica is unavailable in the database. However, according to JPSCo's Annual Report (2008), it was estimated at around 10 percent in 2008. This is close to the 2001-2005 average for LAC of 11 percent. Countries with the best record include Chile (6%), St. Kitts (6%), Costa Rica (7%) and Paraguay (7%). In general, countries with the lowest distributional losses are also those with low technical losses.

Figure 21: Technical Distribution Losses (%)

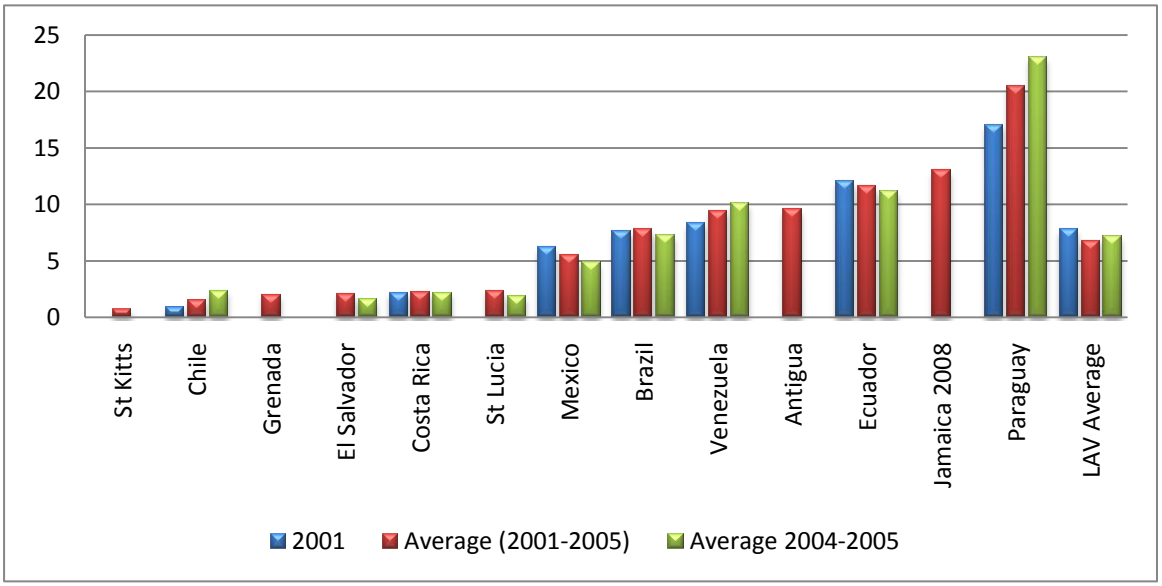


Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Non-technical Distribution Losses

Non-technical losses are caused by actions external to the power system and consist primarily of electricity theft, non-payment by customers, and errors in accounting and record-keeping.

Figure 22: Non-technical Distribution Losses (%)



Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Energy losses in distribution (%) per year due to non-technical or commercial reasons (illegal connections and losses due to failure in the billing system) are presented in Table 35 (Annex 1) and Figure 22. The LAC average for non-technical distribution losses are between 6-7 percent. Available data suggests that LAC countries with the best record were St. Lucia, Costa Rica, El Salvador, Grenada, Chile and St. Kitts at about 2 percent.

Data presented by the JPSCo in its 2009 Tariff Review Application (Table 5 below) shows that distribution losses have deteriorated since 2005. Furthermore, the very incremental approach the JPSCo is proposing to reduce non-technical losses is probably an indication that the problem requires policy assistance for its solution.

Table 5: Breakdown of JPSCo Total Losses (%)

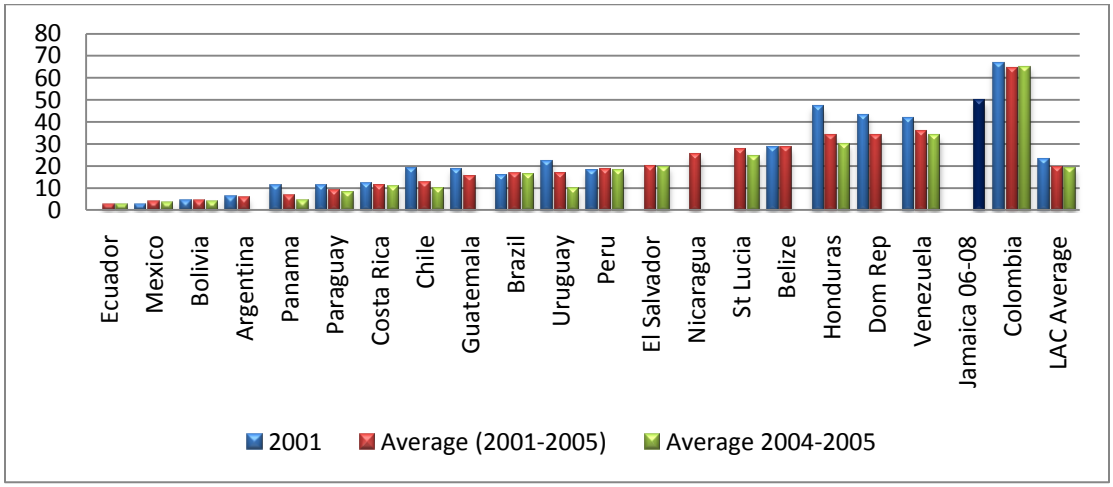
Type of losses	Actual December 2008	Forecast Losses		
		June 2009	June 2010	June 2011
Technical	9.9	12.9	12.2	11.4
Non-technical	13.0	9.6	9.3	9.1
Total	22.9	22.5	21.5	20.5

Source: JPSCo (2009) Tariff Review Application

Average Duration of Interruptions per Subscriber (SAIDI)

This indicator measures the number of hours subscribers of the system were without power in a year, divided by the total number of subscribers. The equivalent is SAIDI, System Average Interruption Duration Index calculated by dividing the sum of all customer interruption durations by the total number of customers served. Data for this indicator is presented in Table 36 (Annex 1) and summarized in Figure 23. The average for this indicator in the LAC over the 2001-2005 period was 21 hours. Using the NOIC average of 22 hours and below implies that the top 5 performers included countries such as Ecuador (3), Bolivia (4), Mexico (4), Panama (6) and Argentina (6). Countries with the worst performance record for this indicator include Colombia (65), Honduras (34), the Dominican Republic (34) and Venezuela (36). Based on JPSCo data, Jamaica falls within this worst category as it recorded 51.3, 50.1 and 42 hours in 2006, 2007 and 2008, respectively (JPSCo Annual Report, 2008).

Figure 23: Average Duration of Interruptions per Subscriber (SAIDI) - Hours



Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

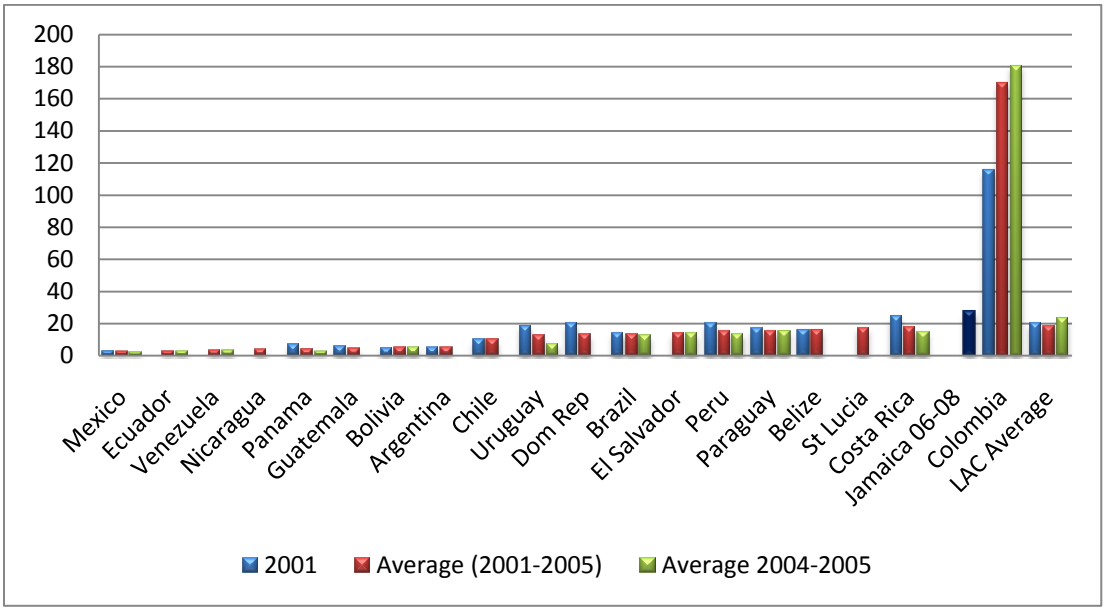
Average Frequency of Interruptions per Subscriber (SAIFI)

Average frequency of interruptions per subscriber is the average number of interruptions experienced by a consumer unit during one year. The equivalent is SAIFI, System Average Interruption Frequency Index calculated by dividing the total number of sustained customer interruptions by the total number of customers served.

Table 37 (Annex 1) and Figure 24 shows that over the period 2001-2005, the average frequency of interruptions per subscriber for LAC was 19. Taking countries with SAIFI of 13 (NOIC average) or less as "best" implies that the best performers were Venezuela, (3), Mexico (3), Panama (4), Nicaragua (4), Guatemala (4), Bolivia (5) and Argentina (5).

Data was unavailable in the database for the corresponding period for Jamaica. However, JPSCo' Annual Report (2008) suggests that for the period 2006, 2007 and 2008 the values of 33.9, 23.9 and 24.5, respectively would place Jamaica in the worst group with countries such as Costa Rica (18) and Belize (16), but not as bad as Colombia (170).

Figure 24: Average Frequency of Interruptions per Subscriber (SAIFI) – Number



Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

In summary, Table 6 shows that of the five efficiency and quality indicators, Jamaica was located in the fourth quartile for total distributional losses, total non-technical losses, SAIDI and SAIFI, and in the third quartile for total technical distributional losses. With respect to total distribution losses, Jamaica recorded 21% in 2005 which places it in the fourth quartile with Ecuador (21%), Honduras (24%), Nicaragua (29%), Paraguay (31%) and Dominican Republic (42%). Clearly, this level of waste will be reflected in a higher electricity tariff.

Countries with the lowest total distributional losses (first quartile) included Chile (7%), Costa Rica (8%), El Salvador (9%), Bolivia (10%), St. Lucia (10%), Antigua (10%) and Panama (10%). At 10 percent, Jamaica was positioned in the third quartile for technical distribution losses alongside Mexico (9.6%), the NOECs (10.1) and Ecuador (10.2%). This is in contrast to the best performers (first quartile) such as Chile (5.9%), Venezuela (7.4%), Costa Rica (7.4%), Paraguay (7.7%) and Panama (7.7%).

Non-technical distributional losses in Jamaica were 13 percent (2008) which places the country in the fourth quartile with Paraguay at 23 percent (2005). El Salvador, St. Lucia, Costa Rica and Chile recorded the best performance (first quartile) with 1%, 2%, 2% and 3%, respectively.

Table 6: Summary of Technical Efficiency and Quality Indicators – 2005

First Quartile		Second Quartile		Third Quartile		Fourth Quartile	
Percent Total Distribution Losses % (2005)							
Chile	7	Grenada	11	NOEC	16	Jamaica	21
Costa Rica	8	Peru	11	Colombia	16	Ecuador	21
El Salvador	9	Belize	13	Colombia	16	Honduras	24
Bolivia	10	Argentina	14	LAC Average	17	Nicaragua	29
Antigua	10	Brazil	14	NOIC	17	Paraguay	31
St Lucia	10	Mexico	15	Venezuela	18	Dom Rep	42
Panama	10			Uruguay	18		
Percent Technical Distribution Losses (2005)							
Chile	5.9	Brazil	8.0	Mexico	9.6	LAC Average	12.2
Venezuela	7.4	El Salvador	8.1	Jamaica 2008	10.0	Colombia	13.0
Costa Rica	7.4	St Lucia	8.2	NOEC	10.1	NOIC	13.2
Panama	7.7			Ecuador	10.2	Dom Rep	52.9
Paraguay	7.7						
Percent Non-technical Distribution Losses (2005)							
El Salvador	1	**Mexico**	5	**NOEC**	9	**Ecuador**	11
Costa Rica	2	**NOIC**	6	**Venezuela**	10	**Jamaica 2008**	13
St Lucia	2	**Brazil**	7			**Paraguay**	23
Chile	3	**LAC Average**	7				
2005 SAIDI (hours)							
Ecuador	2	Costa Rica	10	Peru	18	NOEC	24
Panama	4	Chile	12	LAC Average	19	Honduras	36
Mexico	5	El Salvador	16	St Lucia	22	Venezuela	42
Bolivia	5	NOIC	16			Jamaica 2008	42
Paraguay	8	Brazil	16			Colombia	66
2005 SAIFI (Number)							
Mexico	2	Bolivia	7	Peru	14	Jamaica 2008	24
Panama	2	El Salvador	12	Costa Rica	14	LAC Average	25
Ecuador	3	NOIC	12	Paraguay	16	NOEC	40
Venezuela	4	Brazil	12			Colombia	186

Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

In terms of SAIDI, the value for Jamaica was 42 minutes in 2008, which places the country in the fourth quartile with the NOECs (24), Honduras (36), Venezuela (42) and Columbia (66). This is in contrast with first quartile countries (best performers) such as Ecuador (2), Panama (4), Mexico (5), Bolivia (5) and Paraguay (8).

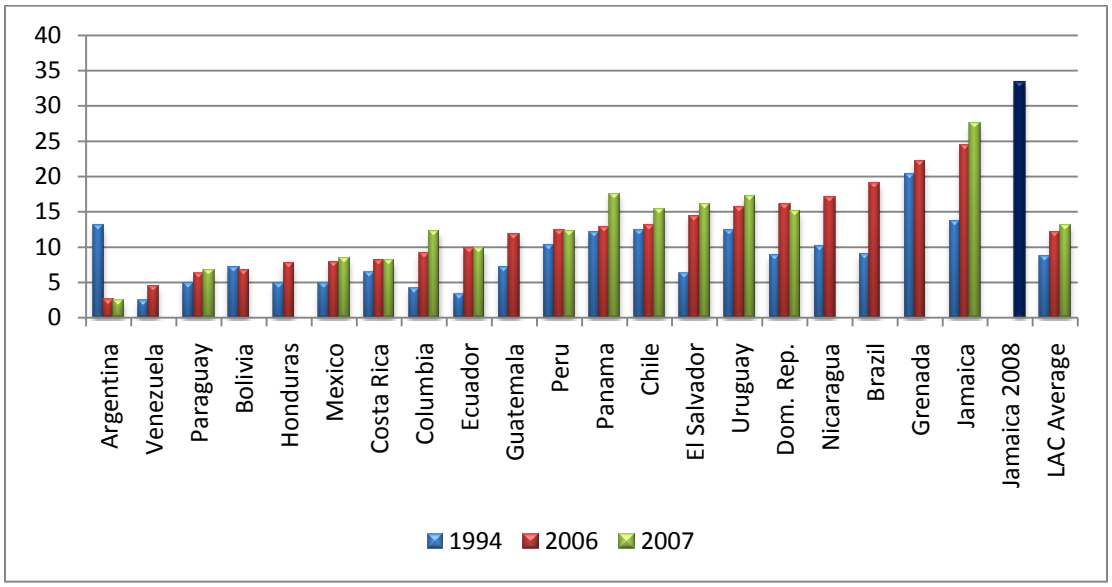
With respect to SAIFI, Jamaica remained in the fourth quartile with a value of 24, alongside the LAC average (25), NOEC average (40) and Columbia (186). The best performing countries (first quartile) were Mexico (2), Panama (2), Ecuador (3) and Venezuela (4).

End-User Prices

Average Residential Electricity Tariff

Residential electricity prices are presented in Table 38 (Annex 1) and summarized in Figure 25. Residential tariff in 1994 averaged 8.67 US cents/KWh in LAC, peaking at 12.95 US cents/KWh in 2006 and 2007. In 1994 the residential tariff in Jamaica was 13.73 US cents/KWh making it the second highest in LAC, following Grenada (20.37 US cents/KWh), the third highest was Argentina (12.96 US Cents/KWh). In 2006 Jamaica overtook Grenada to record the highest residential tariff in LAC (24.50 US cents/KWh). This was further increased to 27.54 and 33.33 US cents/KWh in 2007 and 2008, respectively.

Figure 25: Residential Electricity Prices (US cents/KWh)



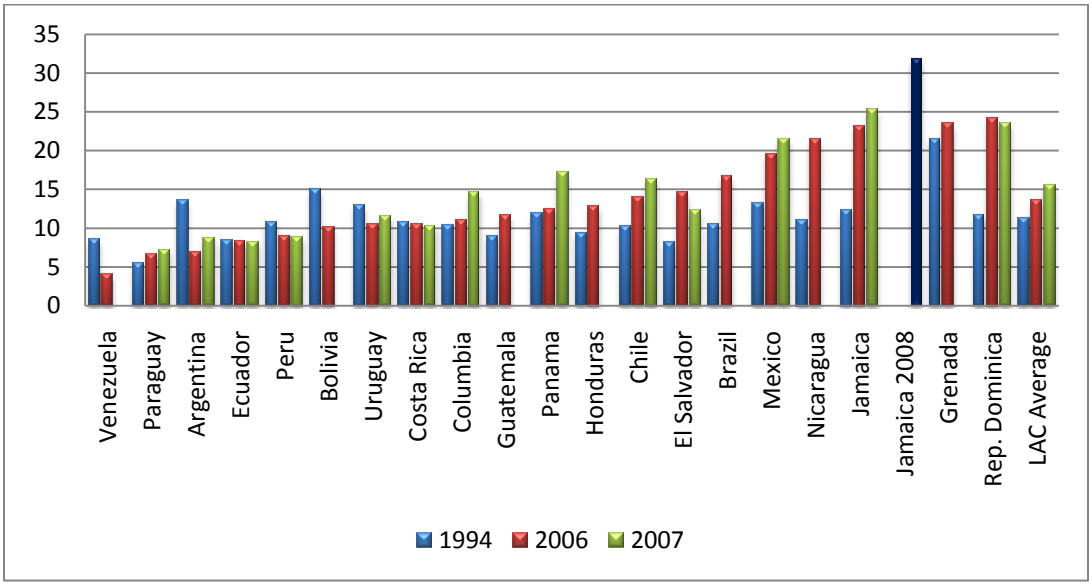
Source: Latin American Energy Organization (OLADE) (various years)

On average, for LAC economies, residential tariffs showed an increase of 64 percent in 2007 relative to 1994. The corresponding increases were Jamaica (78%), Mexico (74%), Colombia (192%) and Ecuador (184%). The lowest increases for the corresponding period were recorded in Grenada (8.5%), Peru (18%), Paraguay (37%), Panama (45%) and Costa Rica (26%). Interestingly, residential tariff decreased 81 percent in Argentina and 7 percent in Bolivia over the corresponding period.

Average Commercial Electricity Tariff

Data for commercial prices are presented in Figure 26 and Table 39 (Annex 1). Figure 26 compares the average commercial rates in 1994, 2006 and 2007. In general, between 1994 and 2006 prices rose in all LAC states, except Venezuela, Argentina, Ecuador, Bolivia, Uruguay and Costa Rica. Over the period 2006 to 2007 average commercial tariffs in LAC increased from 13.51 to 15.49 US cents/KWh. In the case of Jamaica, the comparative prices were 25.32 and 31.73 US cents/KWh in 2007 and 2008, respectively. Price trends in Jamaica were followed by those in the Dominican Republic, Mexico, Panama and Chile of 23.49, 21.49, 17.16 and 16.34 US cents/KWh, respectively.

Figure 26: Commercial Electricity Prices (US cents/KWh)

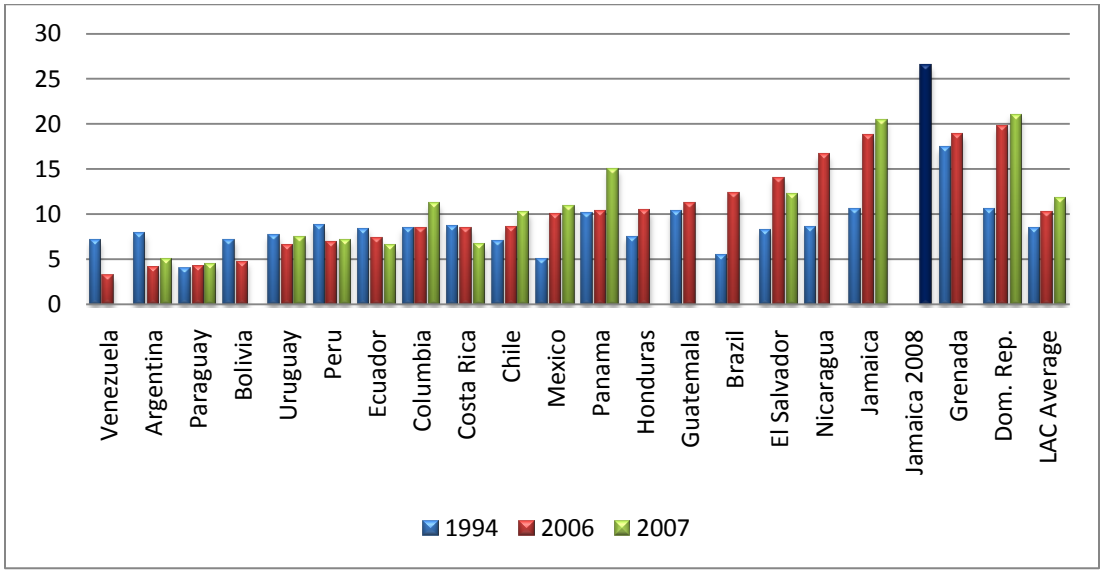


Source: Latin American Energy Organization (OLADE) (various years)

Average Industrial Electricity Tariff

Data for industrial prices are summarized in Figure 27 and Table 40 (Annex 1). LAC recorded industrial prices of 8.42, 10.21 and 11.77 US cents/KWh in 1994, 2006 and 2007, respectively. In 2007, average industrial prices exceeded the LAC average in the Dominican Republic (21.0), Jamaica (20.42) and Panama (15.0). In 2008, average industrial prices reached 26.54 US cents/KWh in Jamaica. In 2007, the lowest industrial prices were observed in Paraguay (4.5), Argentina (5.0), Ecuador (6.54), Costa Rica (6.6) and Uruguay (7.41).

Figure 27: Industrial Electricity Prices (US cents/KWh)



Source: Latin American Energy Organization (OLADE) (various years)

Table 7 summarizes tariffs for 2005 across the three tariff categories. In the case of residential tariff, Jamaica as the worst performer leads the fourth quartile group at 24.5 US cents/KWh. This is followed by Grenada, Brazil, Nicaragua, the Dominican Republic and Uruguay with 22.10, 19.06, 17.13, 15.99 and 15.61 US cents per KWh, respectively. The first quartile countries recording the lowest residential tariffs were Argentina, Venezuela, Paraguay, Bolivia, NOEC and Honduras with 2.48, 4.50, 6.17, 6.72, 6.74 and 7.76 US cents per KWh, respectively.

Commercial tariff in Jamaica at 23.04 US cents/KWh was the third highest for countries in the fourth quartile. The leader was the Dominican Republic at 24.17 US cents/KWh followed by Grenada at 23.40 US cents/KWh. Average commercial tariff in the first quartile countries were 4.02, 6.58, 6.93, 8.20, 9.01 and 9.96 US cents/KWh in Venezuela, Paraguay, Argentina, Ecuador, Peru and the NOECs, respectively.

At an average 18.69 US cents/KWh, Jamaica had the third highest industrial tariff after the Dominican Republic (19.65 US cents/KWh) and Grenada (18.80 US cents/KWh).

This is in contrast to the first quartile where prices ranged from 3.17 US cents/KWh in Venezuela to 6.49 US cents/KWh in Peru.

Table 7: Summary of Electricity Tariffs (US cents/KWh) by End-user Categories

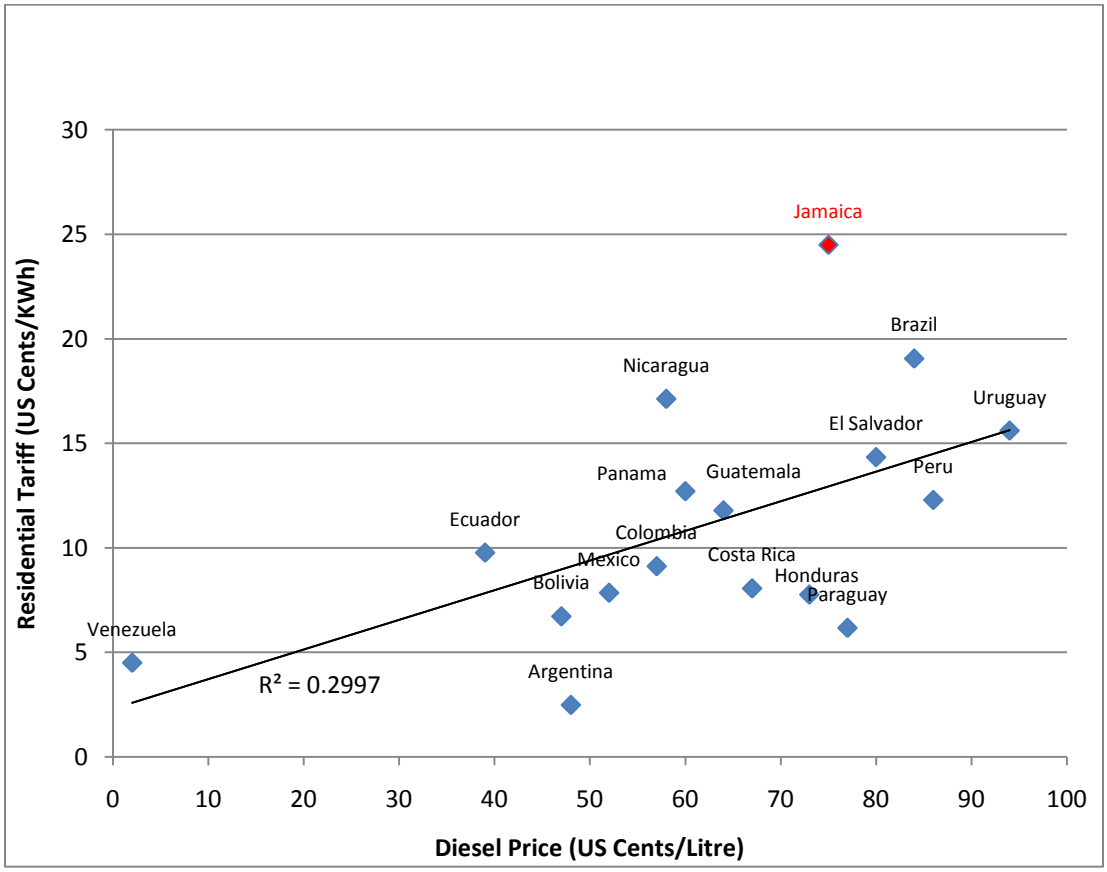
First Quartile		Second Quartile		Third Quartile		Fourth Quartile	
Residential Electricity Prices (2006)							
Argentina	2.48	Mexico	7.85	Peru	12.29	Uruguay	15.61
Venezuela	4.50	Costa Rica	8.06	Panama	12.71	Rep. Dominica	15.99
Paraguay	6.17	Columbia	9.12	Chile	13.06	Nicaragua	17.13
Bolivia	6.72	Ecuador	9.77	NOIC	14.33	Brazil	19.06
NOEC	6.74	Guatemala	11.79	El Salvador	14.34	Grenada	22.10
Honduras	7.76	LAC Average	12.05			Jamaica	24.50
Commercial Electricity Prices (2006)							
Venezuela	4.02	Bolivia	10.14	Honduras	12.84	Brazil	16.64
Paraguay	6.58	Uruguay	10.44	LAC Average	13.51	Mexico	19.50
Argentina	6.93	Costa Rica	10.46	Chile	13.98	Nicaragua	21.42
Ecuador	8.20	Columbia	10.95	El Salvador	14.54	Jamaica	23.04
Peru	9.01	Guatemala	11.57	NOIC	15.04	Grenada	23.40
NOEC	9.96	Panama	12.43			Rep. Dominica	24.17
Industrial Electricity Prices (2006)							
Venezuela	3.17	Peru	6.94	LAC Average	10.21	Brazil	12.37
Argentina	4.05	Ecuador	7.32	Panama	10.36	El Salvador	14.00
Paraguay	4.14	Columbia	8.40	Honduras	10.40	Nicaragua	16.61
Bolivia	4.68	Costa Rica	8.41	Guatemala	11.21	Jamaica	18.69
NOEC	6.28	Chile	8.53	NOIC	11.90	Grenada	18.80
Uruguay	6.49	Mexico	10.06			Dom. Rep.	19.65

Source: Latin American Energy Organization (OLADE)

Figure 28 and Table 41 (Annex 1) shows that although fuel (Diesel) price explains electricity prices, reasonably well, it does so only partially. For example, the net oil exporting countries such as Venezuela, Argentina, Bolivia, Mexico, Colombia and Ecuador all have diesel prices below 60 US cents/litre and electricity prices below 10 US cents/KWh. The net oil importers like Costa Rica, Honduras, Paraguay, Guatemala and Panama have diesel prices between 60-80 US cents/litre and electricity prices within the range of 10-12 US cents/KWh. A third group of countries comprising El Salvador, Brazil and Uruguay have diesel prices of between 80-100 US cents/litre and electricity prices of between 12-19 US cents/KWh. Finally, a country like Jamaica has diesel price of 75 US

cents/litre but electricity price of 24.5 US cents/KWh. This suggests that other important factors are at play influencing electricity prices.

Figure 28: Residential Tariff versus Diesel Price



Source: Latin American Energy Organization (OLADE)

The average electricity prices in some countries in Figure 28 and Table 41 (Annex 1) are relatively high compared with best practice. For example, in Jamaica the price of electricity, at an average of more than 24 US cents per KWh, is relatively high for the system size, relative to say Nicaragua and the Dominican Republic. This is partly because 98 percent of Jamaica's electricity is generated with imported oil. However, it also reflects the fact that the overall fuel efficiency of the JPSCo generating plant is relatively low and the system losses are high. In other words, higher electricity prices in Jamaica, the Dominican Republic, Grenada, St. Vincent and Dominica are not explained by fuel mix or economies of scale. Countries with similar combinations of primary energy to

Jamaica, or with less hydro energy than St. Vincent and Dominica (St. Lucia) have lower prices.

Labour Productivity Indicators

Electricity Sold per Employee

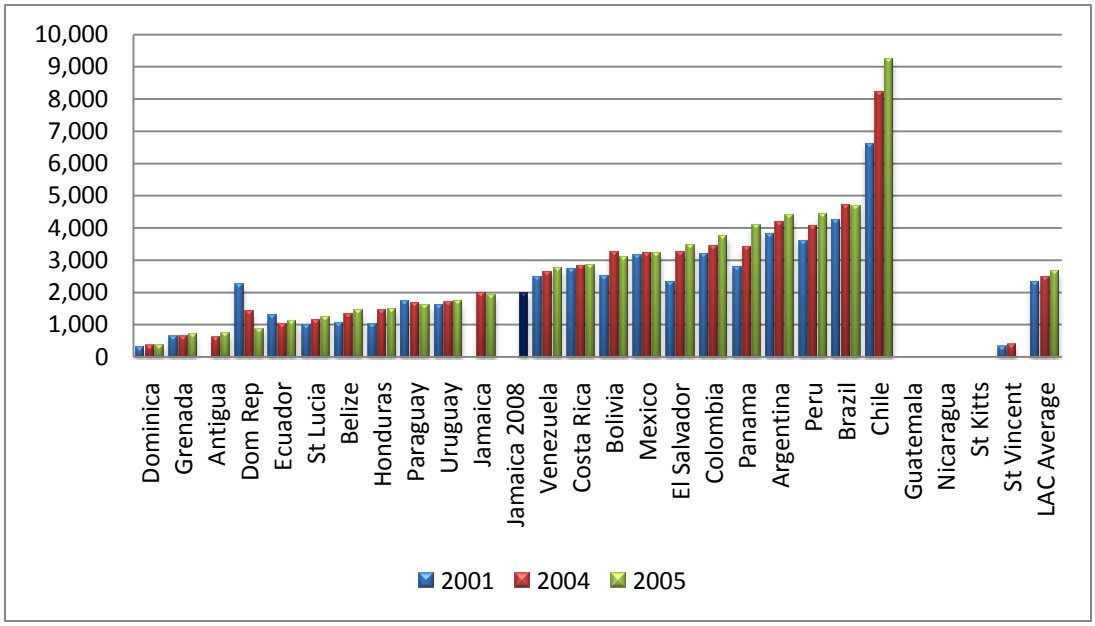
MWh of electricity sold divided by the number of employees is presented in Figure 29 and Table 42 (Annex 1). On average, electricity sold per employee in LAC was 2,316 MWh in 2001, rising to 2,656 MWh in 2004 and 2005. Countries below the LAC average and with lower than 2000 MWh per employee, in ascending order, included St. Vincent, Dominica, Grenada, Antigua, the Dominican Republic, Ecuador, St. Lucia, Belize, Honduras, Paraguay, Uruguay and Jamaica. In the case of Jamaica, energy sold per employee decreased from 1,984 MWh in 2004 to 1,919 MWh in 2005. However, by 2008 this figure had risen to 1,987, due partly to reduction in the number of persons employed.

On the other hand, countries with electricity sales per employee exceeding the LAC average in ascending order were Venezuela, Costa Rica, Bolivia, Mexico, El Salvador, Columbia, Panama, Argentina, Peru, Brazil and Chile (which recorded 9,248 MWh/employee in 2005). This finding suggests that electricity sold per employee is independent of country size (scale) and per capita consumption.

Number of residential connections per employee

According to Figure 30 and Table 43 (Annex 1), most countries showed a tendency for residential connections per employee to rise in 2005 relative to 2001. The average for LAC economies was 485 residential connections in 2005 compared to 434 in 2001. Jamaica recorded 307 residential connections per employee in 2005 and 329 in 2008. Eleven (11) countries in the sample performed lower than Jamaica, these included Antigua (107), Dominica (138), Grenada (157), St. Lucia (209), the Dominican Republic (219), Venezuela (235), Costa Rica (244), Paraguay (268), Belize (279), Honduras (289) and Uruguay (293). Those exceeding Jamaica included Chile (1,348), Peru (1,118), El Salvador (987), Colombia (972), Bolivia (876), Brazil (814) and Argentina (633).

Figure 29: Electricity Sold per Employee (MWh)



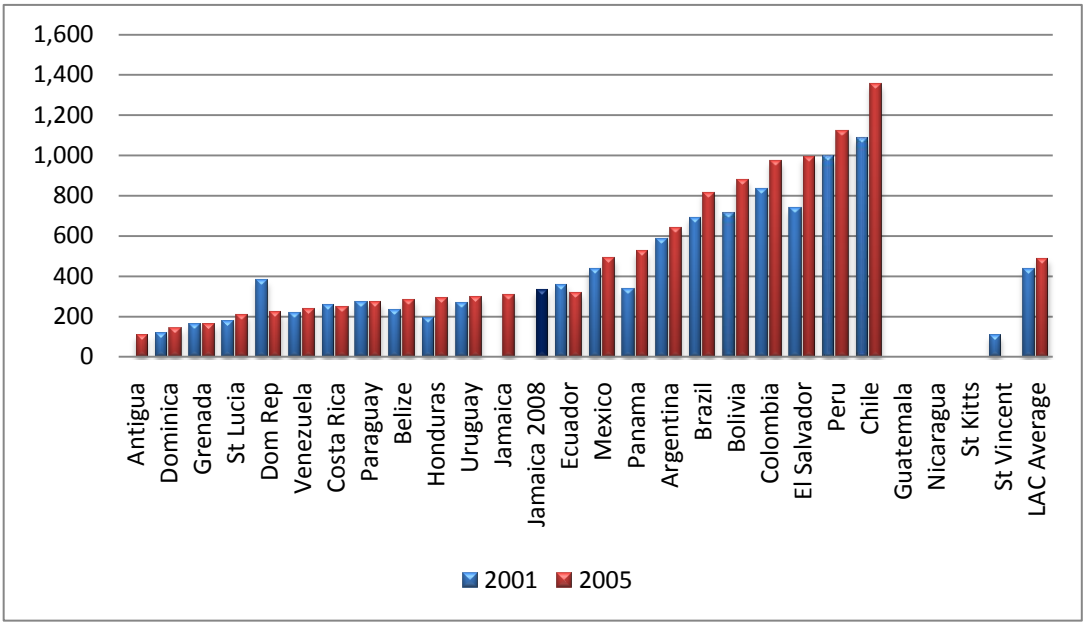
Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Table 8 summarises the labour productivity results for 2005. Residential connections per employee in Jamaica (307) was located in the second quartile with countries such as Paraguay (268), Belize (279), Honduras (289), Uruguay (293) and Ecuador (318). In contrast, the best performing countries (fourth quartile) were Chile (1,349), Peru (1,118), El Salvador (987), Colombia (972), Bolivia (876) and Brazil.

With respect to electricity sold per employee, Jamaica was located in the second quartile with a value of 1,910 MWh per employee, trailing the LAC and NOIC average of 2,686 and 2,549 respectively. Other countries in the group were Honduras (1,488), Paraguay (1,585) and Uruguay (1,748). The best performers (fourth quartile) were Chile (9,248), Brazil (4,663), Peru (4,430), Argentina (4,389), Panama (4,082), and Colombia (3,737).

For both labour productivity variables, Argentina, Brazil, Colombia and Chile were consistently the best performers. The countries that were consistently the worst performers were the small island Caribbean States and the Dominican Republic.

Figure 29: Residential Connections per Employee



Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

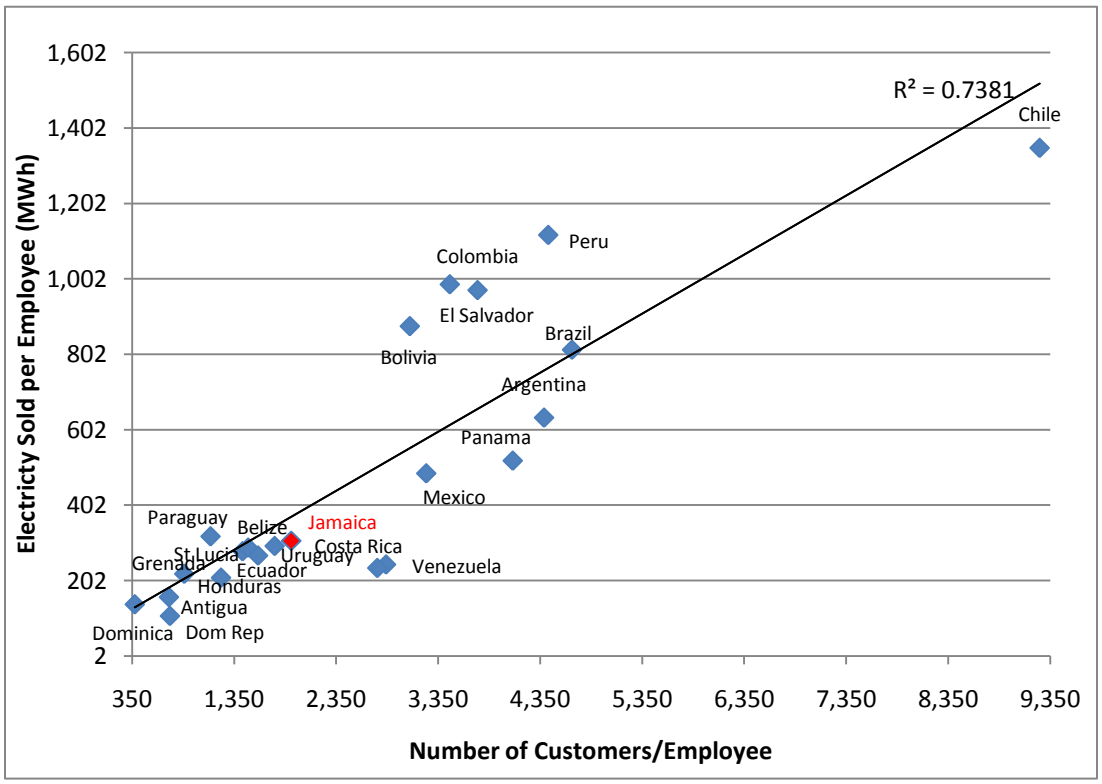
Table 8: Summary of Electricity System Productivity (2005)

First Quartile		Second Quartile		Third Quartile		Fourth Quartile	
Number of Residential Connections per Employee (2005)							
Antigua	107	Paraguay	268	NOIC	456	Brazil	814
Dominica	138	Belize	279	Mexico	486	Bolivia	876
Grenada	157	Honduras	289	LAC Average	492	Colombia	972
St Lucia	209	Uruguay	293	Panama	519	El Salvador	987
Dom Rep	219	Jamaica	307	NOEC	587	Peru	1,118
Venezuela	235	Ecuador	318	Argentina	633	Chile	1,349
Costa Rica	244						
MWh of Electricity Sold per Employee (2005)							
Dominica	377	**Honduras**	1,488	**Venezuela**	2,754	**Colombia**	3,737
Grenada	711	**Paraguay**	1,585	**Costa Rica**	2,840	**Panama**	4,082
Antigua	721	**Uruguay**	1,748	**NOEC**	3,051	**Argentina**	4,389
Dom Rep	862	**Jamaica**	1,910	**Bolivia**	3,073	**Peru**	4,430
Ecuador	1,119	**NOIC**	2,549	**Mexico**	3,234	**Brazil**	4,663
St Lucia	1,222	**LAC Average**	2,686	**El Salvador**	3,465	**Chile**	9,248
Belize	1,433						

Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

An issue worth exploring is the relationship between electricity sold per employee and number of customers per employee. Figure 31 suggests a positive relationship between the two. That is, as the number of customers per employee increase, electricity sales per employee should increase. Indeed, the data appears to suggest that some countries with higher labour productivity have lower electricity prices (e.g. Bolivia, Argentina, Peru and Colombia) and were able to offer consumers lower prices. With few exceptions, countries with low labour productivity have high electricity prices. However, other factors are also important, for instance, whether fuel prices are subsidized or taxed.

Figure 30: Electricity Sold per Employee versus Number of Customers per Employee



Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

It is important to note that increasing labour productivity (measured as number of residential connections per employee or electricity sold per employee) should lower distribution cost as well as electricity prices. However, electricity sold per employee will

rise faster if the number of large commercial and industrial consumers increases faster than the number of residential customers. This in turn will foster economic growth.

6. Conclusions and Recommendations

This study provides data and information that is useful to stakeholders in the electricity sector (i.e., OUR, JPSCo, IPPs, consumers and government). It highlights the fact that Jamaica's relative underperformance in the cross-country comparison explains the higher electricity prices faced by its consumers. It is an irrefutable fact that if the high electricity prices are to be reversed this will require urgent and coordinated actions by stakeholders. These interrelated actions must include, but are not limited to:

Jamaica's relative underperformance in the cross-country comparison explains the higher electricity prices faced by its consumers.

1. Capacity Addition - establishing urgent yet realistic timelines for the replacement of inefficient generation capacity in the public electricity grid;
2. Tackling the problem of distribution losses and inefficiency in fuel conversion to bring costs and prices down to regionally comparative levels;
3. Reducing dependence on a single energy source through fuel diversification;
4. Improving sector governance, especially as it relates to measurement issues such as the X-Factor and Q-Factor;
5. Improving policy coordination and implementation;
6. Energy Efficiency – using the ESCO model; and
7. Research to explain and model the role of electricity in economic development.

6.1 Generating Capacity: Replacement and Expansion

On the generating side, the most significant finding was that the oil-based IPPs performed superior to the JPSCo, recording a fuel productivity of 780 KWh/BOE in 1998 and rising to 1,078 KWh/BOE in 2007. This is in contrast to the JPSCo which yielded 512 KWh/BOE in 1998 and 478 KWh/BOE in 2007. The results also indicate that over the period 2004-2008, the JPSCo generation assets yielded heat rates averaging 11,677 KJ/KWh. For the corresponding period the heat rate for the overall system averaged 10,620 KJ/KWh. For the same period the IPPs as a group recorded

The actual heat rates for the JPSCo generating assets were consistently higher than those for the system as well as the individual IPPs.

average heat rate of 8,186 KJ/KWh. In other words, the actual heat rates for the JPSCo generating assets were consistently higher than those for the system as well as the individual IPPs. This means that the system is dependent on the relatively low heat rate performance of the IPPs to counterbalance the relatively high heat rate performance of the JPSCo.

These results suggest that if appreciable progress is to be made in fuel use efficiencies (heat rate reduction), the most inefficient generating assets must be systematically retired. Even with high world oil prices, electricity could be cheaper if modern and efficient technology was utilized in generation. It is well documented (Loy and Coviello, 2005; World Bank, 2005; MEM, 2009; OUR, 2007) that a significant number of the generating plants owned by the JPSCo have exceeded their useful economic lives and require replacement. In other words, the average age and technical characteristics of some plants in the generating fleet are such that they cannot be expected to deliver even modest heat rate improvement.

Even with high world oil prices electricity could be cheaper if modern technology was utilized in generation.

The OUR (2004) in a document "Generation Expansion Plan 2004–2012 Decision and Recommendations" indicated that if a real decrease in retail price of electricity is to be achieved, base load plants must be added to the system. It cautioned that the practice of adding intermediate plants to meet incremental increases in demand must be discontinued, and to this end capacity additions must be structured to provide the opportunity for the maximum possible capacity using "base load technology" that can be added economically.

The Director General of the OUR (Annual Report, 2007) stated that in addition to the 60 MW that it begun the procurement process for in 2006, an additional 300 MW will be required by 2015 to replace existing inefficient capacity and supply incremental demand. He further lamented that the statutory framework in the electricity sector provides very limited room for the OUR to employ competition as a means of securing real

improvements in the price and delivery of services. He argued that the All Island Electric Licence 2001 granted to the JPSCo provides that the addition of new capacity after 2004 be the subject of competition, in which the JPSCo can participate. However, he posited that the three critical factors impacting the development of this very desirable competitive environment included:

(i) The initiative by the Government since 2002 to introduce LNG into the energy mix and its own desire to secure supplies through government to government arrangements.

(ii) The inability of the OUR and the JPSCo to settle on a Least Cost Plan because of the uncertainties concerning the availability and pricing of LNG and,

(iii) The initiatives taken by certain industries to offer capacity to the grid without the benefit of competition.

Within the constraints of the current Electricity Licence (2001) opportunities exist for the OUR to reduce electricity cost to consumers by operating an "almost competitive market for electricity generation" (OUR, 2006). Condition 24 of the Licence provides for the addition of generation capacity on a competitive basis, it also sets out the framework principles that governs the competitive bidding process.

Using the competitive bidding process to add capacity to the grid has several advantages. First, a competitive bidding process will deliver the best combination of price and technology even with high world market prices for fuel. Second, it minimizes the concentration of generating capacity in a single ownership structure thereby minimizing the exercise of monopoly power. Third, strict adherence to an open competitive bidding process, over time, facilitates the decoupling of generation from transmission and distribution. Fourth, a competitive generation market facilitates economic dispatch. That is, the most expensive plants will be low on the economic order of merit, as they will not minimize the system's variable costs, which is primarily fuel.

Given the threat of continued loss of international competitiveness for Jamaican businesses and the burden imposed on residential customers by high electricity prices it is

critical that the MEM takes the lead to develop a medium-term plan and fast-track its implementation to ensure base load capacity replacement and expansion. Immediate action is required as the entire process is a time consuming one, that includes requesting proposals, evaluating them and approving, followed by construction and commissioning of plants and equipment.

6.2 Reducing Distribution Losses and Increasing Fuel Conversion Efficiency

The main factors driving high electricity prices in Jamaica are high distribution losses, high fuel prices and low fuel conversion efficiency. Tackling these problems are necessary conditions for bringing Jamaica's electricity prices in line with those of low cost NOICs of the region.

As part of the PBRM framework, the OUR implemented a penalty/reward system to encourage generating plants to operate efficiently by meeting mandated heat rate targets. In addition, the distribution company (JPSCo) is required to keep total system losses to 15.8 percent of net generation. The penalty/reward system is applied through the combination of heat rate and distribution loss targets to the monthly fuel cost that the JPSCo recovers from customers through the fuel rate (see Equation 2).

The OUR (2009) has ruled that during the 2009-2014 rate cap period the system heat rate target must fall to 10,400 KJ/KWh. However the OUR is going in the wrong direction by moving distribution loss target from 15.8 percent to 19.5 percent then to 17.5 percent. Such movements are inconsistent with the 2004 rate application in which JPSCo proposed to reduce distribution losses to 16.5 percent by 2009. It is also inconsistent with the OUR 2004 determination where it projected that the JPSCo could reduce systems losses to 14 percent by 2009.

The JPSCo proposed reductions are quite insignificant when viewed against the backdrop of average system loss levels (Table 33) for small Caribbean states (2001-2005) of 7, 11, 11, and 12 percent realized in St. Kitts, St. Lucia, Grenada and Belize, respectively. The

possibilities are even greater when countries with the lowest distributional losses are examined. In general, lowest total distributional losses were observed in Chile (7%), Costa Rica (8%), El Salvador (9%), Bolivia (10%), St. Lucia (10%), Antigua (10%) and Panama (10%). By contrast, the corresponding values for Jamaica was 21 percent (2005), with 22.9, 23.3 and 23 percent, in 2006, 2007 and 2008, respectively. In other words, Jamaica's distributional losses were more than twice those of the worst performer in the first quartile.

In addition, the JPSCo requested a two-step reduction (improvement) to the heat rate target for the rate cap period 2009 – 2014, as follows:

- An initial reduction to 10,850 KJ/kWh for the period July 2009 – June 2010;
- A further reduction to 10,700 KJ/kWh for the period July 2010 – June 2014 (contingent on the 60 MW JEP expansions).

In the second step, the 150 KJ/KWh reduction in the heat rate target would be implemented only if the JEP 60 MW expansion was expected with certainty by August 2010. If not, it would be implemented in the month after the JEP 60 MW expansion is commissioned, or on a prorated basis for each 10 MW of capacity that is commissioned. So, if 30 MW were commissioned, the target would be reduced by 30/60ths of 150 KJ/kWh or by 90 KJ/kWh. The JPSCo wants the heat rate target to be set for the five-year tariff period. However, it would agree to a revision of the target if any major fuel diversification project (i.e. LNG or Petcoke) is commissioned into service during the price cap period.

The above demonstrates that the OUR is moving with a greater sense of purpose relative to the JPSCo. In fact, the JPSCo in its 2009 rate application noted that "significant investment in plant rehabilitation, the introduction of 50 MWs of new capacity by one IPP and generally good plant performance across the system has led to improved heat rate performance over the last tariff period. The JPSCo has therefore been able to meet the heat rate target with sufficient regularity to avoid material adverse impact on its earnings." Notwithstanding this claim, the JPSCo has proposed that for the 2009-2014 period a cap of US$1 million on the fuel penalty/reward mechanism in conjunction with

the application of the fuel efficiency measures, i.e. heat rate and system loss be implemented. The proposal is for the cap to be symmetrical thereby reducing the upside or downside exposure of the JPSCo in relation to fuel costs. This proposal was rejected by the OUR.

The OUR (2009) in its Determination Notice observed that the "JPSCo has indicated that for every 100 KJ/KWh difference in heat rate, the benefit using 2008 fuel prices would be US$4.5 M per annum. Based on this, the net benefit to the JPSCo in 2008 was in excess of US$44 Million or J$4 Billion. The fact that the JPSCo was making a significant profit on fuel used would mean that, all other things being equal:

- Consumers were paying more than they should have; and
- The JPSCo had an incentive to purchase fuel at the highest price possible rather than at the lowest possible price".

It should be placed in context that the OUR compromised targeted heat rate of 10,400 KJ/KWh is 21 percent higher than the average heat rates of 8,172 KJ/KWh achieved by the IPPs over the period 2004-2008. This implies that the magnitude of the savings on fuel, holding loss constant, that would accrue from more efficient generating plants is quite substantial. In order to highlight the significance of reducing heat rate and distribution losses several impact assessments are presented below.

- If the heat rate target was set to reflect expected heat rate under efficient performance, and distribution loss target reflected improvements that should have been achieved to date, the impact on reducing the fuel component of consumer price would be huge. For example, holding distribution loss constant, and radically reducing heat rate from 10,400KJ/KWh to 8,100 KJ/KWh would reduce fuel pass through cost by 26.3 percent or an estimated savings of J$7.86 billion, yielding savings of 1.2 million BOE.

- Several others are detailed below:

Options	2004-2008 Rate Cap Period		2009-2014 Rate Cap Period		Fuel Pass Through Savings to Consumer (J$B)
	Heat Rate Target (KJ/KWh)	Target System Losses (%)	Heat Rate Target (KJ/KWh)	Target System Losses (%)	
Option 1	11,200	15.8	10,400	15.8	2.30
Option 2	11,200	15.8	10,400	19.5	0.92
Option 3	11,200	15.8	10,400	17.5	1.68
Option 4	11,200	15.8	10,000	15.8	3.45

Clearly options 1 and 4 yield the highest savings. It is also clear that moving from 11,200 to 10,400 KJ/KWh and increasing distribution loses from 15.8 percent to 19.5 percent undo the benefits of heat rate reduction. This is one example where discretion is inferior to a rules-based framework that would unambiguously specify the direction of distribution losses.

The impression is given that the economic consequences of inefficiencies in the generation and distribution system can be accommodated indefinitely

- If the JPSCo were to reduce total distribution losses from 23.99 percent to 16 percent (the average for NOIC in the sample) this would lead to a 17.39 percent decline in average electricity price or yield a savings of J$7.43 billion annually (using 2009 prices).

- Non-technical losses in Jamaica, at 13 percent (mainly electricity theft) are very high by regional standards. There is no evidence that this reported value has been validated by the OUR. However, if the JPSCo were to reduce non-technical losses from the current 13 to 5 percent (the average for NOIC in the sample), this would yield an 8 percent savings or J$7.43 billion.

The JPSCo (2009) proposals contained in the recent rate review application seem to suggest that the speed with which the heat rate and distribution losses must be reduced is not fully appreciated. Indeed, the impression is given that the economic consequences of inefficiencies in the generation and distribution system can be accommodated

indefinitely. The potential for further erosion of competitiveness means that these two key performance indicators must attract urgent policy attention to bring them more in line with those realized in economies of LAC. This is critical as any reduction in the target system heat rate and system loss will yield reduction in the fuel charge for any given fuel price.

6.3 Fuel Diversification

The share of oil in the electricity generation mix has been reduced substantially in several LAC countries. For example, among the net oil exporters it stood at 27, 32, 39, 47, and 69 percent in Bolivia, Argentina, Colombia, Mexico, and Equator, respectively. In contrast, for the net oil importing countries of LAC the shares of oil was Brazil (40%), Chile (40%), Guatemala (40%), El Salvador (46%), Costa Rica (50%), Peru (50%), Uruguay (51%) and Honduras (52%). The geothermal leaders in the region are Costa Rica and El Salvador, where this sources supply 13 and 17 percent, respectively. Furthermore, in Costa Rica around 24 percent of the supply mix is hydro. In Peru, hydro, gas, and coal accounts for 60 percent of its supply mix. In short, countries with diversified fuel mix are generally those with the lowest electricity prices (Argentina, Venezuela, Paraguay, Bolivia, Honduras, Mexico, Costa Rica, and Columbia).

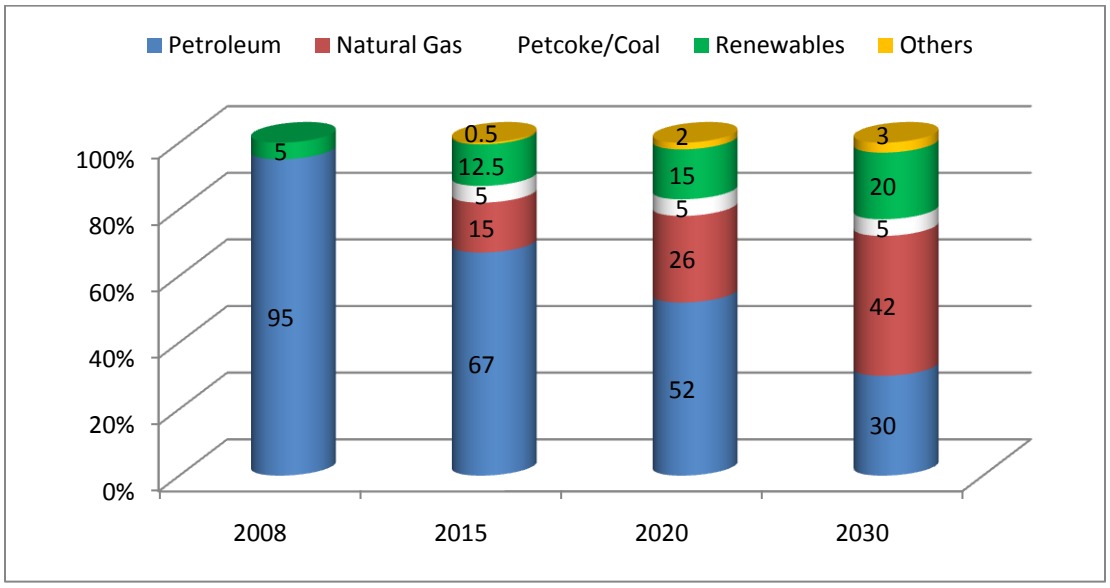
In Jamaica, residential, commercial, and industrial electricity prices are among the highest in the LAC region. This is partly because 95 percent of the electricity generated uses expensive imported petroleum coupled with the inefficiency with which fuel is converted to electricity. Jamaica's dependence on petroleum resulted in erratic swings in the price of electricity over the last tariff period (2004-2009), reaching a record high of 38 US cents/KWh in July 2008 (JPSCo, 2009). Effective fuel diversification is expected to improve energy security, reduce generation costs, mitigate the volatility of oil prices, and reduce vulnerability to external shocks**.**

According to the OUR Director General (Annual Report, 2007), "the OUR had hoped that the addition of new capacity would have been timely, based on the outcome of the planning process, thus realising gains for consumers through lower prices. The OUR

continues to be of the view that the industry will take the right decisions for consumers on a competitive basis once a fuel diversification policy is declared. The highest priority facing the Electricity Sector is, and has been since 2002, a policy decision on fuel".

According to the MEM (2009), in 2008 Jamaica's electricity generating mix consisted of 95 percent petroleum and 5 percent renewables. This mix is expected to change markedly by 2015 when petroleum is expected to represent 67 percent, natural gas 15 percent, petcoke/coal 5 percent and renewables 12.5 percent. By 2030, the share of petroleum in the supply mix is expected to decline to 30 percent, with natural gas accounting for as much as 42 percent of the mix, renewables 20 percent and others 3 percent. In other words, the implied policy is that no single fuel source will constitute more than 42 percent of the electricity generating mix in the year 2030.

Figure 31: Past and Expected Contribution of Fuels Mix to Electricity Generation



Source: Jamaica's National Energy Policy 2009-2030

With respect to the choice of natural gas and coal, the following two observations by Byer, Crousillat and Dussan (2009) are stated without commentary:

- Countries with access to natural gas will continue to rely on thermal expansion based on gas-fired Gas Turbine (GT) and Combined Cycle Gas Turbine (CCGT). Although this appears to be a least-cost generation expansion strategy, it may not

minimize risks. Except for Peru and Bolivia, which have ample reserves, the other countries face the risk of constraints in the supply of pipeline gas or the risk of volatile and high LNG prices indexed to Henry Hub[6].

- Coal-fired generation is an attractive least-cost option to mitigate the risk of volatile oil prices. LNG prices are tracking those of crude oil. Coal is the only conventional fuel whose price has remained decoupled from that of oil, with price ranging from 50-60 percent less than that of gas, which compensates for higher investment costs, including the use of CCTs. Levelized generation costs for coal plants are in the range of US$50 to 57/MWh.

According to the OUR (2005) fuel diversification can be achieved in several ways that are consistent with the current regulatory policy for the addition of generating capacity to the grid:

a) Installation of conventional technologies;
b) Setting up of co-generation installations, and
c) Utilization of renewable sources.

Conventional Technologies - produce electricity from fuel sources such as oil, coal, natural gas and hydroelectric. These technologies are classified into two types:

1. Capacity greater than 15 MW
2. Capacity of 15 MW and less.

The capacity breakpoint of 15 MW reflects the limit imposed by the Licence on new generation which may be purchased without undergoing a competitive procedure. Acquisition of plant above 15 MW will be on a competitive basis and initiated through a request for proposal following the approval of the Least Cost Expansion Plan (LCEP). Successful bidders must satisfy the criterion of lowest evaluated economic cost to the

[6] The Henry Hub pipeline is the pricing point for natural gas futures on the New York Mercantile Exchange. The NYMEX contract for deliveries at Henry Hub began trading in 1990 and is deliverable 18 months in the future. The settlement prices at the Henry Hub are used as benchmarks for the entire North American natural gas market.

system and, among other things, must be in line with the technical and financial conditions specified in the Request for Proposals.

Capacity additions equal to or less than 15 MW, do not require competitive bidding. Additions will be considered either on the basis of providing firm capacity and energy to the grid or supplying energy-only. The contractual arrangements negotiated between the JPSCo and the investor will form the basis of the Power Purchase Agreement (PPA) between the parties. The PPA must be approved by the OUR before being made effective. Prices under these PPAs will be based on the avoided cost[7] of generation to the grid. The criteria of technical practicality and financial robustness must also be satisfied in this category.

The OUR, (2007, 2008) has calculated the avoided costs as follows:

Table 9: Avoided Cost in 2008 and 2009

Plant Type	Avoided Cost 2007 (US cents/KWh)	Avoided Cost 2008 (US cents/KWh)
Conventional Technologies (Capacity and Energy)	6.1-6.9	10.48
Energy only	4.6-5.0	8.88

Source: The OUR's Declaration of Generation Avoided Costs (Ele 2007/04) and Declaration of Indicative Generation Avoided Costs (Ele 2008/04).

Renewable Energy

The Centre of Excellence for Renewable Energy (CERE) was established in November 2006 as a division within the Petroleum Corporation of Jamaica (PCJ). It is comprised of a Renewable Fuels Unit and a Renewable Electricity Unit. The Mission of CERE is to enhance the contribution of renewables to Jamaica's energy mix by:

- Bringing focus to the development and diversification of renewable energy sources and technologies;

[7] Avoided cost is the incremental cost that is not incurred by the utility if the additional output is provided by an alternative project, such as an IPP.

- Researching, educating and demonstrating new technologies and methods and collaborating with various energy stakeholders, local and foreign investors and environmental stewards; and
- Meeting the energy policy goal of 15 percent renewables in the energy supply mix by 2020.

The CERE is expected to act as a one-stop agency of central coordination to aggressively seek and attract the best technologies and methods to be employed in Jamaica, and the financial and fiscal incentives to increase the levels of investment in renewable energy. The main renewable energy technologies that are of interest to Jamaica, and that have recently engaged the interest of the multilateral and bilateral agencies are solar and photovoltaic, wind power, mini-hydro, and biomass, including bagasse.

One major output of the CERE to date is the WWF, a wholly owned subsidiary of the PCJ, which produced over 53,000,000 KWh in 2008/09. The main functions of the subsidiary are to:

- Manage and operate the 20.7 MW wind farm at Wigton, Manchester.
- Double the energy supplied from this facility to the national grid.
- Supply wind power to the local grid at the most competitive rate.
- Identify wind potential sites in Jamaica.
- Analyze wind data and ascertain the most feasible sites for expansion of wind power.
- Negotiate the sale of carbon credits realized from operating a clean development mechanism.

According to the MEM (2009), the GOJ is facilitating the expansion of the renewable energy industry by providing the following concessions:

- Reductions of import duty from 30 percent to 5 percent on all renewable energy equipment;
- Zero rating for GCT purposes on renewable energy equipment;

- Payment of a premium of 15 percent above the current "Avoided Generation Cost" for the procurement of electrical energy from renewable sources.

Byer, Crousillat and Dussan (2009) have suggested that three conditions are necessary to encourage the supply of renewable based electricity. First, price must be based on prospected avoided costs; that is, on the basis of displaced power plants and their respective production costs. Second, price should incorporate a premium for environmental and social benefits. Third, price will only be attractive for operators and financing institutions if they are fixed for a period of at least 10 years and adjusted for annual inflation and currency devaluation.

It is interesting to note that the WWF was up for divestment without any takers. This raises the question of the business viability of the 7.7 US cents/KWh it is paid for electricity by the JPSCo. Furthermore, the OUR avoided cost (2008) of 8.8 US cents/KWh raises the question of why the WWF is undertaking this expansion (doubling of the capacity) as opposed to private investors.

One can reasonably assume that the fundamental objective of energy diversification is to reduce supply and price volatility as well as end-user electricity prices. In this connection, a national strategic electricity target price could be seen as a useful starting point. The choice of fuel mix is then made based on their relative contribution to meeting that strategic electricity target price.

If Jamaica could reduce its residential electricity prices from J$16.14 in 2006 to that of the NOIC of J$9.40 in 2006, this would yield benefits to consumers in the order of J$7.4 billions. Similarly, if industrial prices could be reduced from J$12.31 to J$7.84 in 2006, it would yield benefits to consumers estimated at J$2.3 billion.

This means that all fuel types including nuclear should be subjected to rigorous technical, financial, and economic analysis. In terms of price risk analysis, it seems logical that the

price of fuels that are highly co-integrated with oil prices would present the greatest risk to the achievement of the national strategic electricity target price.

6.4 Improving Governance through Measurement

The JPSCo is regulated by the OUR under an incentive-based framework, known as a price cap regime, introduced through the 2001 Electricity Licence. Under this price cap framework, non-fuel base rates are set once every five (5) years. The tariff charged for electricity consists of two components, the **fuel rate** and the **non-fuel rate base**. The **fuel rate** represents the fuel cost to the JPSCo and IPPs to generate electricity. It is recovered directly from customers through a Fuel and IPP charge subject to adjustments for performance against heat rate and system loss targets. The **non-fuel base rate** is used to recover costs associated with the operation and maintenance of the Company's regulated assets (the rate base) and its weighted average cost of capital.

The price cap regime also includes a Performance Based Rate Adjustment Mechanism (PBRM) through which non-fuel rates are adjusted annually based on a productivity offset to inflation (X-factor) and performance against quality of service targets (Q-factor). The OUR can improve the governance structure of the sector by addressing issues relating to accurate measurement of the X-factor and the Q-factor using a more systematic framework (rules-based versus a discretionary approach). Both the OUR and the JPSCo should abide by the agreed methodology. The Electricity Licence (2001) stipulates a "Price Cap Regime" of the form:

Equation 3

dCPI = dI ± X ± Q ± Z

Where:

dCPI	=	annual rate of change in Non-Fuel electricity prices;
dI	=	the annual growth rate in an inflation and devaluation measure;
X	=	the offset to inflation (annual real price increase or decrease) resulting from productivity changes in the electricity industry;
Q	=	the allowed price adjustment to reflect changes in the quality of service provided to the customers; and
Z	=	the allowed rate of price adjustment for special reasons not captured by the other elements of the formula.

X-Factor

A central element of this price cap regime is the X-factor which decreases the allowed tariff by a pre-defined percentage each year based on expected TFP gains. TFP is a comprehensive efficiency indicator which measures changes in the quantity of all outputs relative to the quantity of all inputs. It therefore captures the influence on growth of factors such as technological change, efficiency improvements, returns to scale and reallocation of resources due to shifts in factor inputs. The usefulness of TFP analysis is that it allows one to gauge "the company's dynamic efficiency, or the extent to which the company has lowered costs over time through innovation.

Typically, there are two approaches to the calculation of TFP growth: the index number approach and the econometric approach. The former applies an index number formula to construct TFP growth rates. Input and output indices are constructed to aggregate all of the inputs used and the outputs produced, and the TFP growth rate is defined as the difference between the rate of output growth and input growth. When the growth in the output index exceeds the growth in the input index, one observes TFP growth. If, on the other hand, input growth exceeds output growth, there is a decline in TFP[8].

The econometric approach estimates a specified cost function for firms that are being benchmarked. This framework identifies an efficient cost frontier using firms in the sample and measures the relative performance of less efficient firms against this frontier. Individual X-factors are then assigned to utilities based on their relative inefficiency. In practice, the more inefficient a utility, the higher is the X-factor assigned to that firm. The rationale is to provide the inefficient firms with an incentive to close their efficiency gap with the frontier firms.

Analysts have relied on cross-country econometric cost analysis to evaluate the performance of national utilities within the larger context of international practice.

[8] See for example the Division of ratepayers Advocacy (DRA) in California and the JPSCo which based their findings and conclusions upon the index approach.

Addition of international firms to the sample enables analysts to measure efficiency of the utilities relative to international best practice (Jamasb and Pollitt, 2002).

The way the X-factor is currently determined can result in major disagreement between the OUR, the JPSCo and consumers. Several issues of methodology must be agreed on between the OUR and the JPSCo. These include the index technique to be used for measuring TFP, the variables comprising the output and input indices and their respective weights as well as the length of the period for the TFP estimate.

Since TFP growth is defined as output growth less input growth, measured TFP growth will be influenced by the definition of output. A key element in measuring productivity is defining an appropriate measure of output. **A**ll measures of output suffer from potential bias. In the context of productivity analysis, if output growth is suppressed due to successful conservation efforts and input growth does not decline, in the same proportion, then measured productivity growth will decline.

It has been demonstrated that average TFP growth will differ significantly, depending on the output measures such as total electric sales adjusted for conservation (i.e., Demand Side Management or DSM), total electric customers and revenue weighted sales to residential, commercial, industrial and resale classes of service. For example, TFP for Pacific Gas and Electricity (PG&E) over the historic period 1987 through 2008, with output defined as DSM adjusted electric sales, electric TFP grew on average by 1.59 percent per year. Defining output as total electric sales, historic electric department TFP grew, on average, by 0.60 percent per year. Relying on the Division of Ratepayers Advocate (DRA) output definition, results in an historic TFP growth rate of 1.37 percent per year (DRA, 2011).

In addition, once the TFP is determined, other issues such as stretch factors, TFP growth rate for the USA, TFP growth rate for Jamaica and the share of costs that is local and USA must be decided.

The TFP growth rates for the US and Jamaica used to determine the X-factor shows very important conceptual methodological differences that needs to be re-examined including the measurement of output, labour input and capital services. In the US, the TFP growth rates are based on the multifactor productivity (MFP) index of the US nonfarm, private business sector, computed by the Bureau of Labour Statistics (BLS). This differs from the methodology used to calculate TFP in Jamaica where PEG utilizes a growth accounting framework that is based on the overall Jamaican economy.

Analysis by the JPC suggests that if the TFP measure from the Groningen Total economy Database which uses standard growth accounting framework for the period 2001-2007 was used for both Jamaica and the US, the X-factor would be 1.58 instead of 0.78. The major issue here is the need to standardize the X-factor measurement for both the USA and Jamaica.

The discretionary approach currently used by the OUR to arrive at the X-factor should be discontinued. For example, in the 2009 rate application the JPSCo recommended an X-factor of 0.8 percent for the period 2009-2014. In contrast, the OUR determined that the X-factor should be zero percent at June 2010 and 2.72 percent for the period June 2011-2014. A zero percent change in the X-factor is not in the interest of consumers. Furthermore, the JPSCo suggested that the TFP growth rate for the Jamaican economy should be zero as this could not be accurately measured based on inadequate data. In addition, the Conference Board has published TFP growth rates for both the USA and Jamaican economy for the period 1990-2009[9].

It should also be noted that the non-fuel base rate (ABNF) is extremely sensitive to adjustments in the weights applied to the US and Jamaican components of costs as well as adjustments for productivity (X-Factor). Exhibit 1 of the Electricity Licence sets the weights at 60:40 for US and Jamaica, respectively. However, for the 2004-2009 and 2009-2014 tariff adjustment periods this ratio was changed to 76:24. The justification

[9] The Conference Board Total Economy Database, January 2011, http://www.conference-board.org/data/economydatabase/

being that depreciation of the Jamaican dollar has led to an increase in the proportion of US$ non-fuel costs relative to local cost components.

According to the OUR, along with the change in weights "the inflation adjustment formula (dI) to be used during the 2004 -2009 and 2009-2014 tariff periods, has been changed to more accurately reflect the inflation costs incurred on JPSCo". There are three issues of concern associated with the assumed debt factor adjustment of 0.922 in the dI formula. First, the way in which the debt factor is defined suggests that its value should be 0.078 and not 0.922. Accurate definition is important to allow other analyst to replicate the OUR's calculation. The second issue has to do with the economic rationale for the debt factor as it has been observed that increasing the debt factor actually reduces the annual adjustment for inflation and devaluation (dI). The third issue questions the rationale for adjusting the non-debt costs (1-d) for US inflation and exchange rate depreciation, a point that can be highly debatable. The main concern here is the need to appropriately define terms that will allow analysts to replicate calculations, thereby avoiding confusion.

Q-Factor

The JPSCo (2004) in its Rate Application proposed that for the first 5-year rate cap period (2004-2009), SAIDI and SAIFI should be used as the quality of service indicators. That is, the Q-factor value will be based upon actual values for SAIDI and SAIFI for each year of the PBRM relative to a benchmark year. The JPSCo proposed that the benchmarks be set such that, in each year between 2004 and 2008, the company would be incentivized to improve continuously its performance on SAIDI and SAIFI, relative to 2003. In other words, SAIDI and SAIFI should be continuously improving by 2 percent relative to the actual 2003 performance level, in each year from 2004 to 2008. The proposed targets are shown in Table 10.

Table 10: Proposed Targets for SAIDI and SAIFI: 2004 – 2008

Year	Target SAIDI	Target SAIFI
2004	$SAIDI_{2003}$	$SAIFI_{2003}$
2005	$SAIDI_{2003\ (1-0.02)}$	$SAIFI_{2003\ (1-0.02)}$
2006	$SAIDI_{2003\ (1-0.04)}$	$SAIFI_{2003\ (1-.04)}$
2007	$SAIDI_{2003\ (1-0.06)}$	$SAIFI_{2003\ (1-0.06)}$
2008	$SAIDI_{2003\ (1-0.08)}$	$SAIFI_{2003\ (1-0.08)}$

Source: 2009-2014 JPSCo Rate Case Application

In each of the five years following 2003:

- If SAIDI and SAIFI calculations show marked improvement relative to the target, Q will be a fixed positive addition to the inflation adjustment factor, dI.
- If SAIDI and SAIFI calculations show little or no improvement relative to the target, Q will be zero (a dead band).
- If SAIDI and SAIFI calculations show deterioration relative to the target, Q will be a fixed negative reducer to dI.

In response, the OUR (2004) in its determination ruled that the Q-factor should remain at zero until June 2005 when the data on forced outages at both the feeder and sub-feeder levels would be collected, audited and analyzed. Baseline data on SAIDI, SAIFI and CAIDI will then be available at that time in order to apply the Q-factor at that date. Should the JPSCo not provide the supporting data, the OUR will apply international benchmarks to inform the derivation of the Q-factor with effect from June 2005. The targets required the JPSCo to reduce the frequency and duration of customer outages by 8 percent between 2006 and 2009, or otherwise face a penalty that would be applied so as to reduce tariffs.

The JPSCo (2009) in its Rate Application argues that its capital investment of US$9M for maintenance of its generating fleet over the five year period has begun to yield improvements. It suggested that forced outage rates improved significantly from 12.7 percent in 2004 to 8.5 percent in 2008. System availability also improved to 83.9 percent in 2008, up from 80.8 percent in 2004. Customers have benefited significantly, as the level of interruptions from the generating system continued to fall as shown below:

Table 11: Actual SAIDI, SAIFI and CAIDI for JPSCo: 2006 - 2008

	2005	2006	2007	2008	Average
SAIDI	57	57	50	42	52
SAIFI	37	34	24	24	30

Source: 2009-2014 JPSCo Rate Case Application

The OUR (2009) in its determination stated that the current baseline data is risky as there is need for auditing of the data collection procedure and processes along with further analysis on the variability of the performance of the indices overtime. Accordingly, the OUR is of the view that the Q-factor should continue with a dead band with zero points until the integrity of the data and the data collection procedures are fully implemented and audited.

The OUR (2009) argues that once the base-line data is deemed reliable for SAIDI, SAIFI and CAIDI on the improved basis that the targets and penalty/reward scoring system be revised during the 2009-2014 annual adjustment submissions. The Q-factor adjustment for 2009 will therefore remain within the dead band and therefore zero.

Applying the proposed OUR methodology (2004) and using the NOIC average for SAIDI and SAIFI of 16 hours per customer per year and 12 times per year (in 2005 as the base), savings to consumers in 2009 would amount to J$ 0.13 billion, and for the five year (2005-2009) amount to J$ 0.44 billion.

The bottom-line is that both the OUR and the JPSCo have not succeeded in providing reliable data on which to calculate and incorporate an appropriate Q-factor in its rate making determination. Furthermore, there is no evidence to suggest that the OUR has made good on its promise to apply international benchmarks to inform the derivation of the Q-factor with effect from June 2005. In addition, there is no evidence that the JPSCo has faced any penalty aimed at reducing tariffs, as promised by the OUR. As such, it appears that the consumer is the loser.

The OUR must establish transparent and consistent monitoring protocols and procedures for administering the rate cap regime and the related PBRM. The transparency of these processes is critical to the enhancement of the credibility of the regulator. In particular, consumers must be assured by the regulator that:

- The heat rate used to calculate the fuel pass through is not simply that submitted by the Licensee, but rather that determined and verified by the economic dispatch log.
- Consumers are retroactively compensated for any heat rate deviations from economic dispatch.
- The distribution loss data employed in the fuel pass through calculations are adequately validated and published.
- The procurement of goods is regularly audited as provided for by Condition 20 of the Licence.
- The weights applied to the US and Jamaican components of costs as well as in determining the X-Factor are not arbitrarily adjusted.
- International benchmarks for SAIDI and SAIFI indicators are applied if JPSCo fails to supply the requisite verifiable data.
- Protocols, policies and procedures are subject to periodic auditing by an independent body.

6.5 Improving Policy Coordination and Implementation

According to the MEM (2009) the following nineteen entities will play key roles in implementing the seven goals of the National Energy Policy (Table 12). However, all the agencies will be coordinated by the MEM. However, this coordinating role is not explicitly clear. For example, CERE claims it is a one-stop agency of "central coordination" to aggressively seek and attract the best technologies and methods to be employed in Jamaica, and the financial and fiscal incentives to increase the levels of investment in renewable energy. The roles and responsibilities of the participating agencies must be well defined to minimize duplication of efforts and areas of omission.

The main concern of this Report is that Jamaica has a better record of planning than that of implementing. There have been many proposals but no implementation (Biomass Investment Group 70 MW E-Grass Renewable Energy Project; JPSCo 120 MW Coal Plant at Old Harbour by 2012; Petcoke 100 MW Project by JPSCo; Windalco Cogeneration 60 MW; Jamalco 85 MW cogeneration). For example, the JPSCo invested in constructing the 120 MW plant at Bogue in 2002. However, since that time, Jamaica has not undertaken any electricity generating investment even close to that magnitude. Furthermore, despite the capacity required for replacement and expansion, no progress is obvious on the ground.

Table 12: Matrix of Implementing Agencies According to Energy Policy Goals

	Goal 1	Goal 2	Goal 3	Goal 4	Goal 5	Goal 6	Goal 7
MEM	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MTW	Yes					Yes	
MFPS	Yes					Yes	Yes
MIIC							Yes
PCJ		Yes	Yes	Yes	Yes	Yes	Yes
PETROJAM	Yes	Yes					
CERE			Yes	Yes			
OUR		Yes	Yes	Yes	Yes		
OC					Yes	Yes	
OPM	Yes	Yes	Yes	Yes		Yes	
JPSCo		Yes					
IPPS		Yes					
JBS	Yes						
JTI							Yes
JBI		Yes					
SRC			Yes				
NWA						Yes	
NEPA							Yes
MIND	Yes					Yes	

Source: Jamaica's National Energy Policy 2009-2030

An overriding objective of the MEM should be the achievement of a specified strategic national target price for electricity. Subsequently all the policies, projects and programmes should be aligned to achieve that strategic target price. For instance, if Jamaica could reduce its 2006 residential tariff from J$16.14 per KWh to J$9.40 (the average for NOIC in the sample) the savings to consumers would be J$7.4 billion.

6.6 Energy Efficiency

There is great potential for increasing the efficiency of electricity use in Jamaica, particularly in the residential and commercial sectors. Efficiency improvements can be made economically in both new construction and existing buildings if adequate incentives are provided. These improvements would reduce the intensity of electricity use. On the other hand, such reductions could be offset by new uses of electricity in production and household applications. In addition, some established electricity applications, such as air conditioning and lighting still exhibit potential for market growth. Efficiency improvements through conservation and load management can also benefit economic growth by reducing the long-term costs of electricity supply, and thus the price of electricity.

If Jamaica could reduce its energy intensity, measured as BOE required to produce each U$1,000 of GDP (in 2000 prices) from 2.87 to 1.85 (the average for NOIC) at 2009 GDP, this would save approximately 1.0 million BOE.

There is ample room for improving energy efficiency. The successful experience of Mexico indicates that savings of about 15 percent of peak electricity demand are possible with adequate price levels and well designed EE programs. These programmes should be based, among other things, on the enactment of efficiency legislation, application of norms, financing of projects, labelling of appliances and equipment, dissemination of information and the promotion and establishment of required policies and frameworks for the creation of a viable Energy Service Company (ESCO) industry in Jamaica.

6.7 Research Needs

Further research is needed to identify and quantify the forces affecting the relationships between electricity and economic growth in view of their critical importance and complexity. The strong and persistent relationship between electricity use and gross domestic product (GDP) requires that close attention be paid to the adequacy of electricity supply to sustain a high future rate of economic growth. The adequacy of electricity supply can be maintained not only through new generation facilities but also through efficiency improvements that use existing generating capacity better. Although favourable electricity supply conditions of themselves will not assure economic growth, inadequate supply will almost certainly constitute a serious impediment to such growth. Accordingly, we need to learn more about the correlations and causal relationships between economic growth and the use of electricity. Well-directed policy, regulatory and managerial decisions rest on such knowledge. Some of the key areas suggested for further work include:

1. Firm and industry-level benchmarking of key performance indicators and best practices to identify opportunities for productivity improvement.
2. Econometric estimates of appropriate elasticities (price and income), technical change and productivity growth to advance the understanding of the impact of electricity prices on economic growth.
3. Benchmarking of the governance and tariff structures against global best practices
4. Detailed technical review of the existing Licence.

References

Byer. T., Grousillat, E. and Duddan, M. (2009). Latin America and the Caribbean Region Energy Sector – Retrospective Review and Challenges, ESMAP Technical Paper 123/09.

Division of Ratepayers Advocate (2010). Report on Total Factor Productivity for Pacific Gas and Electric Company General Rate Case Test Year 2011, California Public Utilities Commission, San Francisco, California.

Division of Ratepayer Advocates (2006). Report on Total Factor Productivity for Pacific Gas and Electric Company, General Rate Case Test Year 2007, California Public Utilities Commission, San Francisco, California April 14, 2007

Hulten, C. R. (2003). "Total Factor Productivity: A Short Biography" Working Paper No. 7471, National Bureau of Economic Research, January 2003, p. 23.

Jamasb, T. and Pollitt, M. (2002). International Utility Benchmarking & Regulation: An Application to European Electricity Distribution Companies, DAE Working Paper, No. 0115, Department of Applied Economics, University of Cambridge.

JPSCo (2004). Rate Submission, Volume 1, March 2004

JPSCo (2009). Jamaica Public Service Company Limited, 2009-2014 Tariff Review Application, March 2009

Jamaica Gazette, All Island Electricity Licence (2001)

Loy, D. and Coviello, M. (2005). Renewable Energies Potential in Jamaica. United Nations Economic Commission for Latin America and the Caribbean (ECLAC). Prepared in Collaboration with Ministry of Commerce, Science and Technology – Jamaica, June 2005.

MEM (2009). Jamaica's National Energy Policy 2009-2030.

National Research Council (1986). "Electricity in Economic Growth", Commission on Engineering and Technical Systems, National Academic Press, Washington DC 1986.

OUR (2004). Summary Decisions

OUR (2004). Generation Expansion Olan 2004-2012 Decision and Recommendation.

OUR (2005). Regulatory Policy for Addition of New Generating Capacity to the Public Electricity Supply System (Ele 2005/08).

OUR (2007). Evaluation of Generation Expansion Option and Tariff Impact Assessment Study (Ele 2007/03).

OUR (2007). Declaration of Generation Avoided Costs (Ele 2007/04)

OUR (2008). Declaration of Indicative Generation Avoided Costs (Ele 2008/04).

OUR (2009). Determination Notice, Tariff Review for Period 2009-2014 (Ele 2009/04, Det/Jamaica Public Service Company Limited

Planning Institute of Jamaica (2002, 2007), Economic and Social survey of Jamaica.

Sirasoontorn Puree, "Incentive Regulation in Electricity Supply Industry". http://www.uniten.edu.my/newhome/uploaded/coe/arsepe/2007/lecture/week%201/UNITEN%20ARSEPE%2007%20L10%20Incentive%20Regulation%20in%20Electricity%20Supply%20Industry%20Pure.pdf. Accessed July 20, 2009

Tariff Determination (2004 – 2009) http://www.our.org.jm/index.php?option=com_sectionex&view=category&id=28&Itemid=443. Accessed June 15-29, 2009

Vogelsang, I. (2002), Incentive Regulation and Competition in Public Utility Markets: A 20-Year Perspective, Journal of Regulatory Economics, 22:1.

World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005. http://info.worldbank.org/etools/lacelectricity/home.htm. Accessed June 1, 2009

World Bank (2005). Institutions, Performance and the Financing of Infrastructure Services in the Caribbean, World Bank Working Paper No. 58

Annex 1

Table 13: Electricity Consumption (KWh/capita) compared to GDP per capita (US$)

Country	GDP/Capita (US$)	Electricity Consumption/Capita (KWh)
Argentina	10,326	2,598
Bolivia	2,831	467
Colombia	6,845	916
Ecuador	4,723	864
Mexico	7,960	1,695
Venezuela	10,300	2,977
NOEC	7,164	1,586
Brazil	6,215	2,057
Chile	12,912	3,187
Costa Rica	8,227	1,838
Guatemala	4,415	538
Jamaica	3,832	2,401
Peru	4,822	965
Dom Rep	4,808	1,342
Uruguay	9,414	2,138
NOIC	6,831	1,808
LAC Average	6,974	1,713

Source: Compiled using data from United States Energy Information Administration (EIA) and World Bank

Table 14: Value Added Contribution of the Electricity Sector

Year	Value Added GDP (J$2003 prices)
1998	9,946,700,000
1999	10,447,000,000
2000	11,075,000,000
2001	11,291,100,000
2002	11,862,500,000
2003	12,439,700,000
2004	12,533,400,000
2005	13,044,600,000
2006	13,592,500,000
2007	13,712,400,000
2008	13,866,700,000

Source: Compiled using data from STATIN

Table 15: JPSCo and Non-JPSCo Sources of Electricity Generation

Year	JPSCo Sources	Non-JPSCo sources (GWh)
1998	2,228	722
1999	2,257	842
2000	2,295	1,007
2001	2,451	910
2002	2,458	1,067
2003	2,674	1,022
2004	2,764	953
2005	2,811	1,067
2006	2,702	1,344
2007	2,800	1,276
2008	2,865	**1,258**

Source: Compiled using data from the Planning Institute of Jamaica

Table 16: Electricity Output, Sales, and Percent Distribution Losses: 1998 – 2009

Year	Total Output (GWh)	Sales (GWh)	%Distribution Losses
1998	2,950	2,446.20	17.1
1999	3,100	2,576.10	16.9
2000	3,302	2,739.00	17.1
2001	3,361	2,793.40	16.9
2002	3,525	2,896.50	17.8
2003	3,696	2,998.30	18.9
2004	3,717	2,974.00	20.0
2005	3,878	3,011.30	22.3
2006	4,046	3,094.00	23.5
2007	4,076	3,164.00	22.4
2008	4,123	3,130.00	24.1

Source: Compiled using data from the Planning Institute of Jamaica

Table 17: Total Wind and Hydro Output (GWh): 1998 – 2009

Year	Output - Wind (GWh)	Output - hydro (GWh)
1998	0.00	87.80
1999	0.00	88.80
2000	0.00	78.40
2001	0.00	60.50
2002	0.00	104.60
2003	0.00	146.30
2004	32.00	134.30
2005	49.90	151.30
2006	55.00	169.60
2007	51.90	159.80
2008	49.00	158.00
2009	59.00	140.70

Source: Compiled using data from the Planning Institute of Jamaica and Ministry of Energy

Table 18: Installed Capacity by Energy Sources and Percent Distribution (2007)

Country	MWh					% Distribution				
	Hydro	Thermal	Others	Nuclear	Total	Hydro	Thermal	Others	Nuclear	Total
Argentina	9,940	17,076	29	1,018	28,063	35	61	0	4	100
Bolivia	485	1,014	0	0	1,499	32	68	0	0	100
Colombia	8,525	4,667	504	0	13,696	62	34	4	0	100
Ecuador	2,057	2,429	2	0	4,489	46	54	0	0	100
Mexico	11,340	36,101	1,045	1,365	49,851	23	72	2	3	100
Venezuela	14,597	7,943	0	0	22,540	65	35	0	0	100
NOEC	7,824	11,538	263	397	20,023	44	54	1	1	100
Brazil	76,942	21,779	247	2,007	100,974	76	22	0	2	100
Chile	5,370	10,496	20	0	15,886	34	66	0	0	100
Costa Rica	1,412	444	236	0	2,092	68	21	11	0	100
Dom Republic	469	5,049	0	0	5,518	9	91	0	0	100
El Salvador	472	695	204	0	1,372	34	51	15	0	100
Grenada	0	32	0	0	32	0	100	0	0	100
Guatemala	775	1,318	47	0	2,140	36	62	2	0	100
Honduras	504	1,070	0	0	1,575	32	68	0	0	100
Jamaica	22	796	36	0	854	3	93	4	0	100
Nicaragua	104	649	88	0	841	12	77	10	0	100
Panama	847	621	0	0	1,467	58	42	0	0	100
Paraguay	8,130	6	0	0	8,136	100	0	0	0	100
Peru	3,234	3,793	1	0	7,028	46	54	0	0	100
Uruguay	1,538	689	0	0	2,227	69	31	0	0	100
NOIC	7,130	3,388	63	143	10,724	41	56	3	0	100
LAC Average	7,338	5,833	123	220	13,514	42	55	2	0	100

Source: Compiled using data from United States Energy Information Administration (EIA)

Table 19: Energy Productivity (KWh/BOE): 1998 – 2009

Year	System	JPSCo	IPPs
1998	560.49	511.9506	779.5697
1999	571.61	506.2809	855.8923
2000	547.28	492.9073	722.9435
2001	547.19	487.2495	808.4412
2002	557.41	483.5224	840.8328
2003	548.51	486.6275	800.0125
2004	570.31	519.3633	792.2823
2005	560.89	503.2165	800.9064
2006	598.08	533.2379	785.7102
2007	580.65	478.4003	1077.544
2008	624.03	541.5008	947.3528
2009	611.45	542.9129	785.336

Source: Compiled using data from the Planning Institute of Jamaica and Ministry of Energy

Table 20: Realized Heat Rate (KJ/KWh): 2003 – 2008

	2003	2004	2005	2006	2007	2008
System	10,847	10,832	10,985	10,174	10,629	10,251
IPPs		8,211	8,268	8,152	8,161	8,136
JPSCo		11,752	12,138	11,338	11,900	11,257
JEP		8,355	8,355	8,189	8,166	8,166
JEP 50				8,189	8,166	8,166
PPPC		8,074	8,066	8,009	8,061	8,048

Source: Compiled using data from the JPSCo Tariff Application

Table 21: Total Number of Connections (Residential and Industrial) 2001-2005

Country	2001	2002	2003	2004	2005	Average
Argentina	9,905,927	9,903,190	10,100,000	10,400,000	10,600,000	10,181,823
Bolivia	899,356	935,775	982,267	1,025,776	1,075,816	983,798
Colombia	7,876,103	8,140,206	8,252,895	8,559,976	8,848,554	8,335,547
Ecuador	2,503,292	2,617,457	2,746,930	2,893,899	3,025,614	2,757,438
Mexico	24,800,000	25,900,000	27,000,000	28,000,000	29,000,000	26,940,000
Venezuela	4,877,084	4,998,433	5,106,783	5,197,020	5,392,500	5,114,364
NOEC	8,476,960	8,749,177	9,031,479	9,346,112	9,657,081	9,052,162
Antigua	ND	26,142	27,017	27,752	28,724	27,409
Belize	57,083	59,815	63,076	66,081	68,635	62,938
Brazil	50,200,000	52,200,000	53,800,000	56,300,000	57,900,000	54,080,000
Chile	4,284,722	4,423,545	4,572,684	4,720,346	4,861,913	4,572,642
Costa Rica	1,084,482	1,128,837	1,170,012	1,203,339	1,236,847	1,164,703
Dom Rep	732,426	782,451	859,313	876,870	914,279	833,068
Dominica	26,665	26,495	27,513	28,980	29,025	27,736
El Salvador	1,147,837	1,162,071	1,211,749	1,257,429	1,293,664	1,214,550
Grenada	34,288	35,225	36,437	34,921	33,406	34,855
Guatemala	1,632,058	1,740,658	1,853,680	1,849,629	1,849,629	1,785,131
Honduras	692,142	744,707	789,405	834,758	888,797	789,962
Jamaica	493,497	507,560	516,681	536,434	548,446	520,524
Nicaragua	454,077	459,130	488,622	539,143	574,808	503,156
Panama	526,504	561,314	614,843	648,398	681,600	606,532
Paraguay	959,579	964,448	976,278	1,000,156	1,006,807	981,454
Peru	3,468,651	3,640,445	3,755,480	3,888,523	3,997,575	3,750,135
St Lucia	47,760	48,633	50,253	51,766	53,002	50,283
St Vincent	31,179	32,230	33,282	34,208	34,208	33,021
Uruguay	1,195,767	1,186,990	1,187,430	1,211,226	1,217,021	1,199,687
NOIC	3,726,040	3,670,037	3,791,250	3,953,156	4,064,126	3,801,989
LAC Average	4,913,770	4,889,030	5,048,905	5,247,465	5,406,435	5,062,030

Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Table 22: Total Number of Residential Connections 2001-2005

Country	2001	2002	2003	2004	2005	Country Average	Growth (%) 2001-2005	Growth (%) 2004-2005
Argentina	8,635,153	8,650,949	8,794,676	9,031,651	9,252,165	8,872,919	3	2
Bolivia	780,983	814,862	858,078	897,045	942,804	858,754	10	5
Colombia	7,019,836	7,250,289	7,302,601	7,570,499	7,788,933	7,386,432	5	3
Ecuador	2,188,977	2,287,573	2,400,262	2,526,967	2,647,131	2,410,182	10	5
Mexico	21,900,000	22,800,000	23,700,000	24,600,000	25,500,000	23,700,000	8	4
Venezuela	4,340,105	4,448,820	4,544,260	4,624,775	4,802,261	4,552,044	5	4
NOEC	7,477,509	7,708,749	7,933,313	8,208,490	8,488,882	7,963,389	7	4
Antigua	23,835	23,835	24,596	25,293	26,188	24,749	4	4
Belize	56,599	59,362	62,544	65,544	68,041	62,418	10	4
Brazil	42,700,000	44,500,000	46,300,000	48,400,000	49,600,000	46,300,000	8	2
Chile	4,025,170	4,169,667	4,288,490	4,326,318	4,486,053	4,259,140	6	4
Costa Rica	953,462	989,715	1,023,214	1,051,957	1,080,591	1,019,788	7	3
Dom Rep	679,515	725,927	797,237	813,525	844,613	772,163	14	4
Dominica	23,069	23,210	24,333	25,181	24,851	24,129	5	-1
El Salvador	1,061,405	1,070,261	1,121,401	1,157,537	1,191,459	1,120,413	6	3
Grenada	29,903	30,674	31,707	30,415	29,123	30,364	2	-4
Guatemala	1,417,390	1,501,818	1,599,331	1,583,268	1,583,268	1,537,015	8	0
Honduras	629,695	678,285	718,902	752,667	809,843	717,878	14	8
Jamaica	427,908	452,388	462,107	480,665	491,452	462,904	8	2
Nicaragua	422,614	429,495	455,451	502,353	534,885	468,960	11	6
Panama	461,027	493,410	544,390	575,486	606,127	536,088	16	5
Paraguay	812,964	819,693	835,201	881,602	871,716	844,235	4	-1
Peru	3,132,490	3,285,108	3,395,316	3,516,542	3,597,326	3,385,356	8	2
St Kitts	4,782	4,782	4,782	4,782	4,782	4,782	0	0
St Lucia	42,548	43,460	44,980	46,347	47,417	44,950	6	2
St Vincent	27,671	28,595	29,535	30,304	30,304	29,282	6	0
Uruguay	1,073,336	1,067,164	1,067,727	1,086,775	1,091,523	1,077,305	0	0
NOIC	2,900,269	3,019,842	3,141,562	3,267,828	3,350,978	3,136,096	7	2
LAC Average	3,956,555	4,101,898	4,247,351	4,407,981	4,536,648	4,250,087	7	3

Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Table 23: Electricity Sold Per Year (MWh)

Country	2001	2002	2003	2004	2005	Country Average	Growth (%) 2001-2005	Growth (%) 2004-2005
Argentina	55,000,000	52,400,000	55,000,000	58,700,000	62,800,000	56,780,000	14	7
Bolivia	2,883,952	3,000,472	3,094,457	3,291,468	3,485,516	3,151,173	21	6
Colombia	28,100,000	28,200,000	28,600,000	29,800,000	31,700,000	29,280,000	13	6
Ecuador	7,952,569	8,097,051	8,342,504	8,716,181	9,152,424	8,452,146	15	5
Mexico	157,000,000	160,000,000	161,000,000	163,000,000	170,000,000	162,200,000	8	4
Venezuela	103,000,000	104,000,000	103,000,000	108,000,000	117,000,000	107,000,000	14	8
NOEC	58,989,420	59,282,921	59,839,494	61,917,942	65,689,657	61,143,887	14	6
Brazil	268,000,000	274,000,000	280,000,000	287,000,000	285,000,000	278,800,000	6	-1
Chile	21,200,000	22,100,000	23,500,000	25,200,000	29,000,000	24,200,000	37	15
Costa Rica	9,607,288	10,100,000	10,700,000	11,100,000	11,800,000	10,661,458	23	6
Dominica	63,914	63,981	62,735	66,419	67,789	64,968	6	2
El Salvador	3,347,136	3,552,188	3,779,903	4,079,516	4,199,616	3,791,672	25	3
Grenada	123,918	129,214	138,292	125,511	131,571	129,701	6	5
Guatemala	3,413,007	3,336,190	4,267,427	4,473,864	4,476,000	3,993,298	31	0
Honduras	3,343,186	3,546,972	3,775,227	4,010,720	4,176,357	3,770,492	25	4
Jamaica	2,793,375	2,896,547	2,998,345	2,975,509	3,055,154	2,943,786	9	3
Belize	256,715	278,946	307,553	329,977	349,726	304,583	36	6
Antigua	150,000	162,400	150,133	168,833	175,897	161,453	17	4
Nicaragua	1,554,100	1,565,764	1,619,682	1,688,203	1,780,119	1,641,574	15	5
Panama	3,876,076	4,035,640	4,352,807	4,504,627	4,666,343	4,287,099	20	4
Paraguay	5,138,685	5,074,303	4,932,154	5,166,682	5,164,954	5,095,356	1	0
Peru	10,500,000	11,200,000	11,600,000	12,200,000	13,400,000	11,780,000	28	10
Dom Rep	4,361,804	4,758,000	4,363,324	3,344,052	3,719,640	4,109,364	-15	11
St Kitts	33,000	34,270	N/A	34,280	34,300	33,963	4	0
St Lucia	243,416	239,387	252,120	266,402	277,398	255,745	14	4
St Vincent	86,605	89,825	95,431	106,524	106,800	97,037	23	0
Uruguay	6,426,000	6,151,000	5,978,000	6,304,000	6,515,000	6,274,800	1	3
NOIC	17,225,911	17,665,731	19,098,586	18,657,256	18,904,833	18,119,817	16	4
LAC Average	26,863,644	27,269,698	28,876,404	28,640,491	29,701,331	28,048,449	15	5

Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Table 24: Length of Distribution Network

Country	2001	2002	2003	2004	2005	Country Average	Growth (%) 2001-2005
Argentina	319,492	328,406	333,773	333,764	333,011	329,689	3
Bolivia	21,112	23,331	23,744	24,413	27,079	23,936	13
Colombia	71,093	71,885	73,555	73,735	74,000	72,854	2
Ecuador	110,780	102,801	107,712	119,274	120,196	112,153	1
Mexico	657,573	669,418	682,433	698,818	710,376	683,724	4
NOEC	236,010	239,168	244,243	250,001	252,932	244,471	5
Antigua	630	649	658	666	666	654	4
Brazil	194,385	208,852	214,300	220,603	235,343	214,697	10
Chile	29	33	24	33	31	30	3
Costa Rica	21,117	21,939	22,654	23,249	23,986	22,589	7
El Salvador	29,275	33,501	35,006	35,875	37,614	34,254	17
Grenada	354	354	354	354	354	354	0
Guatemala	1,601	2,080	2,496	2,995	3,594	2,553	59
Jamaica	14,000	14,000	14,000	14,000	14,000	14,000	0
Nicaragua	3,950	3,952	3,998	3,998	3,998	3,979	1
Panama	10,595	11,298	11,492	11,492	11,492	11,274	6
Paraguay	53,547	54,443	55,542	56,201	56,912	55,329	3
Peru	21,650	22,829	23,809	24,611	24,611	23,502	9
St Kitts	53	53	53	53	53	53	0
St Lucia	1,410	1,410	1,425	1,425	1,425	1,419	1
Uruguay	59,779	61,661	62,826	64,428	66,595	63,058	5
NOIC	27,492	29,137	29,909	30,666	32,045	29,850	8
LAC Average	79,621	81,645	83,493	85,499	87,267	83,505	7

Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Table 25: Electricity Coverage (%)

Country	2005	2006	2007
Argentina	95	95	95
Bolivia	67.1	69	69
Colombia	90.9	90.9	94
Ecuador	89.7	88.7	90.2
Mexico	96	96	96
Suriname	97	97	97
T&T	92	92	92
Venezuela	97	97	97
NOEC	90.6	91	91
Barbados	98	98	98
Brazil	97	97.5	97.9
Chile	96.8	99	99
Costa Rica	98.1	98.4	98.6
Cuba	95.5	95.5	95.5
Dom. Rep.	92.3	92.3	95.7
El Salvador	84	95.5	95.5
Grenada	82	82	82
Guatemala	84	85.1	84.7
Guyana	82	82	82
Haiti	34	34	34
Honduras	67	67	67
Jamaica	93	95	95
Nicaragua	55.2	69.2	69.2
Panama	83	83	83

Paraguay	93.2	93.2	93.2
Peru	78.1	78.1	78.1
Uruguay	98	98	98
NOIC	84	86	86
LAC Average	86	87.2	87.6

Source: Latin American Energy Organization (OLADE)

Table 26: Electricity sold per connection (MWh/yr)

Country	2001	2002	2003	2004	2005	Average 2001-2005	Average 2004-2005
Argentina	6	5	5	6	6	6	6
Bolivia	3	3	3	3	3	3	3
Colombia	4	3	3	3	4	4	4
Ecuador	3	3	3	3	3	3	3
Mexico	6	6	6	6	6	6	6
Venezuela	10	9	9	10	10	10	10
NOEC	5	5	5	5	5	5	5
Antigua	N/A	6	6	6	6	6	6
Belize	4	5	5	5	5	5	5
Brazil	5	5	5	5	5	5	5
Chile	5	5	5	5	5	5	5
Costa Rica	9	9	9	9	10	9	9
Dom Rep	6	6	5	4	4	5	4
Dominica	2	2	2	2	2	2	2
El Salvador	3	3	3	3	3	3	3
Grenada	4	4	4	4	4	4	4
Guatemala	2	2	2	2	N/A	2	2
Honduras	5	5	5	5	5	5	5
Jamaica	6	6	6	6	6	6	6
Nicaragua	3	3	3	3	3	3	3
Panama	7	7	7	7	7	7	7
Paraguay	5	5	5	5	5	5	5
Peru	3	3	3	3	3	3	3
St Kitts	N/A	6	N/A	N/A	N/A	6	N/A
St Lucia	5	5	5	5	5	5	5
St Vincent	3	3	3	3	N/A	3	3
Uruguay	5	5	5	5	5	5	5
NOIC	5	5	5	5	5	5	5
LAC Average	5	5	5	5	5	5	5

Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Table 27: Operating Expenditure (OPEX) per Connection (US$/MWh)

Country	2001	2002	2003	2004	2005	Average 2001-2005	Average 2004-2005
Argentina	238	79	96	N/A	N/A	138	N/A
Bolivia	N/A	318	302	289	N/A	303	289
Colombia	370	330	334	374	406	363	390
Ecuador	26	35	47	55	71	47	63
Mexico	95	97	86	87	99	93	93
Venezuela	926	741	591	538	496	658	517
NOEC	331	267	243	269	268	267	270
Antigua	N/A	1,458	1,597	1,744	1,805	1,651	1,775
Belize	160	134	134	128	129	137	128
Brazil	134	117	91	105	138	117	122
Chile	288	288	300	344	435	331	390
Costa Rica	178	181	175	188	201	184	194
Dom Rep	N/A	199	192	91	N/A	161	91
Dominica	510	440	519	564	647	536	605
Grenada	576	539	603	640	926	657	783
Honduras	16	19	17	18	49	24	33
Jamaica	204	200	204	201	214	204	207
Panama	N/A	N/A	156	151	146	151	148
Paraguay	28	19	22	26	24	24	25
Peru	143	139	132	141	N/A	139	141
St Kitts	N/A	840	N/A	N/A	N/A	840	
St Lucia	674	637	692	769	984	751	876
St Vincent	463	451	501	565	N/A	495	565
NOIC	281	377	356	378	475	400	406
LAC Average	296	346	323	351	423	364	372

Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Table 28: Operating Expenses (OPEX) per MWh sold (US$)

Country	2001	2002	2003	2004	2005	Average 2001-2005	Average 2004-2005
Argentina	48	18	19	N/A	N/A	28	N/A
Bolivia	N/A	68	65	59	N/A	64	59
Colombia	110	105	105	117	123	112	120
Ecuador	9	12	17	20	25	17	23
Mexico	15	16	15	15	17	16	16
Venezuela	85	74	60	53	48	64	51
NOEC	53	49	47	53	53	50	54
Antigua	N/A	235	287	287	295	276	291
Belize	36	29	27	26	25	29	25
Brazil	28	25	19	23	31	25	27
Chile	56	55	55	61	76	61	69
Costa Rica	14	15	14	15	15	15	15
Dom Rep	N/A	33	38	24	N/A	31	24
Dominica	213	182	228	246	277	229	261
Grenada	159	147	159	178	235	176	207
Honduras	3	4	4	4	10	5	7
Jamaica	36	35	35	36	38	36	37
Panama	N/A	N/A	23	23	23	23	23
Paraguay	5	4	4	5	5	5	5
Peru	95	84	82	83	N/A	86	83
St Kitts	N/A	135	N/A	N/A	N/A	135	
St Lucia	132	130	138	149	188	147	169
St Vincent	167	162	175	182	N/A	171	182
NOIC	79	85	86	89	102	91	95
LAC Average	71	75	75	80	89	80	85

Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Table 29: Capital Expenditure (CAPEX) per connection (in US$)

Country	2001	2002	2003	2004	2005	Average 2001-2005	Average 2004-2005
Argentina	25	8	9	N/A	N/A	14	N/A
Bolivia	N/A	66	97	154	N/A	106	154
Colombia	38	35	37	48	N/A	39	48
Ecuador	35	60	38	53	60	50	57
Mexico	19	17	15	15	12	15	13
Venezuela	146	130	60	61	67	93	64
NOEC	53	53	43	66	46	53	67
Antigua	N/A	N/A	61	122	147	110	134
Belize	342	243	428	193	184	278	188
Brazil	31	24	21	26	40	29	33
Chile	37	39	30	40	64	42	52
Costa Rica	26	26	27	34	21	27	27
Dominica	143	101	86	64	168	112	116
Grenada	180	86	121	79	233	140	156
Honduras	23	3	11	19	12	14	16
Jamaica	N/A	200	123	58	61	110	60
Paraguay	12	12	16	11	9	12	10
Peru	8	10	9	8	N/A	9	8
St Kitts	N/A	533	N/A	N/A	N/A	533	N/A
St Lucia	156	97	128	307	190	176	248
St Vincent	78	216	135	262	N/A	173	262
NOIC	94	122	92	94	103	126	101
LAC Average	81	100	76	86	91	104	91

Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Table 30: Capital Expenditure (CAPEX) per MWh of Electricity Sold (US$)

Country	2001	2002	2003	2004	2005	Average 2001-2005	Average 2004-2005
Argentina	5	2	2	N/A	N/A	3	N/A
Bolivia	N/A	14	21	32	N/A	22	32
Colombia	9	9	9	12	N/A	10	12
Ecuador	14	26	17	24	27	22	26
Mexico	3	3	3	3	2	3	2
Venezuela	13	13	6	6	7	9	6
NOEC	9	11	10	15	12	12	16
Antigua	N/A	N/A	11	20	24	18	22
Belize	76	52	88	39	36	58	37
Brazil	8	6	5	7	14	8	10
Chile	7	8	6	8	12	8	10
Costa Rica	2	2	3	3	2	3	3
Dominica	59	42	38	28	72	48	50
Grenada	50	24	32	22	59	37	41
Honduras	5	1	2	4	3	3	3
Jamaica	N/A	35	21	10	11	19	11
Paraguay	2	2	3	2	2	2	2
Peru	6	7	7	6	N/A	7	6
St Kitts	N/A	85	N/A	N/A	N/A	85	N/A
St Lucia	31	20	26	60	36	34	48
St Vincent	28	77	47	84	N/A	59	84
NOIC	25	28	22	23	25	28	25
LAC Average	20	23	18	21	22	23	23

Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Table 31: Total Expenditure (TOTEX) per Connection (US$)

Country	2001	2002	2003	2004	2005	Average 2001-2005	Average 2004-2005
Argentina	262	79	104	N/A	N/A	149	N/A
Bolivia	N/A	383	399	443	N/A	409	443
Colombia	375	332	340	376	457	376	416
Ecuador	58	95	84	96	117	90	107
Mexico	93	91	86	86	94	90	90
Venezuela	1,071	871	651	599	563	751	581
NOEC	372	309	277	320	308	311	327
Antigua	N/A	N/A	1,658	1,866	1,952	1,825	1,909
Belize	502	377	561	321	313	415	317
Brazil	149	132	118	136	185	144	160
Chile	330	326	333	387	500	375	443
Costa Rica	201	208	200	220	215	209	217
Dominica	653	541	605	628	814	648	721
Honduras	39	22	28	37	61	37	49
Jamaica	N/A	400	326	259	275	315	267
Paraguay	39	30	38	37	32	35	35
Peru	82	149	139	149	N/A	130	149
St Kitts	N/A	1,373	N/A	N/A	N/A	1,373	N/A
St Lucia	830	734	820	1,076	1,174	927	1,125
St Vincent	541	666	636	827	N/A	668	827
NOIC	337	413	455	495	552	546	518
LAC Average	348	378	396	444	482	472	462

Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Table 32: Total Expenditure (TOTEX) per MWh of Electricity Sold (US$)

Country	2001	2002	2003	2004	2005	Average 2001-2005	Average 2004-2005
Argentina	53	18	20	N/A	N/A	31	N/A
Bolivia	N/A	82	86	91	N/A	87	91
Colombia	104	96	98	110	135	109	123
Ecuador	22	38	35	40	49	37	45
Mexico	15	15	15	15	17	16	16
Venezuela	98	87	67	59	55	73	57
NOEC	58	56	54	63	64	59	66
Antigua	N/A	N/A	298	307	319	308	313
Belize	112	81	115	64	61	87	63
Brazil	32	28	25	30	42	31	36
Chile	64	63	61	69	88	69	79
Costa Rica	17	17	16	18	17	17	17
Dominica	272	224	265	274	349	277	311
Grenada	209	170	191	200	294	213	247
Honduras	8	5	6	8	13	8	10
Jamaica	N/A	70	56	47	49	56	48
Paraguay	7	6	8	7	6	7	7
Peru	52	91	87	89	N/A	80	89
St Kitts	N/A	220	N/A	N/A	N/A	220	N/A
St Lucia	163	149	163	209	224	182	217
St Vincent	195	239	222	266	N/A	230	266
NOIC	103	105	116	122	133	128	131
LAC Average	89	90	97	106	115	107	113

Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Table 33: Total and Average Distribution Losses 2001-2005 and 2004-2005 (%)

Country	2001	2002	2003	2004	2005	2006	2007	2008	Average (2001-2005)	Average 2004-2005
Argentina	14	15	15	14	14	N/A	N/A	N/A	14	14
Bolivia	9	10	10	11	10	N/A	N/A	N/A	10	10
Colombia	19	18	17	16	16	N/A	N/A	N/A	17	16
Ecuador	22	21	22	22	21	N/A	N/A	N/A	22	22
Mexico	14	14	14	14	15	N/A	N/A	N/A	14	15
Venezuela	17	17	17	17	18	N/A	N/A	N/A	17	18
NOEC	16	16	16	16	16	N/A	N/A	N/A	16	16
Antigua	N/A	18	14	10	10	N/A	N/A	N/A	13	10
Belize	13	12	12	13	13	N/A	N/A	N/A	12	13
Brazil	13	14	14	14	14	N/A	N/A	N/A	14	14
Chile	6	7	7	6	7	N/A	N/A	N/A	6	6
Colombia	19	18	17	16	16	N/A	N/A	N/A	17	16
Costa Rica	9	9	10	10	8	N/A	N/A	N/A	9	9
Dom Rep	N/A	28	36	40	42	N/A	N/A	N/A	37	41
El Salvador	11	11	10	10	9	N/A	N/A	N/A	10	10
Grenada	N/A	10	13	10	11	N/A	N/A	N/A	11	10
Guatemala	12	15	17	16	N/A	N/A	N/A	N/A	15	16
Honduras	20	21	22	23	24	N/A	N/A	N/A	22	24
Jamaica	17	18	19	20	21	23	23	23	19	21
Nicaragua	31	33	33	30	29	N/A	N/A	N/A	31	30
Panama	16	15	17	14	10	N/A	N/A	N/A	14	12
Paraguay	22	26	27	30	31	N/A	N/A	N/A	27	30
Peru	11	11	11	11	11	N/A	N/A	N/A	11	11
St Kitts	N/A	7	N/A	N/A	N/A	N/A	N/A	N/A	7	
St Lucia	N/A	13	12	10	10	N/A	N/A	N/A	11	10
Uruguay	15	16	19	19	18	N/A	N/A	N/A	17	19
NOIC	15	16	17	17	17	N/A	N/A	N/A	16	17
LAC Average	15	16	17	17	17	N/A	N/A	N/A	16	17

Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Table 34: Technical Distribution Losses (%) 2001-2005

Country	2001	2002	2003	2004	2005	2006	2007	2008	Average (2001-2005)	Average (2004-2005)
Colombia	N/A	14	23	16	13	N/A	N/A	N/A	16	14
Ecuador	10	10	10	10	10	N/A	N/A	N/A	10	10
Mexico	8	8	8	9	10	N/A	N/A	N/A	9	9
Venezuela	8	8	8	8	7	N/A	N/A	N/A	8	7
NOEC	9	10	12	11	10	N/A	N/A	N/A	11	10
Antigua	N/A	9	N/A	N/A	N/A	N/A	N/A	N/A	9	
Brazil	7	7	7	8	8	N/A	N/A	N/A	8	8
Chile	7	7	6	6	6	N/A	N/A	N/A	6	6
Costa Rica	7	7	7	8	7	N/A	N/A	N/A	7	8
Dom Rep	N/A	28	45	49	53	N/A	N/A	N/A	44	51
El Salvador	N/A	8	8	8	8	N/A	N/A	N/A	8	8
Grenada	N/A	8	N/A	N/A	N/A	N/A	N/A	N/A	8	
Jamaica	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10	N/A	N/A
Panama	N/A	N/A	9	8	8	N/A	N/A	N/A	8	8
Paraguay	6	8	7	7	8	N/A	N/A	N/A	7	7
St Kitts	N/A	6	N/A	N/A	N/A	N/A	N/A	N/A	6	
St Lucia	N/A	9	9	9	8	N/A	N/A	N/A	9	8
NOIC	7	10	12	13	13	N/A	N/A	N/A	11	13
LAC Average	7	10	12	12	12	N/A	N/A	N/A	11	12

Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Table 35: Non-technical Distribution Losses (%)

Country	2001	2002	2003	2004	2005	Average 2001-2005	Average 2004-2005
Ecuador	12	12	12	11	11	12	11
Mexico	6	6	6	5	5	6	5
Venezuela	8	9	9	10	10	9	10
NOEC	9	9	9	9	9	9	9
Antigua	N/A	10	N/A	N/A	N/A	10	
Brazil	8	9	8	8	7	8	7
Chile	1	1	1	2	3	2	2
Costa Rica	2	2	3	2	2	2	2
El Salvador	N/A	3	2	2	1	2	2
Grenada	N/A	2	N/A	N/A	N/A	2	
Paraguay	17	18	21	23	23	20	23
St Kitts	N/A	1	N/A	N/A	N/A	1	
St Lucia	N/A	4	2	2	2	2	2
NOIC	7	6	6	7	6	5	6
LAC Average	8	6	7	7	7	6	7

Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Table 36: Duration of Interruptions per Subscriber – SAIDI (Hrs)

Country	2001	2002	2003	2004	2005	2006	2007	2008	Average (2001-2005)	Average (2004-2005)
Argentina	6	5	N/A	N/A	N/A	N/A	N/A	N/A	6	N/A
Bolivia	4	4	4	3	5	N/A	N/A	N/A	4	4
Colombia	67	63	63	64	66	N/A	N/A	N/A	65	65
Ecuador	N/A	2	3	3	2	N/A	N/A	N/A	3	2
Mexico	3	7	3	2	5	N/A	N/A	N/A	4	3
Venezuela	42	37	33	26	42	N/A	N/A	N/A	36	34
NOEC	24	20	21	19	24	N/A	N/A	N/A	19	22
Belize	28	N/A	N/A	N/A	N/A	N/A	N/A	N/A	28	N/A
Brazil	16	18	16	16	16	N/A	N/A	N/A	16	16
Chile	19	15	8	8	12	N/A	N/A	N/A	12	10
Costa Rica	12	12	12	11	10	N/A	N/A	N/A	11	11
Dom Rep	43	51	7	N/A	N/A	N/A	N/A	N/A	34	N/A
El Salvador	N/A	N/A	20	23	16	N/A	N/A	N/A	20	20
Guatemala	19	14	14	N/A	N/A	N/A	N/A	N/A	15	N/A
Honduras	47	33	29	24	36	N/A	N/A	N/A	34	30
Jamaica	N/A	N/A	N/A	N/A	N/A	57	50	42	50	50
Nicaragua	N/A	N/A	25	N/A	N/A	N/A	N/A	N/A	25	N/A
Panama	11	6	6	5	4	N/A	N/A	N/A	6	4
Paraguay	11	7	10	9	8	N/A	N/A	N/A	9	8
Peru	18	17	21	18	18	N/A	N/A	N/A	19	18
St Lucia	N/A	32	30	26	22	N/A	N/A	N/A	28	24
Uruguay	22	20	15	10	N/A	N/A	N/A	N/A	17	10
NOIC	22	20	16	15	16	N/A	N/A	N/A	22	18
LAC Average	23	20	18	17	19	N/A	N/A	N/A	21	19

Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Table 37: Frequency of interruptions per subscriber – SAIFI (#)

Country	2001	2002	2003	2004	2005	2006	2007	2008	Average (2001-2005)	Average 2004-2005
Argentina	5	5	N/A	N/A	N/A	N/A	N/A	N/A	5	N/A
Bolivia	5	5	5	3	7	N/A	N/A	N/A	5	5
Colombia	115	185	186	175	186	N/A	N/A	N/A	170	180
Ecuador	N/A	1	4	3	3	N/A	N/A	N/A	3	3
Mexico	3	3	3	2	2	N/A	N/A	N/A	3	2
Venezuela	N/A	N/A	4	3	4	N/A	N/A	N/A	3	3
NOEC	32	40	40	37	40	N/A	N/A	N/A	31	39
Belize	16	N/A	N/A	N/A	N/A	N/A	N/A	N/A	16	N/A
Brazil	14	15	13	12	12	N/A	N/A	N/A	13	12
Chile	10	10	N/A	N/A	N/A	N/A	N/A	N/A	10	N/A
Costa Rica	25	16	17	15	14	N/A	N/A	N/A	18	15
Dom Rep	20	16	3	N/A	N/A	N/A	N/A	N/A	13	N/A
El Salvador	N/A	N/A	13	16	12	N/A	N/A	N/A	14	14
Guatemala	6	4	3	N/A	N/A	N/A	N/A	N/A	4	N/A
Jamaica	N/A	N/A	N/A	N/A	N/A	34	24	24	27	27
Nicaragua	N/A	N/A	4	N/A	N/A	N/A	N/A	N/A	4	N/A
Panama	7	5	4	3	2	N/A	N/A	N/A	4	3
Paraguay	17	14	15	15	16	N/A	N/A	N/A	16	16
Peru	20	15	14	13	14	N/A	N/A	N/A	15	14
St Lucia	N/A	N/A	17	N/A	N/A	N/A	N/A	N/A	17	N/A
Uruguay	19	14	10	7	N/A	N/A	N/A	N/A	12	7
NOIC	15	12	10	12	12	N/A	N/A	N/A	13	13
LAC Average	20	22	20	22	25	N/A	N/A	N/A	19	23

Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Table 38: Residential Electricity Tariffs (US cents/Kwh)

Country	1994	1995	1996	1997	1998	2002	2003	2004	2005	2006	2007
Argentina	12.96	13.95	11.91	11.50	11.15	3.74	3.87	3.72	7.36	2.48	2.46
Bolivia	7.22	7.89	7.16	6.94	6.58	5.81	5.54	7.19	6.61	6.72	ND
Columbia	4.16	4.74	13.70	5.88	7.02	7.04	7.23	8.86	9.82	9.12	12.15
Ecuador	3.41	2.88	2.49	8.77	7.09	11.26	12.10	12.64	12.51	9.77	9.69
Mexico	4.81	3.01	4.00	4.33	4.57	8.00	8.46	7.05	7.75	7.85	8.40
Venezuela	2.38	3.32	1.31	3.02	4.18	5.50	5.50	4.50	4.50	4.50	ND
NOEC	5.82	5.97	6.76	6.74	6.77	6.89	7.12	7.33	8.09	6.74	8.18
Brazil	8.89	9.52	13.09	13.20	12.84	7.23	8.06	8.64	13.24	19.06	ND
Chile	12.27	14.50	12.72	11.89	10.24	8.21	8.51	13.66	12.34	13.06	15.28
Costa Rica	6.42	7.33	4.25	6.27	5.22	6.36	5.95	8.23	6.69	8.06	8.12
El Salvador	6.17	6.96	7.95	8.19	8.19	13.33	14.54	12.90	11.64	14.34	16.02
Grenada	20.37	18.95	19.26	19.26	19.26	22.14	22.14	22.10	22.10	22.10	ND
Guatemala	7.12	7.54	7.06	7.35	6.85	7.96	7.89	18.43	11.70	11.79	ND
Honduras	4.79	5.99	6.85	7.13	6.88	7.04	4.53	4.47	7.49	7.76	ND
Jamaica	13.73	14.18	14.64	13.52	13.58	16.30	15.76	17.31	22.31	24.50	ND
Nicaragua	10.19	11.01	10.66	11.48	14.26	12.89	14.10	13.97	13.61	17.13	ND
Panama	12.05	12.07	12.04	11.40	12.12	12.08	12.08	12.10	12.48	12.71	17.52
Paraguay	4.90	4.95	6.57	7.02	6.44	5.25	5.44	5.81	6.03	6.17	6.71
Peru	10.34	13.93	14.96	13.84	10.07	11.48	11.49	10.86	12.72	12.29	12.23
Rep. Dominica	8.79	8.45	9.46	10.74	10.64	12.02	14.17	12.56	18.92	15.99	15.02
Uruguay	12.35	14.59	15.31	15.77	15.89	10.41	9.77	10.78	14.44	15.61	17.21
NOIC	9.88	10.71	11.06	11.22	10.89	10.91	11.03	12.27	13.27	14.33	13.51
LAC Average	8.67	9.29	9.77	9.88	9.65	9.70	9.86	10.79	11.71	12.05	11.73

Source: Latin American Energy Organization (OLADE)

Table 39: Commercial Electricity Tariffs (US cents/KWh)

Country	1994	1995	1996	1997	1998	2002	2003	2004	2005	2006	2007	2008
Argentina	13.52	13.73	14.65	13.95	13.86	4.57	4.82	5.37	4.77	6.93	8.75	ND
Bolivia	15.01	15.89	14.33	13.89	13.17	9.21	8.54	10.51	10.12	10.14	ND	ND
Columbia	10.32	10.88	10.21	12.71	11.46	7.12	8.59	9.88	11.78	10.95	14.59	ND
Ecuador	8.41	7.13	5.95	9.30	5.45	10.85	11.18	10.63	11.14	8.20	8.17	ND
Mexico	13.13	9.06	9.83	11.49	11.35	13.75	14.88	16.30	18.59	19.50	21.49	ND
Venezuela	8.44	8.55	3.98	6.28	7.49	7.90	7.90	4.02	4.02	4.02	ND	ND
NOEC	11.47	10.87	9.83	11.27	10.46	8.90	9.32	9.45	10.07	9.96	13.25	N/A
Paraguay	5.44	5.74	6.99	7.47	6.85	5.62	5.71	6.19	6.31	6.58	7.15	ND
Peru	10.67	11.33	12.16	11.26	7.44	7.72	8.45	8.27	10.33	9.01	8.80	ND
Uruguay	12.94	15.86	16.48	16.55	15.83	7.29	6.99	9.22	10.11	10.44	11.40	ND
Costa Rica	10.74	11.69	11.52	10.61	9.12	9.26	8.55	9.00	8.89	10.46	10.20	ND
Guatemala	9.01	8.49	8.08	8.40	7.84	6.25	6.21	14.67	11.47	11.57	ND	ND
Panama	11.93	11.90	12.03	11.78	11.86	11.76	11.78	11.80	12.20	12.43	17.16	ND
Honduras	9.37	11.09	10.33	11.03	10.71	10.70	2.94	2.92	12.09	12.84	ND	ND
Chile	10.18	11.50	11.40	10.69	9.12	7.82	8.24	8.50	12.93	13.98	16.34	ND
El Salvador	8.09	9.69	10.53	10.70	10.70	12.03	12.05	11.89	13.53	14.54	12.27	ND
Brazil	10.48	11.28	11.33	11.29	11.56	6.40	6.91	7.62	11.49	16.64	ND	ND
Nicaragua	10.99	12.15	13.33	13.64	16.18	15.69	16.23	16.50	16.53	21.42	ND	ND
Jamaica	12.38	12.31	13.82	9.99	11.89	13.73	14.16	15.42	20.16	23.04	25.32	31.73
Grenada	21.48	21.02	20.37	20.37	20.37	23.38	23.39	23.40	23.40	23.40	ND	ND
Rep. Dominica	11.68	11.28	12.54	14.17	14.22	14.37	12.26	15.65	16.88	24.17	23.49	ND
NOIC	11.10	11.81	12.21	12.00	11.69	10.86	10.28	11.50	13.31	15.04	14.68	N/A
LAC Average	11.21	11.53	11.49	11.78	11.32	10.27	9.99	10.89	12.34	13.51	15.49	N/A

Source: Latin American Energy Organization (OLADE)

Table 40: Industrial Electricity Tariffs (US cents/KWh)

Country	1994	1995	1996	1997	1998	2002	2003	2004	2005	2006	2007	2008
Argentina	7.87	7.83	8.36	7.91	7.70	2.13	2.58	3.08	4.67	4.05	5.00	ND
Bolivia	7.18	7.63	7.99	7.76	7.36	4.57	4.05	5.04	5.04	4.68	ND	ND
Columbia	8.39	8.16	8.54	8.41	8.72	6.24	6.29	7.69	8.91	8.40	11.19	ND
Ecuador	8.33	7.43	5.62	7.28	5.32	9.97	9.80	8.74	9.66	7.32	6.54	ND
Mexico	5.05	3.42	3.72	4.42	4.24	6.25	7.50	7.62	8.61	10.06	10.89	ND
Venezuela	7.11	6.18	3.38	2.71	3.05	2.80	2.80	3.17	3.17	3.17	ND	ND
NOEC	7.32	6.78	6.27	6.42	6.07	5.33	5.50	5.89	6.68	6.28	8.41	N/A
Brazil	5.48	5.69	5.52	5.37	5.83	3.29	3.74	4.38	7.31	12.37	ND	ND
Chile	7.05	8.55	7.67	7.03	5.78	5.48	5.52	5.77	7.98	8.53	10.24	ND
Costa Rica	8.63	10.05	10.03	9.00	7.58	7.16	6.95	7.30	7.72	8.41	6.60	ND
Dom. Rep.	10.54	10.11	11.39	12.71	12.52	12.36	12.31	9.92	13.80	19.65	21.00	ND
El Salvador	8.23	8.79	11.25	11.10	11.10	12.11	12.94	12.00	12.39	14.00	12.27	ND
Grenada	17.41	17.41	16.30	16.30	16.30	18.77	18.77	18.80	18.80	18.80	ND	ND
Guatemala	10.34	10.21	9.56	9.93	9.27	7.50	7.42	13.86	11.12	11.21	ND	ND
Honduras	7.47	9.25	9.26	8.88	8.97	9.04	3.54	3.49	9.91	10.40	ND	ND
Jamaica	10.54	10.31	11.22	10.56	10.37	11.02	10.68	12.76	16.55	18.69	20.42	26.53
Nicaragua	8.51	9.79	10.03	10.47	11.46	11.66	12.30	12.69	12.47	16.61	ND	ND
Panama	10.08	10.00	9.99	9.97	9.92	9.90	9.90	9.90	10.17	10.36	15.00	ND
Paraguay	3.91	3.89	5.51	4.04	3.73	3.44	3.65	3.90	3.75	4.14	4.50	ND
Peru	8.72	5.90	5.70	5.24	5.55	7.33	5.92	7.65	7.22	6.94	7.15	ND
Uruguay	7.65	8.29	8.73	7.51	7.28	4.03	3.73	5.17	6.02	6.49	7.41	ND
NOIC	8.90	9.16	9.44	9.15	8.98	8.79	8.38	9.11	10.37	11.90	11.62	N/A
LAC Average	8.42	8.44	8.49	8.33	8.10	7.75	7.52	8.15	9.26	10.21	10.63	N/A

Source: Latin American Energy Organization (OLADE)

Table 41: Residential tariff versus Diesel Prices

Country	2006 Diesel Price (US cents/Litre	2006 Tariff (US cents/KWh)
Argentina	48	2
Bolivia	47	7
Colombia	57	9
Ecuador	39	10
Mexico	52	8
Venezuela	2	5
NOEC	41	7
Brazil	84	19
Costa Rica	67	8
El Salvador	80	14
Guatemala	64	12
Honduras	73	8
Jamaica	75	25
Nicaragua	58	17
Panama	60	13
Paraguay	77	6
Peru	86	12
Uruguay	94	16
NOIC	74	14
LAC Average	63	11

Source: Latin American Energy Organization (OLADE)

Table 42: Electricity Sold per Employee (MWh)

Country	2001	2002	2003	2004	2005	2006	2007	2008	Average 2001 - 2005	Average 2004- 2005
Argentina	3,793	3,653	3,890	4,169	4,389	N/A	N/A	N/A	3,979	4,279
Bolivia	2,502	2,645	2,736	3,262	3,073	N/A	N/A	N/A	2,844	3,168
Colombia	3,205	3,310	3,369	3,433	3,737	N/A	N/A	N/A	3,411	3,585
Ecuador	1,297	997	1,005	1,027	1,119	N/A	N/A	N/A	1,089	1,073
Mexico	3,155	3,190	3,165	3,219	3,234	N/A	N/A	N/A	3,193	3,227
Venezuela	2,474	2,499	2,541	2,642	2,754	N/A	N/A	N/A	2,582	2,698
NOEC	2,738	2,716	2,784	2,959	3,051	N/A	N/A	N/A	2,850	3,005
Antigua	N/A	591	507	614	721	N/A	N/A	N/A	608	667
Belize	1,052	1,177	1,271	1,331	1,433	N/A	N/A	N/A	1,253	1,382
Brazil	4,255	4,410	4,627	4,695	4,663	N/A	N/A	N/A	4,530	4,679
Chile	6,603	6,981	7,361	8,207	9,248	N/A	N/A	N/A	7,680	8,728
Costa Rica	2,718	2,665	2,801	2,805	2,840	N/A	N/A	N/A	2,766	2,823
Dom Rep	2,258	2,880	1,981	1,421	862	N/A	N/A	N/A	1,880	1,141
Dominica	320	271	332	359	377	N/A	N/A	N/A	332	368
El Salvador	2,301	2,629	2,882	3,246	3,465	N/A	N/A	N/A	2,905	3,356
Grenada	652	659	688	647	711	N/A	N/A	N/A	672	679
Guatemala	N/A	984	N/A	N/A	N/A	N/A	N/A	N/A	984	N/A
Honduras	1,031	1,242	1,332	1,433	1,488	N/A	N/A	N/A	1,305	1,461
Jamaica	N/A	N/A	2,352	1,984	1,910	1,875	1,881	1,987	2,082	1,947
Nicaragua	N/A	N/A	1,293	N/A	N/A	N/A	N/A	N/A	1,293	N/A
Panama	2,796	3,692	3,581	3,415	4,082	N/A	N/A	N/A	3,513	3,749
Paraguay	1,703	1,642	1,650	1,658	1,585	N/A	N/A	N/A	1,648	1,622
Peru	3,596	3,585	3,844	4,071	4,430	N/A	N/A	N/A	3,905	4,251
St Kitts	N/A	445	N/A	N/A	N/A	N/A	N/A	N/A	445	N/A
St Lucia	994	1,010	1,046	1,153	1,222	N/A	N/A	N/A	1,085	1,188
St Vincent	332	344	352	389	N/A	N/A	N/A	N/A	354	389
Uruguay	1,591	1,592	1,582	1,698	1,748	N/A	N/A	N/A	1,642	1,723
NOIC	2146.8	2044.389	2193.444	2301.529	2549.063	N/A	N/A	N/A	2044.1	2361.941
LAC Average	2,316	2,212	2,341	2,473	2,686	N/A	N/A	N/A	2,230	2,530

Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Table 43: Residential Connections per Employee

Country	2001	2002	2003	2004	2005	2006	2007	2008	Average 2001-2005	Average 2004-2005
Argentina	585	593	612	623	633	N/A	N/A	N/A	609	628
Bolivia	712	756	800	936	876	N/A	N/A	N/A	816	906
Colombia	833	880	911	932	972	N/A	N/A	N/A	906	952
Ecuador	355	288	296	304	318	N/A	N/A	N/A	312	311
Mexico	438	452	466	484	486	N/A	N/A	N/A	465	485
Venezuela	216	222	233	233	235	N/A	N/A	N/A	228	234
NOEC	523	532	553	585	587	N/A	N/A	N/A	556	564
Antigua	N/A	87	83	92	107	N/A	N/A	N/A	92	100
Belize	232	251	258	264	279	N/A	N/A	N/A	257	272
Brazil	688	728	769	795	814	N/A	N/A	N/A	759	804
Chile	1,084	1,143	1,157	1,214	1,349	N/A	N/A	N/A	1,189	1,282
Costa Rica	252	244	251	250	244	N/A	N/A	N/A	248	247
Dom Rep	380	474	387	303	219	N/A	N/A	N/A	352	261
Dominica	115	98	129	136	138	N/A	N/A	N/A	123	137
El Salvador	734	797	861	925	987	N/A	N/A	N/A	861	956
Grenada	157	157	158	157	157	N/A	N/A	N/A	157	157
Guatemala	N/A	905	N/A	N/A	N/A	N/A	N/A	N/A	905	N/A
Honduras	194	237	254	269	289	N/A	N/A	N/A	249	279
Jamaica	N/A	N/A	362	320	307	319	325	329	330	327
Nicaragua	N/A	N/A	364	N/A	N/A	N/A	N/A	N/A	364	N/A
Panama	333	453	439	427	519	N/A	N/A	N/A	434	473
Paraguay	269	265	279	283	268	N/A	N/A	N/A	273	275
Peru	991	972	1,066	1,108	1,118	N/A	N/A	N/A	1,051	1,113
St Kitts	N/A	72	N/A	N/A	N/A	N/A	N/A	N/A	72	N/A
St Lucia	174	183	187	201	209	N/A	N/A	N/A	191	205
St Vincent	106	110	109	111	N/A	N/A	N/A	N/A	109	111
Uruguay	266	276	283	293	293	N/A	N/A	N/A	282	293
NOIC	398	414	411	420	456	N/A	N/A	N/A	415	429
LAC Average	434	443	446	463	492	N/A	N/A	N/A	447	470

Source: Compiled using data from the World Bank, Benchmarking data of the Electricity Distribution Sector in Latin America & the Caribbean Region 1995-2005

Table 44: Energy Intensity of Gross Domestic Product

Country	2001	2002	2003	2004	2005	2006	2007	2008
Argentina	1.07	1.15	1.11	1.17	1.07	1.11	1.04	0.98
Bolivia	2.21	2.12	2.21	2.59	2.54	2.75	2.87	2.83
Colombia	1.72	1.70	1.64	1.45	1.45	1.38	1.29	1.33
Ecuador	2.85	2.80	2.70	2.85	2.84	2.77	2.70	2.75
México	1.08	1.10	1.06	1.11	1.06	1.04	1.07	1.12
Venezuela	2.18	2.20	2.49	2.21	2.40	2.18	1.87	1.79
NOEC	1.85	1.84	1.87	1.90	1.89	1.87	1.81	1.80
Brasil	1.73	1.74	1.73	1.78	1.73	1.72	1.72	1.70
Chile	1.79	1.78	1.74	1.73	1.63	1.64	1.64	1.59
Costa Rica	1.09	1.05	1.03	1.15	1.09	1.14	1.16	1.19
El Salvador	1.63	1.60	1.65	1.67	1.57	1.57	1.34	1.30
Granada	1.06	1.08	1.05	1.09	1.02	1.08	1.03	1.02
Guatemala	2.70	2.67	2.52	2.51	2.49	2.39	2.31	2.77
Honduras	2.87	2.89	2.95	2.82	2.66	2.56	2.63	2.54
Jamaica	1.75	1.89	1.85	2.15	2.85	2.89	2.85	2.87
Nicaragua	3.74	3.89	3.90	3.95	3.97	4.25	4.33	3.95
Panamá	1.39	1.57	1.33	1.58	1.50	1.61	1.47	1.05
Paraguay	3.62	3.72	3.65	3.41	3.30	3.10	3.03	2.88
Perú	1.48	1.43	1.35	1.34	1.27	1.22	1.17	1.22
Dom Rep	1.64	1.59	1.52	1.51	1.35	1.19	1.17	1.06
Uruguay	0.86	0.90	0.87	0.81	0.77	0.74	0.75	0.82
NOIC	**1.95**	**1.98**	**1.94**	**1.96**	**1.94**	**1.94**	**1.90**	**1.85**
LAC Average	**1.92**	**1.94**	**1.92**	**1.94**	**1.93**	**1.91**	**1.87**	**1.84**

Source: Compiled using data from United States Energy Information Administration (EIA)